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Instructional Media and Technologies for Learning

Seventh Edition

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PREFACE

Instructional Media and Technologies for Learning, Seventh Edition, presents a complete range of media formats in terms of how they can be integrated into classroom instruction using the ASSURE model of lesson planning. Written from the viewpoint of the teacher, the text shows specifically and realistically how media fit into the daily life of the classroom. This book is intended for educators at all levels who place a high value on successful learning. Its purpose is to help them incorporate media and technologies for learning into their repertoire—to use them as teaching tools and to guide students in using them as learning tools. We draw examples from elementary, secondary, and post-secondary education, as well as corporate training and development, because we know that instructors in these different settings have found previous editions of this book useful in their work.

This new edition is necessitated by the amazing pace of innovation in all aspects of media, particularly in those related to computers and computer networks, and especially the Internet. In the few years since the sixth edition, the digitization of information has accelerated rapidly and so has school use of new telecommunications resources, such as the Web.

Rationales

We share a number of convictions that have motivated us since we first contemplated writing a textbook. First, we believe in an *eclectic* approach to the design of instruction. Advocates cite an abundance of theories and philosophies in support of different approaches to instruction—behaviorist, cognitivist, constructivist, and so on. We view these contending theoretical positions as differing *perspectives*—different vantage points—from which to examine the large and complex world of teaching and learning. We value each of them and feel that each is reflected in the advice we offer.

Second, we have a balanced posture regarding the role of technology in instruction. Because of this perspective we consider each technology in light of its advantages, limitations, and range of applications. No technology can be described solely as being either "good" or "bad," so we strive to give a balanced treatment to the hard and soft technologies as well as to the simpler and more sophisticated media.

Third, we believe in the possibility of a rapprochement between the humanistic and technological traditions in education. We contend that technology and humanism are two separable dimensions. We demonstrate in Chapter 1 that it's easy to describe instructional arrangements that are high on both dimensions or low on both dimensions, as well as high on one and low on the other. We view them as complementary concepts.

Fourth, we believe that technology can best be integrated into instruction when viewed from the perspective of the teacher rather than that of the technologist. Therefore, throughout the book we attempt to approach media and technology solutions in terms of the day-to-day challenges of teachers and to avoid technical jargon as much as possible. Our examples deal with real, everyday teaching issues, in real content areas, involving real media and materials.

New to This Edition

Not only have we updated the technological information and methodological perspectives, but we have made a number of other changes.

- *New organization.* The text has been reorganized to facilitate understanding of chapter content. The chapter on Technologies of Instruction has been moved to the front of the text based on suggestions by a number of users.
- *Copyright Concerns.* The copyright information from the sixth edition has been updated based on new laws and interpretations. In addition, the copyright information has been moved from an appendix to individual chapters where specific topics are relevant.
- *New photographs and drawings.* Almost 100 new visuals have been added to this edition to update the materials and equipment presented in the text.

- *Updated Classroom Link.* The "Classroom Link Portfolio" CD-ROM that accompanies the text has been significantly updated and expanded. It features templates for lesson plans and materials evaluation, enabling you to develop your professional portfolios. In addition, everything is connected to the ISTE/NETS Standards. This CD-ROM is packaged in the back of your book.
- *Classroom examples.* We provide more examples of specific classroom applications of media and technologies across grade levels and subjects.
- *Media specialists' role.* We have made a special effort to draw the connections between the roles of teachers and school media specialists, portraying them as highly complementary and interdependent.
- *Expanded Companion Website.* The Companion Website (CW), at www.prenhall.com/heinich, has been expanded and is integrated with the text and the CD-ROM to create a complete learning package.
- *Flashbacks.* These brief historical vignettes that lend a sense of perspective to today's technologies have been moved from the text to the Companion Website.

Text Organization

Introductory Information. The book begins with a visual introduction—a series of vignettes that depict the many applications of media and technology in enhancing learning. The first two chapters parallel the title of the text. Chapter 1 discusses instructional media, and Chapter 2 introduces technologies for learning. Chapter 1 identifies the purposes served by media and technology and provides theoretical grounding in communications and in the psychology of learning and instruction. Chapter 2 describes programmed instruction, programmed tutoring, learning centers, cooperative groups, games, and simulations. Chapter 3 presents the ASSURE model for instructional planning. Readers who are already familiar with lesson planning procedures will find the ASSURE model more congenial than the more technical models associated with full-fledged instructional design. This chapter also presents general procedures for appraising, selecting, and using media.

Core Chapters. Media and instructional materials are described in Chapter 4. Topics include manipulatives, multimedia kits, field trips, printed materials, free and inexpensive materials, and display surfaces. Chapter 5 examines principles and procedures of visual design, an important foundation for use of the visual media discussed in Chapters 6, 8, and 9. The handling of color is a critical element in visual design. To portray the principles of color properly, we have included full-color photos and illustrations in Chapter 5.

Chapters 6 through 10 treat one by one the common formats of media. Chapter 6 deals with visual media. Chapter 7 features audio media and the listening process. Video is examined in Chapter 8. Chapters 9 and 10 focus on computer-based technologies, including computer-assisted instruction, integrated learning systems, computers as student tools, multimedia, and hypermedia.

Chapter 11 focuses on computer networks including the Internet, the World Wide Web, intranets, wide area networks (WANs), and local area networks (LANs). Distance learning is the focus of Chapter 12, with particular attention paid to broadcast radio and television, audio and video teleconferencing, online technologies, and distance learning issues.

A Vision for the Future. In Chapter 13 we consider the possible impacts of current trends in technology, training, and education. We discuss the emerging influences of computer-based media, telecommunications technologies, schools of the future, and workplaces of the future.

Appendixes. *Appendix A: Use of Standard Visuals* includes topics that have been around since the first edition, but which are still very important and useful to readers. *Appendix B: Equipment and Set-ups* provides nuts-and-bolts advice on setting up and handling media hardware, including setups for audio, visual projection, video, and computers. *Appendix C: Information Sources* provides the key for exploring other sources for instructional media beyond this book, giving names and addresses of specialized and comprehensive sources. Dozens more producers, vendors, and information centers are listed on our Companion Website. The text concludes with a glossary of more than 400 technical terms used in this book and in discussions of instructional media generally, followed by a thorough index.

Special Features

- **Advance organizers.** Each chapter begins with a photo essay giving a visual overview of the content and a brief verbal outline. To provide a more concrete notion of what knowledge and skills are featured in each chapter, we open each chapter with a set of knowledge objectives. Following the statement of objectives is the "Lexicon," a list of technical terms or terms used in a specialized sense in that chapter. All of these features are intended to give you a strong set of advance organizers, scaffolds for the main content of the chapter.
- **Appraisal Checklists.** The checklists are related to each of the media formats and are intended to make it easy to preview materials systematically and to preserve the information for later reference. Users have permission to photocopy these for personal use. The "Classroom Link Portfolio" CD-ROM computer software allows you to enter your appraisals directly into a template for storage and future use.

- **ASSURE Blueprints.** These model lesson plans appear at the end of Chapters 3 through 12. They demonstrate how the ASSURE model can be used to integrate media into instructional plans, thus serving as a concrete link with daily professional practice. As a convenience, they are also available on the "Classroom Link Portfolio" CD-ROM.
- **AV Showmanship.** These features give specific tips on using media with flair and dramatic effect.
- **Close-Ups.** These serve as miniature case studies of media applications in a variety of settings. Like the Blueprints, they show media and technology use *in context.*
- **How To . . .** Various media production and operation procedures are spelled out with illustrated step-by-step procedures. Troubleshooting suggestions are included as part of these how-to discussions.
- **Media Files.** Actual materials in various media formats are highlighted as concrete examples of the types of commercially available materials. The materials referred to are meant to be *typical* of a given format, not necessarily as exemplary. No endorsement is implied.
- **Classroom Link Portfolio Activities.** New to this edition, these activities tie together the book, the "Classroom Link Portfolio" CD-ROM, the Companion Website, and the ISTE and NETS-T standards. These activities and projects can be found at the end of each chapter and are indicated with both a CW and a CD-ROM icon.
- **Integration Assessments.** Each chapter concludes with a set of activities, which address the sorts of real-life skills typically cultivated in courses using this book as the textbook. Activities that can be completed on the Companion Website are indicated with a CW icon.

For Students

"Classroom Link Portfolio" CD-ROM. The companion CD-ROM, "Classroom Link Portfolio," will assist you in creating, maintaining, and printing lesson plans and evaluations of materials based on the ASSURE model. The resulting database can be the basis for a teaching portfolio that can grow throughout your career. The portfolio components are connected to ISTE and NETS-S standards. The CD is fully integrated into the text and the Companion Website with performance-based and reflection-based activities and projects. These activities and projects, found at the end of each chapter, are indicated with both a CW and a CD-ROM icon. The guide for using the "Classroom Link Portfolio" CD-ROM is located on the Companion Website; the instructions for using this software have been completely revised and simplified.

Companion Website (CW). The Companion Website, located at http://www. prenhall.com/heinich, includes study materials such as knowledge objectives for each chapter, chapter overviews and summaries, interactive practice quizzes with answers, portfolio activities, integration assessments, links to related web sites, flashbacks, a message board to encourage discussion, a chat feature, and a detailed guide for using the "Classroom Link Portfolio" CD-ROM.

The CW provides students with resources and immediate feedback on exercises and other activities linked to the text. In addition, these activities, projects, and resources enhance and extend chapter content to real-world issues and concepts. Each chapter on the CW contains the following modules (or sections) unless specified otherwise:

- Knowledge Objectives
- True/False—self-quizzes with automatic grading that provides immediate feedback for students
- Multiple Choice—self-quizzes with automatic grading that provides immediate feedback for students
- Web Links—links to WWW sites that relate to and enhance chapter content
- Portfolio Activities—performance-based and reflection-based activities and projects that are connected to the ISTE/NETS standards
- Integration Assessments—projects and activities that enhance students' understanding of chapter content as it relates to technology
- Message Board—serves as a virtual bulletin board to post—or respond to—questions or comments to and from a national audience
- Chat—allows anyone who is using the text anywhere in the country to communicate in a real-time environment—ideal for discussion and study groups, class projects, and so on
- Other Resources: In addition, users have access to PowerPoint Transparencies, Flashbacks, and links to dozens of Information Sources

For Instructors

Instructor's Guide. Ask your Merrill/Prentice Hall representative or contact the publisher directly for a copy of this comprehensive teaching guide, available to adopters without cost. The *Instructor's Guide* includes teaching tips for each chapter, suggestions for different ways to organize an Instructional Media course, and overhead transparency masters on perforated pages.

Computer Test Item Bank. Adopting instructors can obtain a set of computer disks, available in either Windows or Macintosh format, containing a test item bank with instructions on how to create their own tests. Contact your Merrill/Prentice Hall representative.

Companion Website. The Companion Website is located at http://www.prenhall.com/heinich. It includes links to related web sites, a message board to encourage discussion, study materials and other features for students, and a library of PowerPoint slides that can be downloaded for class use. Of particular interest is **Syllabus Manager™**—an online syllabus creation and management instrument that has the following capabilities:

- **Syllabus Manager** provides you, the instructor, with a step-by-step process to create and revise syllabi, with direct links into the Companion Website and other online content without having to learn HTML.
- Your completed syllabus is hosted on our servers, allowing convenient updates from any computer on the Internet. Changes you make to your syllabus are immediately available to your students at their next logon.
- Students may log on to your syllabus at any time. All they need to know is the web address for the Companion Website and the password you've assigned to your syllabus.
- Clicking on a date, the student is shown the list of activities for that day's assignment. The activities for each assignment are linked directly to text content, saving time for students.
- Adding assignments consists of clicking on the desired due date, then filling in the details of the assignment.
- Links to other activities can be created easily. If the activity is online, a URL can be entered in the space provided, and it will be linked automatically in the final syllabus.

Authors' Services. The authors are eager to assist you in putting together an outstanding Instructional Media course. We offer the following services to instructors who have adopted this book:

- *Telelecture.* Call any of us in advance to arrange a guest lecture in your class via telephone. The only cost to you is for the toll charges. Some instructors use this telelecture as a demonstration of the techniques described in Chapter 12. Our phone numbers, fax numbers, and e-mail addresses are listed in the *Instructor's Guide.*
- *Newsletter.* We keep in touch with our adopters through an occasional newsletter. The newsletter keeps you informed about new developments, teaching tips and new teaching materials, and updates on our workshops and other services. You can receive it free of charge by sending your name to Sharon Smaldino.
- *Workshops.* We have conducted workshops annually since 1982 at the national convention of the Association for Educational Communications and Technology (AECT). This is a forum for exchange of ideas and networking among instructors of courses on Instructional Media.

If you are an instructor using this text, send your name and address to Sharon Smaldino, Schindler Education Center 618, University of Northern Iowa, Cedar Falls, IA 50614-0606. We would like to add your name to our newsletter mailing list, and we welcome any comments you have about the text.

ACKNOWLEDGMENTS

Through each of the editions of this book we have been fortunate to have had guidance from the real experts—the people who teach the courses for which this book is designed. In preparing for this edition we surveyed a sample of adopters and other leaders in the field to elicit their advice about contents and emphases. We then asked other colleagues well respected in the field to critique the text. We here thank all those who gave their time and talent to help make this the most useful textbook it could be, and in particular those who reviewed the sixth edition and suggested improvements:

- Bonnie H. Armstrong, Florida State University
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We especially thank those who contributed more directly by writing new material, drawing illustrations, taking photographs, and searching for references.

Elizabeth Boling of the School of Education, Indiana University, is responsible for both the outstanding illustrations in Chapter 5 and the accompanying text related to visual design. We are in awe of her phenomenal artistic skill and scholarly mastery of this area. Dennis Pett, from his professor emeritus setting in Vermont, carefully reviewed drafts of Chapter 5 and gave generous advice on photography, color, and visual design principles, as well as providing a number of exemplary photographs. Their contributions were so substantial they must be considered co-authors of Chapter 5.

Daniel Callison of the School of Library and Information Science, Indiana University, reviewed the whole book and made many helpful recommendations related to the connections between the teacher and the school library media center and media specialist. The extended Blueprint in Chapter 3, which we feel is a significant aid to using the ASSURE model, was developed by Mary Ann Ferkis while a student at Purdue University; it was done as a project in a course using this book.

This book also contains the products of the work of many others who have contributed to past editions; we continue to be indebted to all of them.

The editorial and production staffs of Merrill/ Prentice Hall, particularly Debbie Stollenwerk, Heather Fraser, and Mary Harlan, deserve special commendation. A new member of the production team, Nancy Ritz, our photo coordinator, greatly enhanced the look of this edition. We also want to thank our copy editor, Robert L. Marcum, for his valuable editing contributions and for his assistance with the content related to computers. Molly Lane of Purdue University provided valuable assistance in updating the Suggested Readings. The authors have never had such intense and helpful support from any previous publication team.

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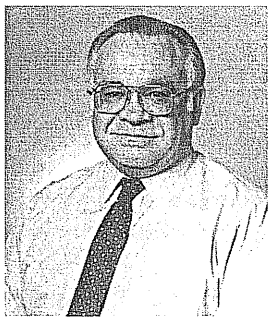
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Robert Heinich
Michael Molenda
James D. Russell
Sharon E. Smaldino

ABOUT THE AUTHORS



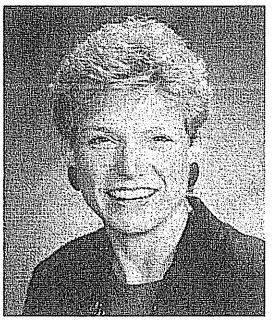
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Robert Heinich. Dr. Heinich is Professor Emeritus in the department of Instructional Systems Technology (IST), Indiana University. He is now retired from active teaching, having served on the faculty since 1969 following completion of his doctorate at University of Southern California and a stint as multimedia editor for Doubleday Publishing. Prior to that he built a nationally prominent media program at the Colorado Springs school district. Bob has been an active leader in the field of educational technology for four decades, serving as president of the Association for Educational Communications and Technology (AECT) in 1971–1972 and as president of AECT's foundation from 1972 to 1982. He was editor of AECT's scholarly journal from 1969 to 1983. Indicative of his professional contributions, Dr. Heinich has received the Presidential Citation of the International Society for Performance and Instruction and the Distinguished Service Award of AECT. At Indiana University he served as chairman of the IST department from 1979 to 1984. His many articles and monographs provide some of the major theoretical underpinnings of the field. The University of Northern Colorado honored Bob with their Trail Blazer Award as an outstanding alumnus. He is currently president of the Old Colorado City Historical Society in Colorado Springs, where he now lives.

Michael Molenda. Dr. Molenda is Associate Professor in Instructional Systems Technology (IST) at Indiana University. He received his Ph.D. from Syracuse University and taught at University of North Carolina at Greensboro before joining Indiana University in 1972. He designs and teaches courses in Media Applications, Instructional Development, Evaluation and Change, and Instructional Technology Foundations. Mike served as chairman of the IST department from 1988 to 1991. He has lectured and consulted extensively on educational technology in Spain, the Netherlands, Indonesia, Korea, Swaziland, and several countries in Latin America and the Middle East. Among his professional distinctions are selection as a Fulbright Lecturer in Peru in 1976, membership on the Board of Directors of AECT, 1988–1991, and presidency of AECT's International Council, 1978–1979. Dr. Molenda's breadth of knowledge of the field of educational technology is indicated by his authorship of articles on educational technology in elementary and secondary education and instructional technology for recent editions of international encyclopedias of education. Since 1997 he has co-authored an annual survey of issues and trends in educational technology for *Educational Media and Technology Yearbook.*

James D. Russell. Dr. Russell is Professor of Educational Technology at Purdue University. During spring semesters he is visiting professor of Instructional Systems at Florida State University. A former high school mathematics and physics teacher, Jim teaches courses on Media Utilization, Instructional Design, Instructional Delivery Systems, and Principles of Adult Education. He was honored as his department's Outstanding Teacher in 1993 and with the School of Education's Best Teacher Award for 1996. Jim works part-time for Purdue's Center for Instructional Excellence, where he conducts workshops on teaching techniques and consults with faculty and graduate assistants on instructional improvement. His specialty areas, in which he has achieved national prominence through his writings and presentations, are presentation skills and using media and technology in classrooms. Because of his commitment to remaining close to the real world of teachers in the classroom, Dr. Russell serves as co-director of the Technology Integration Project, the purpose of which is to improve students' achievement and attitudes in math and science. As part of this project he conducts daylong workshops to train teachers as facilitators to work with other teachers to implement technology in their classrooms. Through these workshops and this textbook, Jim continues to make a significant impact on classroom teaching practice.

Sharon E. Smaldino. Dr. Smaldino is a Professor of Educational Technology at the University of Northern Iowa. Sharon received her Ph.D. in 1987 from Southern Illinois University, Carbondale. Prior to that she received an M.A. in Elementary Education and served for more than a dozen years as teacher, speech therapist, and special educator in school districts from Florida to Minnesota. At Northern Iowa she teaches an introductory educational media course for undergraduates and graduate majors and is coordinator of the Educational Technology program. Dr. Smaldino also teaches graduate courses in Instructional Development, Instructional Computing Design, Desktop Publishing, and Selection and Integration. She is the recipient of the UNI 2000 Outstanding Graduate Teaching Award. Presenting at state, national, and international conferences, Sharon has become an important voice on applications of technology in the classroom and in distance education. In addition to her teaching and consulting, Dr. Smaldino has served as president of a division of AECT, served on the board of directors of IVLA and AECT, and has written articles for state and national journals on her primary research interest, effective technology integration in learning. She is working on a Preparing Tomorrow's Teachers to use Technology (PT3) grant using the Web to deliver information and case studies of teachers using technology in schools.

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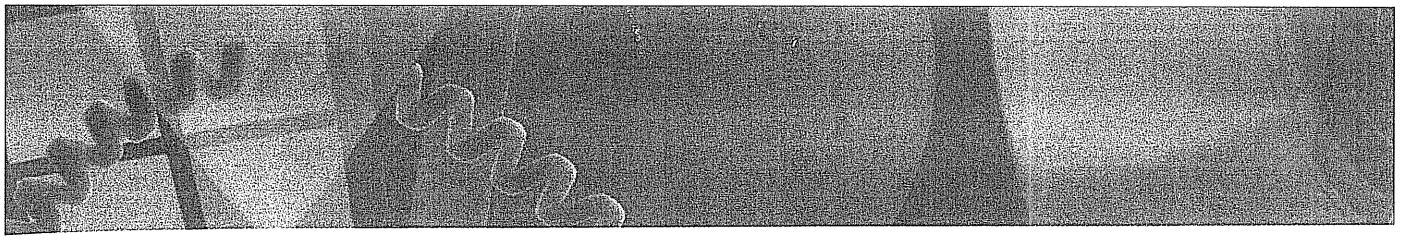
Flashback

Flashbacks are brief historical vignettes that lend a sense of perspective to today's technologies. The following Flashback features are now available on the book's Companion Website at

http://prenhall.com/heinich

Dale's Cone of Experience
From Audiovisual Aids to New Technologies for Learning
Origins of Performance Objectives
That Incomparable Moravian
From Needle to Laser
Mr. Edison's Dream
PLATO: From an Indecisive Committee and a $10 TV Set
Roots of the Internet
Continental Classroom

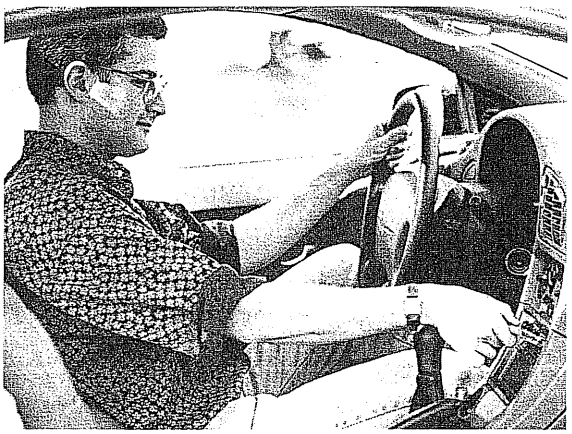
NOTE: Every effort has been made to provide accurate and current Internet information in this book. However, the Internet and information posted on it are constantly changing, so it is inevitable that some of the Internet addresses listed in this textbook will change.



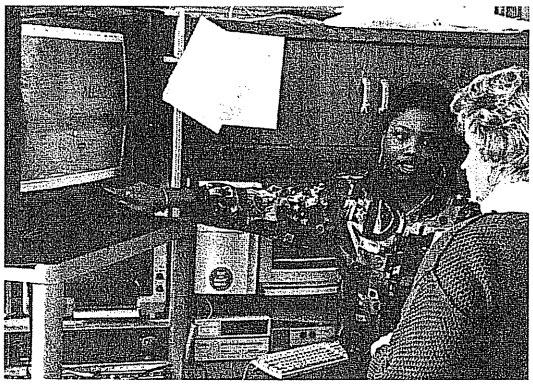
Instructional Media and Technologies for Learning

The Pervasiveness of Instructional Media

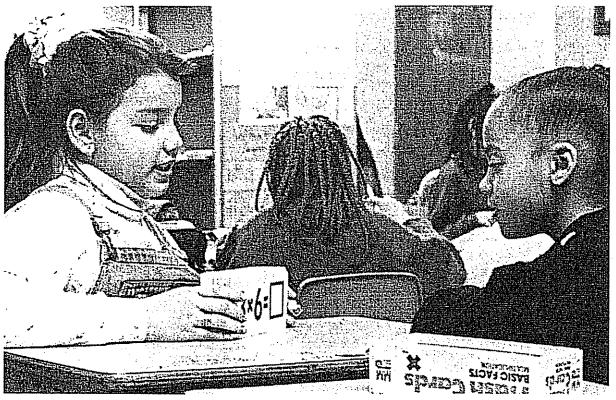
With the coming of the twenty-first century, our era could be characterized as the age of media and technology. As conduits for information and entertainment, the mass media literally surround us day and night. Technology, especially in terms of digital communications, permeates our work and play. Media and technology have transformed not only the worlds of work and leisure but the world of education as well. As you think about your future in the world of education, consider these vignettes as samples of the ways media and technology affect the processes of teaching and learning.



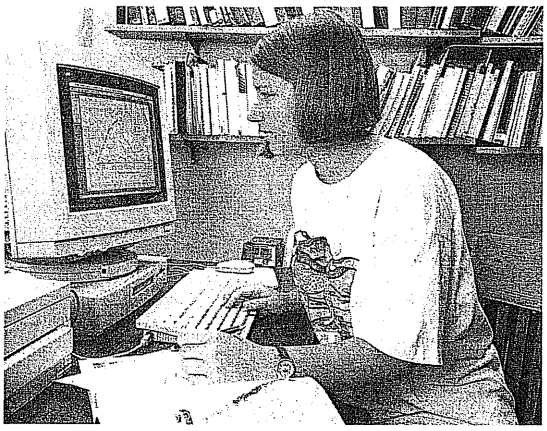
▲ 1 *A pharmaceutical salesman plugs into his car stereo the new cassette from the company sales training center. It introduces him to the distinctive features of a new drug for respiratory infections.*



▲ 2 *In a quiet corner just off the shop floor at Regent Industries, Jean is guided through a videocassette that shows the proper operation and safety features of the machine that she will be operating during her shift today. Jean "floats" among jobs as needed from day to day.*



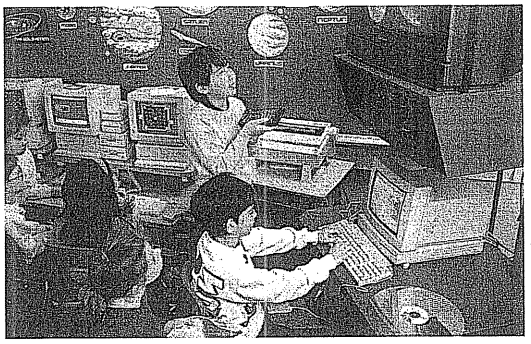
▲ 3 *Second graders Allison and Tiffany use flash cards to practice their multiplication skills. The cards have a problem on one side and an answer on the other; the "repeat" stack grows smaller as Tiffany masters each fact.*



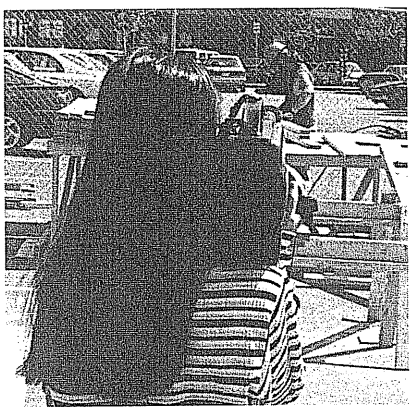
◀ 4 *Anne, a graduate student in veterinary medicine, uses a DVD system in the university's learning center to practice responding to animal owners in stressful situations. The scenarios present situations Anne is likely to face in actual veterinary practice.*

▼ 5 *Samaritan Club members of junior high school age are studying the meanings of the parables. They compete as teams during the afterschool program at their local church. Matching the facts of the stories with the accepted interpretation is the purpose of the game.*

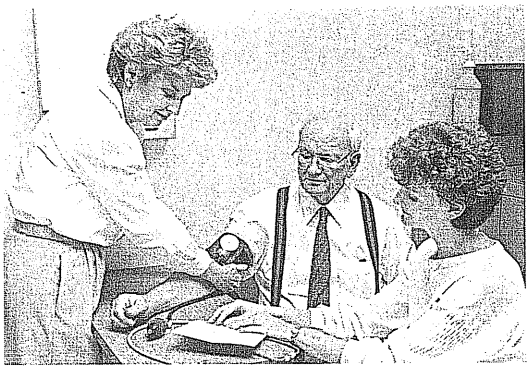




▲ 6 *A group of fifth graders eagerly boot (start up)* The Great Solar System Rescue *disk on their classroom computer. They want to continue where they left off yesterday in a detective story. It challenges their logical reasoning skills in solving the mystery.*

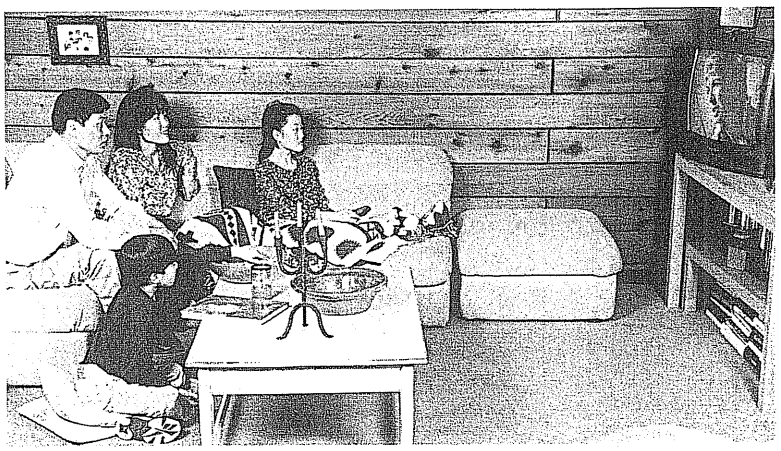


◀ 7 *As she unobtrusively videotapes housing conditions in the inner city, Stephanie, a high school senior, reflects on what brought her here. She had volunteered to do a video report on urban problems for her social studies class.*



▲ 8 *To learn how to take their blood pressure at home, Thelma and Harold listen to the nurse at the hospital as she guides the retired couple through a structured tutoring package. The nurse patiently answers any questions they have.*

▼ 9 *Dinner over, the Lees settle into the family room to watch* This Old House. *They are intrigued with the notion of buying and restoring an older house, and this television series provides them with valuable tips.*

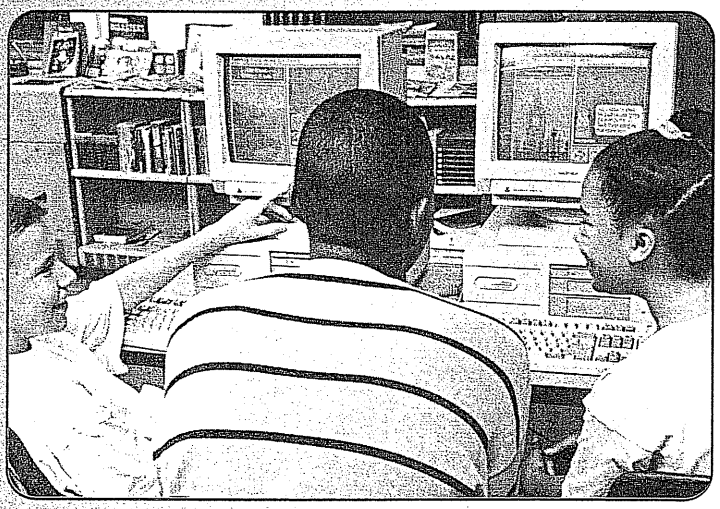


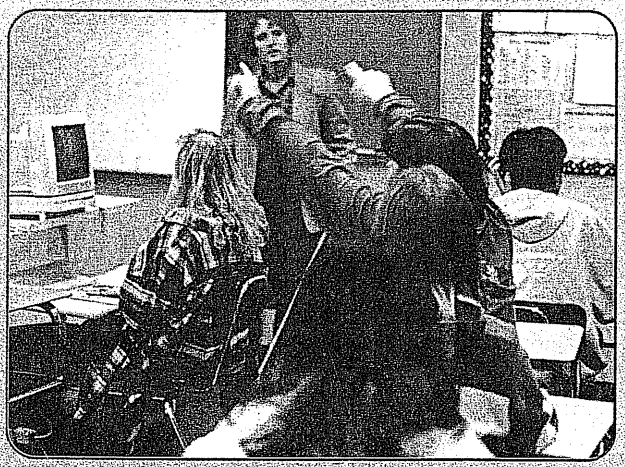
In school and after school, at home and at work, children and adults are enjoying the benefits of learning through media and the new technologies for learning.
The goal of this book is to help put you into this picture.





Instructional media and the technologies for learning provide you with the tools to engage students powerfully in the learning process. The array of media formats and of quality materials available to the teacher is increasing dramatically. As a teacher, you must be prepared to choose the best tools for your students, who are in diverse situations and pursuing different sorts of learning goals.





You can make more effective use of media if you understand some underlying concepts about the learning process. There are a number of different perspectives on how people learn; each offers unique insights and practical tools. Media continue to play a range of roles in the world of corporations and other organizations.

You will be able to make informed decisions about media and technology if you understand and apply the guidelines provided in this book.

Media, Technology, and Learning

CHAPTER 1

OUTLINE

- Learning
- Media
- The Roles of Media in Learning
- Methods
- Technology

KNOWLEDGE OBJECTIVES

1. Distinguish between instruction and learning.
2. Describe four psychological perspectives of learning discussed in the text.
3. Define the term *medium;* name five basic categories of media.
4. Explain the concrete–abstract continuum, indicating how it can be used to aid in the selection of media.
5. Discuss six roles of media in the instructional process, giving an example of media used in each role.
6. Describe 6 of the 10 methods of instruction discussed in this chapter.
7. Describe technologies for learning and cite at least one example.

LEXICON

learning
behaviorism
cognitivism
schema/schemata
assimilation
accommodation
constructivism
social psychology
instruction
medium/media
enactive experience
iconic representation
symbolic representation
advance organizer
portfolio
artifact
cooperative learning
technology
technology for learning

Throughout history, media and technology have influenced education. Most recently, for example, the computer and the Internet have invaded instructional settings. Such tools offer powerful possibilities for improving learning. The teacher, however, makes the difference in the integration of media and technology into this process.

The roles of instructor and learner are clearly changing because of the influence of media and technology in the classroom. No longer are teachers and textbooks the sources of all knowledge. The teacher becomes the director of the knowledge-access process. Along the continuum of instructional strategies, sometimes the teacher will elect to provide direct instructional experiences for students. At other times, with a few keystrokes students can explore the world, gaining access to libraries, other teachers and students, and a host of resources to obtain the knowledge they seek.

It is essential that, as the guide for learning, the teacher examine media and technology in the context of learning and its potential impact on the outcome for students. This chapter concerns the nature of learning, the way the role and responsibility of the teacher change with the approach to instruction used, and the importance of media and technology within that process.

LEARNING

Learning is the development of new knowledge, skills, or attitudes as an individual interacts with information and the environment. The *learning environment* includes the physical facilities, the psychological atmosphere, instructional methods, media, and technology. Learning takes place all the time. We learn things by walking down the street, watching TV, surfing the Net, conversing with other people, or just by observing what goes on around us. This type of incidental learning is not our major interest as education professionals. Rather, we are concerned primarily with the learning that takes place in response to our instructional efforts. How we design and arrange instruction has a great deal to do not only with what is learned but also with how learners use what they learn.

Thus, the learning process involves the selection, arrangement, and delivery of information in an appropriate environment and the way learners interact with that information. In this chapter we first consider learning, looking at several psychological perspectives and a philosophical perspective. Next we introduce the various types of media, which we will explore in later chapters. The concrete–abstract continuum is explained. We describe various roles of media in learning and present different methods, such as presentations, demonstrations, and discussion. The chapter concludes with a discussion of technology as it relates to learning.

Psychological Perspectives on Learning

How instructors view the role of media and technology in the classroom depends very much on their beliefs about how people learn. Over the past half century there have been several dominant theories of learning. Each has implications for instruction in general and for the use of technology specifically. We will briefly survey each of the major perspectives on learning and discuss their implications. Learning theories and their impact on teaching decisions are discussed in greater detail by Driscoll (1994).

Behaviorist Perspective. In the mid 1950s, the focus of learning research started to shift from stimulus design (communication) to learner response to stimuli. At the forefront of this movement was B. F. Skinner, a psychologist at Harvard University. Skinner was a proponent of **behaviorism** but with an important difference: he was interested in voluntary behavior, such as learning new skills, rather than reflexive behavior, as illustrated by Pavlov's famous salivating dog. He demonstrated that the behavior of an organism could be shaped by reinforcing, or rewarding, the desired responses to the environment. Skinner based his learning theory, known as reinforcement theory, on a series of experiments with pigeons, and he reasoned that the same procedures could be used with humans. The result was the emergence of programmed instruction, a technique of leading a learner through a series of instructional steps to a desired level of performance. Unlike earlier learning research, Skinner's work led directly to improved instructional design.

Cognitivist Perspective. Behaviorists refuse to speculate on what goes on internally when learning takes place. They rely solely on observable behaviors. As a result, they are more comfortable explaining relatively simple learning tasks. Because of this posture, behaviorism has limited application in designing instruction for higher-level skills. For example, behaviorists are reluctant to make inferences about how learners process information, even when doing so can be helpful in designing instruction that develops problem-solving ability.

Cognitivists, on the other hand, are making a primary contribution to learning theory and instructional design by creating models of how learners receive, process, and manipulate information. **Cognitivism** leads to a different way of looking at familiar learning patterns. For example, behaviorists simply state that practice strengthens the response to a stimulus. Cognitivists create a mental model of short-term and long-term memory. New information is stored in short-term memory, where it is "rehearsed" until ready to be stored in long-term memory. If the information is not rehearsed, it fades from short-term memory.

Learners then combine the information and skills in long-term memory to develop cognitive strategies, or skills for dealing with complex tasks. Cognitivists have a broader perception of independent learning than that held by behaviorists: Students are less dependent on the guiding hand of the program designer and rely more on their own cognitive strategies in using available learning resources.

A close look at the work of Swiss psychologist Jean Piaget illustrates how a cognitive psychologist views the mental processes individuals use in responding to their environment. The three key concepts of mental development in Piaget's work are schemata, assimilation, and accommodation (Piaget, 1977).

Schemata. **Schemata** (singular, **schema**) are the mental structures by which individuals organize their perceived environment. Schemata are adapted or changed during mental development and learning. They are used to identify, process, and store incoming information and can be thought of as categories individuals use to classify specific information and experiences.

Very young children learn to distinguish between mother and father. They soon separate dogs from cats and later become aware of different varieties of dogs. These differentiations based on experience lead to the development of schemata, or the ability to classify objects by their significant characteristics.

These cognitive structures change by the processes of assimilation and accommodation, which should be encouraged during instruction.

Assimilation. **Assimilation** is the cognitive process by which a learner integrates new information and experiences into existing schemata. Piaget borrowed the term from biology, where it refers to the process by which an organism eats food, digests it, and then assimilates or changes it into a usable form.

During learning, assimilation results from experiences. With new experiences, the schema expands in size but does not change its basic structure. Using the process of assimilation, the individual attempts to place new concepts into existing schemata.

These learning experiences can be real-life experiences. But rather than waiting for experiences to happen naturally, instructors cause experiences to happen through use of media and methods.

Accommodation. The process of modifying existing schemata or creating new ones is called **accommodation.** Because schemata change with experience, adult learners have a broader and more elaborate range of schemata than do children.

When dealing with a new concept or experience, the learner attempts to assimilate it into existing schemata. When it does not fit, there are two possible responses: (1) the learner can create a new schema into which the new stimulus is placed, or (2) the existing schema can be modified so that the new stimulus will fit. Both of these processes are forms of accommodation.

Schemata evolve over time in response to many learning experiences. As instructors, we are responsible for providing learning experiences that will result in the creation of new schemata as well as the modification of existing schemata.

Constructivist Perspective. **Constructivism** is a movement that extends beyond the beliefs of the cognitivist. It considers the engagement of students in meaningful experiences as the essence of learning. The shift is from passive transfer of information to active problem solving. Constructivists emphasize that learners create their own interpretations of the world of information. They contrast their perspective with those of the behaviorists or cognitivists, who believe that the mind can be "mapped" by the instructor. The constructivist will argue that students situate the learning experience within their own experience and that the goal of instruction is not to teach information but to create situations so that students can interpret information for their own understanding. The role of instruction is not to dispense facts but to provide students with ways to assemble knowledge. The constructivist believes that learning occurs most effectively when students are engaged in authentic tasks that relate to meaningful contexts. The ultimate measure of learning is therefore based on the ability of the student to use knowledge to facilitate thinking in real life.

Social-Psychological Perspective. **Social psychology** is another well-established tradition in the study of instruction and learning. Social psychologists look at the effects of the social organization of the classroom on learning. What is the group structure of the classroom—independent study, small groups, or the class as a whole? What is the authority structure—how much control do students have over their own activities? And what is the reward structure—is cooperation rather than competition fostered?

In recent years, researchers such as Robert Slavin have taken the position that cooperative learning is both more effective and more socially beneficial than competitive and individualistic learning (Slavin, 1990). Slavin developed a set of cooperative learning techniques that embodies the principles of small-group collaboration, learner-controlled instruction, and rewards based on group achievement. (We discuss these techniques more fully in Chapter 2.)

Approaches to Instruction

Instruction is the arrangement of information and environment to facilitate learning. By *environment* we mean not only where instruction takes place but also the

methods, media, and technology needed to convey information and guide the learner's study. As implied in the illustrated vignettes on pages 2 and 3 and as detailed later in this chapter, information and environment can change depending on the instructional goal. For example, in Vignette 7, Stephanie must have a camera and seek out a location that will fulfill the requirements of the assignment. She will provide the content for her project. In Vignette 4, Anne goes to a learning center, where she will find the equipment and the media necessary to complete her assignment. The information has been carefully prepared for her.

While behaviorists stress external control over a learner's behavior, cognitivists stress internal, or learner, control over mental processes. This difference in viewpoint influences how media are designed and used.

Behaviorists specify behavioral (performance) objectives, then limit instruction to whatever is necessary to master those objectives. When programmed instruction was introduced, material not directly related to the objectives was carefully screened out. Instructional design and media were highly structured. This approach has been very successful in teaching basic skills and knowledge.

Instructional designs based on cognitive psychology are less structured than those based on behavioral psychology. They allow learners to employ their own cognitive strategies, and they encourage interaction among students. Learning tasks that require problem solving, creative behavior, or cooperative activity lend themselves well to a cognitive instructional approach.

Unlike behaviorists, cognitivists do not limit their definition of learning to observable behavior. They believe that learners learn more than is expressed in immediate behaviors. They may at a later time use knowledge previously learned, but not previously expressed, in building their schemata.

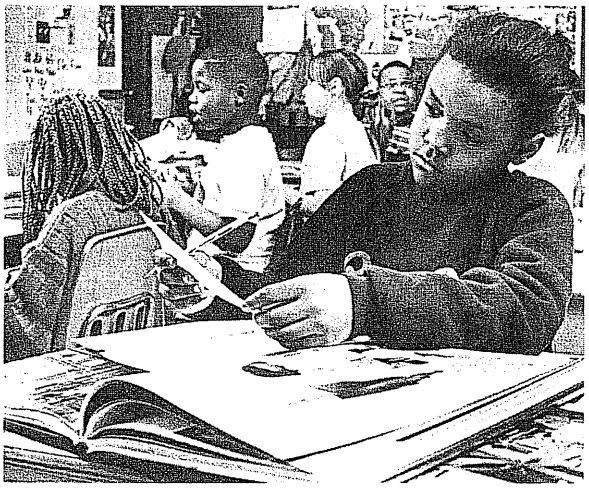
Constructivists, on the other hand, provide a rich learning environment and allow learners to create their own meaning. A rich learning environment can be provided using a variety of media and technology. This is the least structured approach to learning.

Instructors and instructional designers need to develop an eclectic attitude toward competing schools of learning psychology. We are not obliged to swear allegiance to a particular learning theory. We use what works. If we find that a particular learning situation is suited to a behaviorist approach, then we use behaviorist techniques. Conversely, if the situation seems to call for cognitivist or constructivist methods, that is what we use.

Finding a Middle Ground

Throughout this text we recommend an eclectic approach to practice. Inspired by each of the psychological perspectives, designers have developed powerful frameworks for instruction. Indeed, successful instructional practices have features that are supported by virtually all the various perspectives:

FIGURE 1.1
Media can be designed to provide effective individualized instruction.



- *Active participation.* Effective learning happens when students are actively engaged in meaningful tasks, interacting with the content.
- *Practice.* New learning requires more than one exposure to take root; practice, especially in varying contexts, improves retention rate and the ability to apply the new knowledge, skill, or attitude.
- *Individual differences.* Learners vary in terms of personality, general aptitude, knowledge of a subject, and many other factors; effective methods allow individuals to progress at different rates, cover different materials, and even participate in different activities (Figure 1.1).
- *Feedback.* Learners need to know if their thinking is on track; feedback may be provided by teacher correction of papers, electronic messages from a computer, the scoring system of a game, or by other means.
- *Realistic contexts.* We are most likely to remember and to apply knowledge that is presented in a real-world context; rote learning leads to "inert knowledge"—we know something but never apply it to real life.
- *Social interaction.* Fellow humans serving as tutors or peer group members can provide a number of pedagogical as well as social supports.

The learning frameworks that we will examine in detail all attempt to incorporate a number of these pedagogical features. Certainly all of them value active participation and interaction. They also encourage learners to use new knowledge, skills, or attitudes by providing for frequent and varied practice. However, they vary in the extent to which they emphasize the other features.

It follows that an eclectic approach is essential when selecting and designing media. Most educators support the cognitivists' emphasis on stimulus-rich materials, confident that students learn more from, say, a video than may be expressed at the time. For example, a high school student may learn about the scientific method during a video of a chemistry experiment even though the objectives for the experiment do not list that topic. A management trainee may learn a great deal about personality differences during a gaming exercise designed to teach an entirely different skill. On the other hand, there are situations, such as teaching basic knowledge (e.g., multiplication tables) or psychomotor skills (e.g., keyboarding), that call for the tighter control of behaviorist techniques.

A Philosophical Perspective on Learning

More than a few observers have argued that the widespread use of instructional hardware in the classroom leads to treating students as if they were machines rather than human beings—that is, that technology dehumanizes the teaching/learning process. Properly used, however, modern instructional technology can individualize and thus humanize this process to a degree previously considered unattainable.

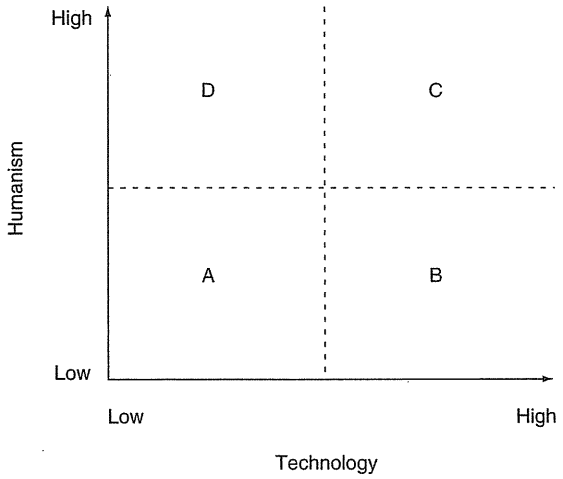
If teachers perceive learners as machines, they will treat them as such, with or without the use of instructional media and technology. If teachers perceive their students as human beings with rights, privileges, and motivations of their own, with or without the aid of media and technology, they will view students as people engaged in learning. In other words, it is the way that media and technology are used, not the media and technology themselves, that tend to mechanize people. Put another way, what is important is not so much what technologies are present in the classroom but rather how the teacher guides students in their use.

Students with a high level of anxiety are prone to make mistakes and to learn less efficiently when under pressure. Many times, stressful learning situations for high-anxiety students make it difficult for them to succeed. Given the same sequence of instruction mediated through technology that will continue only at the command of the students, it may be possible to reduce the pressure. Thus the use of technology can humanize the instruction.

Contrary to what some educators believe, technology and humanism can exist either together or separately in an array of ways. Figure 1.2 suggests four basic combinations of technology and humanism. Here are some examples:

A. A college lecture with little or no interaction between the professor and the students—low in technology and low in humanism.

FIGURE 1.2
Technology and humanism are not opposite ends of a single scale but two different variables, either of which can be high or low.



B. A course consisting of a required series of computer-based lessons, each composed of performance objectives, materials to be used to complete those objectives, and a self-evaluation format—high in technology and low in humanism.
C. Similar to sample B, but students select the topic of study based on their interests and consultation with an instructor. Designed into this instructional system are periodic interactions between student and instructor, discussing the present state of learning and what should be studied next—high in technology and high in humanism.
D. A group meets on a regular basis to discuss common reading assignments—low in technology and high in humanism.

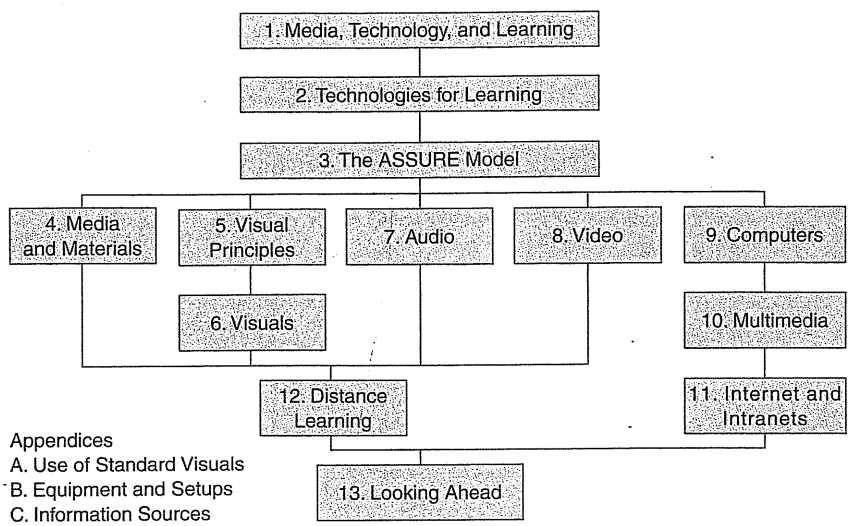
These examples are overly simplified and used only to illustrate the concept, but they serve as a basis for analyzing the relationship between humanism and technology. They illustrate that instruction can be low in both humanism and technology, just as it can be high in both.

Using instructional technology does not preclude a humane teaching/learning environment. On the contrary, instructional media and technologies for learning can help provide a learning atmosphere in which students actively participate. When instructional media and technology are used properly and creatively in the classroom, it is the machines that are turned on and off at will, not the students.

MEDIA

A **medium** (plural, **media**) is a channel of communication. Derived from the Latin word meaning "between," the term refers to anything that carries information

FIGURE 1.3
The diagram shows the structure of the chapters in this text.



between a source and a receiver. Examples include video, television, diagrams, printed materials, computers, and instructors. These are considered instructional media when they carry messages with an instructional purpose. The purpose of media is to facilitate communication.

Since the turn of the century, teachers have used various types of audio and visual aids to help them teach. Recently, teachers have expanded their repertoire of materials and procedures to include the new technologies for learning. The newer techniques include the use of computers, compact discs, digital videodiscs (DVDs), satellite communications, and the Internet.

The teacher is no longer limited to the confines of the classroom. Through the school media center and computer networks such as the Internet and campus intranets, the world becomes each student's classroom.

The media and methods preferred by training directors are often different from those used by educators. One of the major reasons for this is that schools' curricula are fairly uniform, whereas training programs are often industry specific. Formats of media that lend themselves to local production are preferred by training directors.

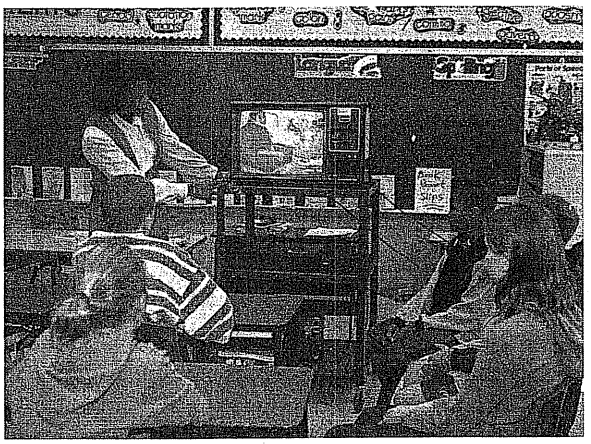
Another difference arises from the fact that training directors are dealing with adults rather than children and adolescents. Role playing, games, and simulations are used much more frequently in training programs, particularly with management, supervisory, and sales personnel. These people's jobs require a great deal of interaction with people, and the types of training methods that develop relevant skills are given high priority. Trainees will have to call on those skills immediately after the training session and are more likely to become impatient with methods more abstract than the situation demands.

The diversity of media used for instruction is illustrated by Figure 1.3.

The Concrete–Abstract Continuum

Instructional media that incorporate concrete experiences help students integrate prior experience and thus facilitate learning of abstract concepts (Figure 1.4). For example, many students have watched various aspects of the construction of a highway or street. They have seen the machine that lays the asphalt down, they have seen graders at work, and they have seen a number of other stages of road building. However, they need to have all these experiences integrated into a generalized notion of what it means to build a highway. Showing a video that represents all these processes in relation to each other is an ideal way to integrate their various experiences into a meaningful abstraction.

FIGURE 1.4
How the instructor integrates the technology into the lesson is the most important factor in successful learning.



Decisions regarding trade-offs between the concreteness of learning experiences and time constraints have to be made continually by the instructor. In 1946, Edgar Dale developed the "Cone of Experience" (Dale, 1969).

In the Cone of Experience we start with the learner as participant in the actual experience, then move to the learner as observer of the actual event, to the learner as observer of an event presented through some medium, and finally to the learner observing symbols that represent an event. Dale contended that learners could make profitable use of more abstract instructional activities to the extent that they had built up a stock of more concrete experiences to give meaning to the more abstract representations of reality.

In general, as you move up Dale's Cone of Experience toward the more abstract media, more information can be compressed into a shorter period of time. It takes more time for students to engage in a direct purposeful experience, a contrived experience, or a dramatized experience than it does to present the same information in a videotape, a recording, a series of visual symbols, or a series of verbal symbols.

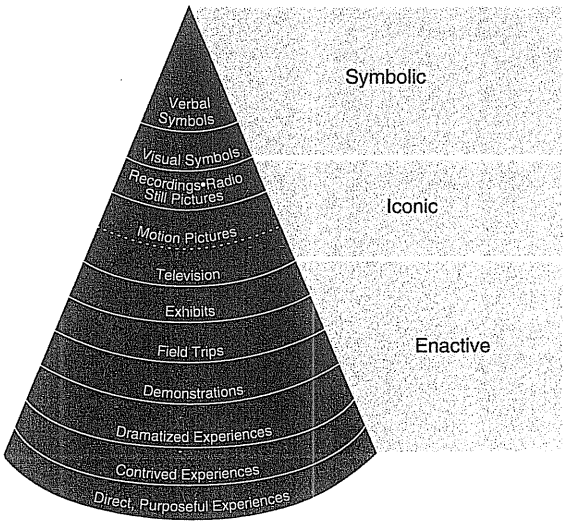
For example, a field trip can provide a learning experience relatively high in concreteness, but it also takes up a good deal of instructional time, and limited resources in a school district often make it difficult to arrange. A videotape depicting the same experiences as the field trip will be more abstract, but may be presented to students in a much shorter period of time and with much less effort and money. Knowledge of local resources will allow media specialists to help teachers select the best approach to an experience, either by identifying a local contact or assisting with selecting an alternative medium.

Dale's Cone of Experience, although a simplification of complex relationships, is a practical guide to analyzing the characteristics of instructional media and methods and the way these media may be useful.

The greatest amount of information can be presented in the least amount of time through printed or spoken words (the top of the concrete–abstract continuum). But if students do not have the requisite background experience and knowledge to handle these verbal symbols, the time saved in presentation will be time lost in learning. The instructor can find out if the instructional method matches learners' backgrounds only by analyzing their responses. If students achieve what was expected of them, the instructional experiences were appropriate.

Psychologist Jerome Bruner, working from a different perspective, devised a descriptive scheme for labeling instructional activities that parallels Dale's. In developing his theory of instruction, Bruner proposed that instruction should proceed from **enactive** (direct) **experience** to **iconic representation** of experience (such as the use of pictures and videotapes) to **symbolic representation** (such as the use of words). He further stated that the sequence in which learners encounter materials has a direct effect on their achieving mastery of the task (Bruner, 1966). Bruner pointed out that this applies to all learners, not just children. When a learning task is presented to adults who have no relevant experiences on which to draw, learning is facilitated when instruction follows a sequence from actual experience to iconic representation to symbolic or abstract representation. As shown in Figure 1.5, Bruner's concepts of enactive, iconic, and symbolic learning may be superimposed on Dale's Cone of Experience.

FIGURE 1.5
Bruner's concepts of enactive, iconic, and symbolic learning may be superimposed on Dale's Cone of Experience.



"The Cone of Experience" from *Audio-Visual Methods in Teaching,* Third Edition, by Edgar Dale, copyright © 1969 by Holt, Rinehart & Winston, Inc., reproduced by permission of the publisher.

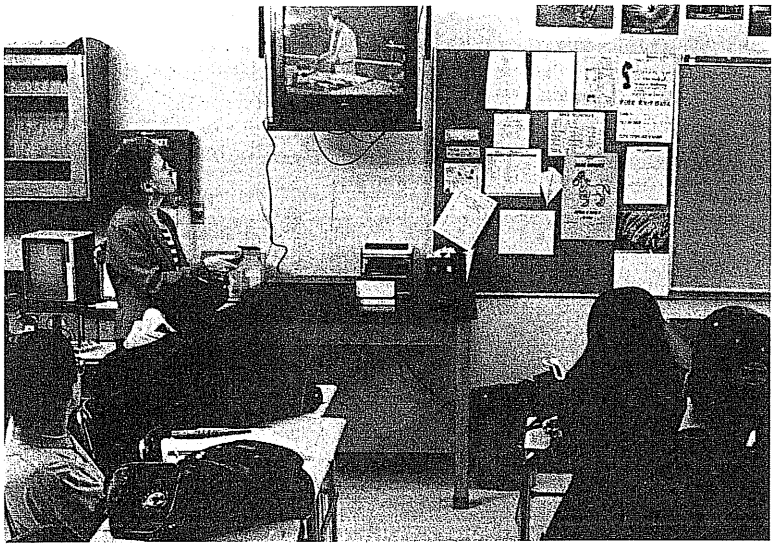
THE ROLES OF MEDIA IN LEARNING

Media can serve many roles in learning. The instruction may be dependent on the presence of a teacher (i.e., instructor directed). Even in this situation, media may be heavily used by the teacher. On the other hand, the instruction may not require a teacher. Such student-directed instruction is often called "self-instruction" even though it is in fact guided by whoever designed the media.

Instructor-Directed Instruction

The most common use of media in an instructional situation is for supplemental support of the "live" instructor in the classroom (Figure 1.6). Certainly, properly

FIGURE 1.6
Instructional media are often used by the classroom teacher to present new information.



designed instructional media can enhance and promote learning and support teacher-based instruction. But their effectiveness depends on the instructor.

Research has long indicated the importance of the instructor's role in effective use of instructional media. For example, early studies showed that when teachers introduced films, relating them to learning objectives, the amount of information students gained from films increased (Wittich & Fowlkes, 1946).

Later research confirmed and expanded on these original findings. Ausubel (1968), for example, developed the concept of **advance organizers** as an aid to effective instruction. An advance organizer may take the form of an overview of or an introduction to lesson content, a statement of principles contained in the information to be presented, a statement of learning objectives, and so on. Whatever the form, it is intended to create a mindset for reception of instruction.

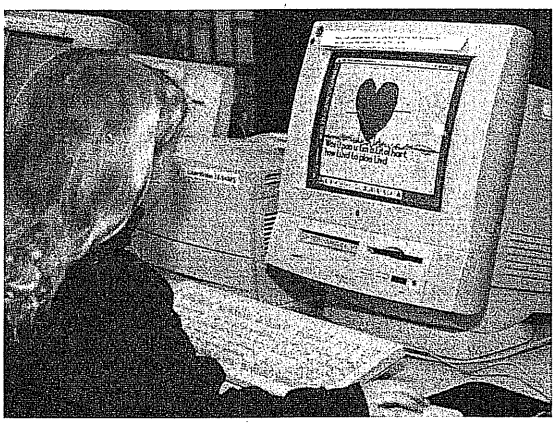
Advance organizers can be effective instruments for ensuring that media play their proper role as supplemental supporters of instruction. Many commercially available materials today have built-in advance organizers, which may be used as is or adapted by the instructor. Specific examples from this text include the photo essays at the beginning of each chapter, the chapter outlines, lexicons, and the chapter organization chart shown in Figure 1.3.

Instructor-Independent Instruction

Media can also be used effectively in formal education situations where a teacher is not available or is working with other students (Figure 1.7). Media are often "packaged" for this purpose: objectives are listed, guidance in achieving objectives is given, materials are assembled, and self-evaluation guidelines are provided. In informal educational settings, media such as videocassettes and computer courseware can be used by trainees at the worksite or at home. In some instances an instructor may be available for consultation via telephone.

Cooperative learning is closely related to self-instruction. As students work together in groups or in collaboration with the teacher on learning projects, they take more responsibility for learning. Newer technologies such as hypermedia (see Chapter 10) encourage students to rely on their own cognitive strategies in learning. Cooperative learning with hypermedia can lead to stimulating interchanges among students as they go through and discuss their response to the materials.

FIGURE 1.7
Carefully designed media make independent learning effective.



Hypermedia programs that allow for users to make additions to the information lend themselves particularly well to this type of learning experience. Students report that learning activities with fellow students, as well as with the teacher, help them to gain confidence. This can be a way of building individual responsibility in group work.

The use of self-instructional materials allows teachers to spend more of their time diagnosing and correcting student problems, consulting with individual students, and teaching one on one and in small groups.

How much time the teacher can spend on such activities will depend on the extent of the instructional role assigned to the media. Indeed, under certain circumstances, the entire instructional task can be left to the media. Experimental programs have demonstrated, for example, that an entire course in high school physics can be successfully taught through the use of videotapes and workbooks without direct classroom intervention by the teacher. Successful computer-based courses in calculus have been developed for use by able students whose high schools have no such course.

This is not to say, of course, that instructional technology can or should replace the teacher, but rather that media can help teachers become creative managers of the learning experience instead of merely dispensers of information. Today there are many online resources available to learners and even courses offered through distance learning (see Chapter 12).

Media Portfolios

A **portfolio** is a collection of student work that illustrates growth over a period of time. Portfolios often include such **artifacts** as student-produced illustrated books, videos, and audiovisual presentations.

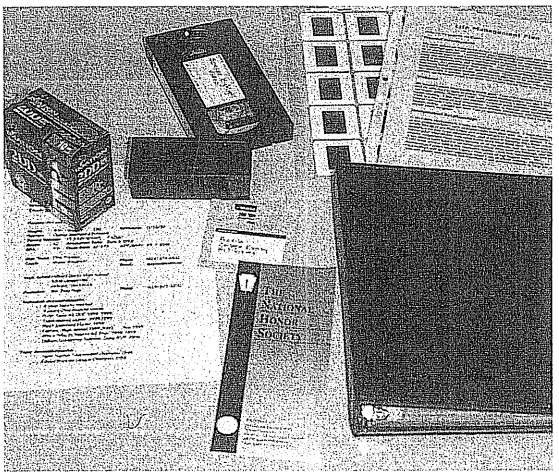
Students' abilities to use multimedia research sources and to prepare mediated presentations that summarize their own understanding of a thematic topic are central to the schooling experience under the concept of media portfolios. Portfolios allow students to do the following:

- Gather, organize, and share information
- Analyze relationships
- Test hypotheses
- Communicate the results effectively
- Record a variety of performances
- Reflect on their learning and activities
- Emphasize their goals, outcomes, and priorities
- Demonstrate their creativity and personality

Portfolios could contain the following artifacts:

- Written documents such as poems, stories, or research papers
- Media presentations, such as slide sets or photo essays
- Audio recordings of debates, panel discussions, or oral presentations

FIGURE 1.8
Slides, videos, computer-based multimedia, and other student-produced media are included in student portfolios.



- Video recordings of students' athletic, musical, or dancing skills
- Computer multimedia projects incorporating print, data, graphics, and moving images

Educators frustrated with standardized testing and conventional paper-and-pencil assessments are having students demonstrate their achievements by compiling portfolios of their work. Many feel that assessment of portfolios gives a truer, more rounded view of an individual's strengths and weaknesses. Portfolio assessment is consistent with the constructivist philosophy, which emphasizes that what is important is *the knowledge that students themselves construct.* They claim that the usable residue of years of schooling is rather small, and the small fraction of "school learning" that does remain usable is a conglomeration of information and practical skills that were constructed in the student's own mind through her struggle with a meaningful project (Figure 1.8).

The idea of portfolio assessment, then, is to measure students' achievements by their ability to create tangible products exemplifying their accomplishments in terms of analysis, synthesis, and evaluation. Portfolios provide a broad picture of what students know and can do. They can portray both the process and products of student works, as well as demonstrate student growth. Student reflection should be an important component of portfolios. Self-reflection actively involves students in assessing their own leaning and actively promotes reflection on their work and abilities.

Electronic Portfolios. The use of computer workstations with video and audio digitizing cards, printers, scanners, and digital cameras allow students to produce

HOW TO . . . Develop Media Portfolios

Following are guidelines for the use of portfolios:

- Many different skills and techniques are needed to produce an effective portfolio. Students need models of finished portfolios as well as examples of how others develop and reflect on them.
- Students should be involved in selecting the pieces to be included in their portfolios. This promotes reflection on their part.
- A portfolio should convey the following: *rationale* (purpose for forming the portfolio), *intents* (its goals), *contents* (the actual displays), *standards* (what are good and not-so-good performances), and *judgments* (what the contents tell the viewer).
- Portfolios should contain examples that illustrate growth.
- Student self-reflection and self-evaluation can be promoted by having students ask themselves the following questions: What makes this my best work? How did I go about creating it? What problems did I encounter? What makes my best piece different from my weakest piece?
- Date all pieces so that viewers may note progress over time.
- Students should regularly be given time to read and reorganize their portfolios.
- The portfolio should be organized, inviting, and manageable. Plan a storage system that is convenient for both you and your students.
- Students should be aware of the criteria used for evaluating the portfolio.

Source: Adapted from *Instructional Technology for Teaching and Learning,* 2d ed. (p. 229), by Timothy J. Newby, Donald A. Stepich, James D. Lehman, and James D. Russell, copyright 2000 by Merrill/Prentice Hall. Reprinted by permission of the publisher.

electronic or digital portfolios. Electronic portfolios are a means of organizing, designing, and viewing traditional styles of portfolios. They are a way of assessing student learning using technology. Physical and social development can be measured as well (Campbell, 1996).

Electronic portfolios have advantages over traditional portfolios in the way they are created and navigated. First, creating electronic portfolios can expand the size of the audience to include other teachers, principals, parents, and students. Online portfolios open the size of the audience to the world. (Be sure to get parental permission before putting any child's materials online. See the "Copyright Concerns" in Chapter 11.) Students become more motivated by the larger audience. Photos, video clips, audio recordings, animation, scanned drawings and writings, and hypertext make creating the portfolio more fun and interesting. Students have the opportunity to be creative and exhibit their interests and hobbies. It is easier to satisfy the continual need to add to and update. Storage space is another benefit; rather than file cabinets and shoeboxes, a Zip® or floppy disk can be used to save space. Navigation is another advantage—electronic portfolios are generally better organized and interconnected, allow for multiple paths, are more appealing, and are easily viewed from remote locations (main office, counselor's office, principal's office). Electronic portfolios commonly have a table of contents that make viewing them easier.

Drawbacks are equipment, access, security, and time. To create electronic portfolios with full capabilities hardware is needed: a computer with audio and video capabilities, video camera, digital camera, color scanner, software program, and Internet accessibility. The bare minimum would be a computer and an appropriate software program. Both students and teachers need access to the equipment. Security is a concern when deciding who will have access to the files, such as parents, principals, counselors, teachers, and other students. The project of creating electronic portfolios is time consuming for teachers to learn the program and for teachers and students to input the information. Once the information is in, one has to resize and edit the work to make it presentable.

For some practical tips on assembling media portfolios, see Mundell and DeLario (1994) and Schipper and Rossi (1997). For additional information on this topic, go to the Web Links module in Chapter 1 of the Companion Website (http://www.prenhall.com/heinich).

Thematic Instruction

Many teachers are now organizing their instruction around themes or anchors. Elementary teachers in particular are integrating content and skills from many subjects. At the secondary level, teams of teachers from different content areas are working together to show the overlap of their course content.

These units provide a rich environment or focus within which learning takes place. A good anchor or theme must capture and hold students' attention, provide problem-solving experiences, support interdisciplinary activities, and include a variety of media and technology. (See "How to . . . Develop Thematic Units (or Anchored Instruction).")

Begin the unit with a "shared experience" by having all students read the same book, view a videotape, participate in a simulation, visit a museum, or hear a guest

HOW TO . . . Develop Thematic Units (or Anchored Instruction)

- Select a theme that involves a variety of areas. Incorporate only those subjects that naturally fit together. The theme should allow multiple perspectives and approaches to the topic. Not all themes naturally fit all content areas. Trying to incorporate too much content can dilute the focus of the unit. Themes may be concepts (e.g., the family, justice, equilibrium), content areas (e.g., social studies, science, mathematics, art), current events (e.g., elections, the space program, local and/or state government issues), people (e.g., the president, sports heroes, movie stars, authors, composers, scientists), or natural disasters (e.g., earthquakes, volcanoes, tornadoes, hurricanes).
- Provide content *and* skills learning in each unit. While investigating the theme, students should learn new content and skills. Students can learn reading skills while studying reference materials. They can improve their viewing and listening skills while exploring media (e.g., videotapes, CD-ROMs). Writing skills can be learned while preparing individual or group reports on the topic.
- Incorporate a variety of media and methods. Well in advance of beginning the thematic unit, research with your school media specialist to find out what materials and media are available. Check for books, magazines, journals, videotapes, what's on the Internet, possible guest speakers, and field trips. In addition, consult with other teachers who have used thematic units and review resources on how to use thematic units in the classroom. (See, for examples, Bauer, Ellefsen, & Hall [1994], and Walmsley [1996].)
- Include meaningful learner activities. The activities should be related to the objectives of the unit. Think in terms of the learner activities, the objectives, and how the unit and students will be evaluated. These three components—activities, objectives, and evaluation—should be closely related (i.e., parallel and consistent).
- Make your thematic unit the proper size for your students and the topic. Younger students may complete the unit in only part of a day. For older students, it may last from a week to six weeks. Some teachers report success with yearlong themes. The recommendation is to start small regardless of the topic or grade level. Be sure that you and your students don't get bored!

speaker. Then move to "shared expertise," through which students cooperate to gather data and information, analyze their findings, draw conclusions, prepare a group report, and share their results in a mediated presentation. Possible activities include library research, Internet searches, and small-group activities.

Themes used successfully include the Oregon Trail, the Civil War, the Olympics (every four years), the solar system, local history, local industry, travel, holidays (such as Martin Luther King's birthday), and countries.

Distance Education

Distance education is a rapidly developing approach to instruction worldwide. The approach has been widely used by business, industrial, and medical organizations. For many years doctors, veterinarians, pharmacists, engineers, and lawyers have used it to continue their professional education. These individuals are often too busy to participate in classroom-based education. Recently, academic institutions have been using distance education to reach a more diverse and geographically dispersed audience who do not have access to traditional classroom instruction (see Chapter 12 for a full discussion).

The distinguishing characteristic of distance education is the separation of the instructional team and student(s) during the learning process. As a consequence, the course content must be delivered by instructional media.

The media may be primarily print (books and paper-and-pencil tests), as in traditional correspondence courses. Or, it might involve a variety of media, including audiocassettes, videotapes, videodiscs, and computer courseware sent to individual students. In addition, radio, broadcast television, and teleconferences are utilized for "live" distance education (Figure 1.9). The latter allows for real-time interactive instruction between instructor and students. Computer conferencing enables "conversations" among students who log on at different times and different locations to exchange messages. In addition there are chatrooms, bulletin boards, and listservs to support distance learning. Computer networks and online courses can be used for distance education (see Chapters 11 and 12).

Education for Exceptional Students

Media play an important role in the education of students with exceptionalities. Adapted and specially designed media can contribute enormously to effective instruction of all students and can help them achieve at their highest potential regardless of their innate abilities.

Children with disabilities in particular need special instructional treatment. Children with mental retardation need highly structured learning situations because their prior knowledge and ability to incorporate messages into mental constructs is limited. They need to have much more of the message placed within a context with which they are familiar. Students who are hearing impaired, blind, or visually impaired require different kinds of learning materials. More emphasis should be

FIGURE 1.9
Students can learn effectively from instructors at a distance via a telecommunications distribution system.

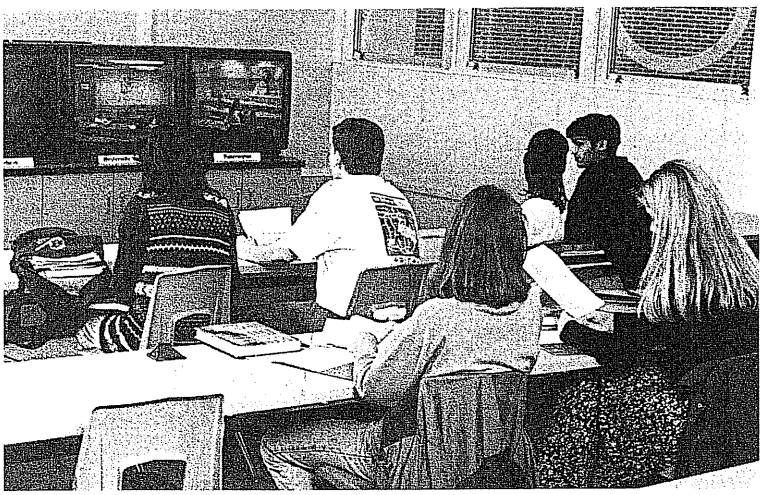
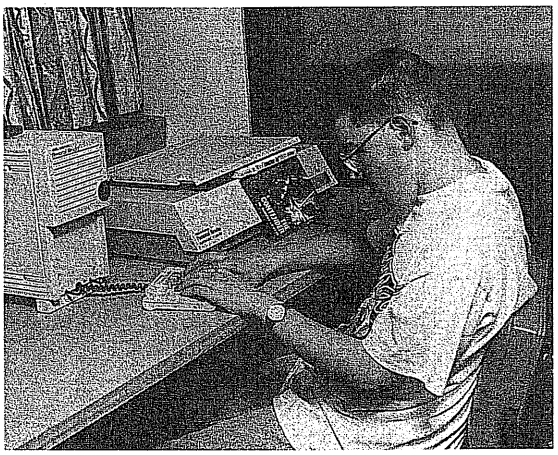


FIGURE 1.10
The Kurzweil reading machine allows those who are visually impaired to "read" printed material. The device scans the printed page, analyzes letter combinations through a computer, and speaks the words by means of a voice synthesizer.



placed on audio for students with visual impairments than for other students (Figure 1.10). Adjusting instruction for all exceptional groups requires heavy reliance on media and materials and the appropriate selection of these materials to fit specific purposes.

Gifted and talented students can use videotape and other media to explore topics beyond or in addition to that covered by other students in the class. They can also use the Internet to search for information related to topics being covered in class or for their own personal interests and hobbies. They can be asked to analyze the information they locate and to synthesize a class presentation for other students, perhaps using *PowerPoint* and other media and materials.

For more information, see Merrill/Prentice Hall's Special Education Resource page. Visit this website through the Web Links module in Chapter 1 of the Companion Website (http://www.prenhall.com/heinich).

METHODS

Traditionally, instructional methods have been described as "presentation forms" such as lectures and discussions. In this text, we will differentiate between instructional methods and instructional media. *Methods* are the procedures of instruction selected to help learners achieve the objectives or to internalize the content or message. *Media* then, as already defined, are carriers of information between a source and a receiver.

Ten Method Categories

We describe in the following sections ten categories of instructional methods. Each represents a family of methods within which there may be many different specific techniques and procedures. For example, the cooperative learning method includes project groups, self-directed learning teams, Team-Assisted Individualization, and many other variations. The general categories of methods are presentation, demonstration, discussion, drill-and-practice, tutorial, cooperative learning, gaming, simulation, discovery, and problem solving. Virtually any of the media described throughout this book can be used to implement any of these methods.

Presentation. In the presentation method, a source tells, dramatizes, or otherwise disseminates in-



FIGURE 1.11
The presentation method allows the teacher to give the same message to all students.

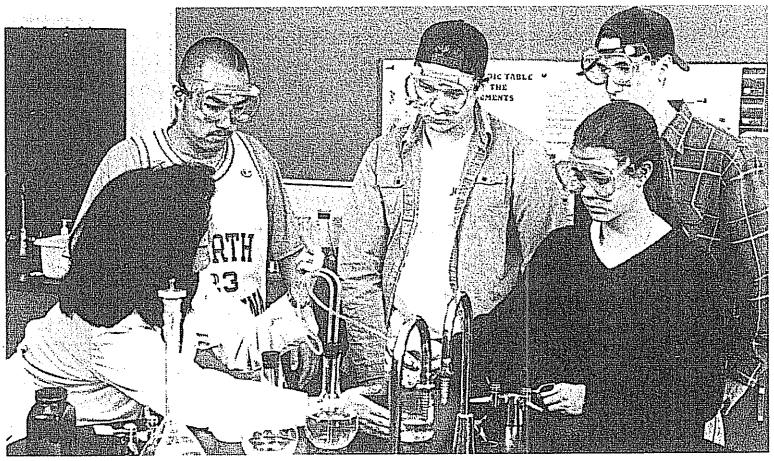


FIGURE 1.12
Demonstrations show a process to be learned or the way something works.

formation to learners. It is a one-way communication controlled by the source, with no immediate response from or interaction with learners. The source may be a textbook, an audiotape, a videotape, a film, an instructor, and so forth. Reading a book, listening to an audiotape, viewing a videotape, and attending a lecture are examples of the presentation method (Figure 1.11).

Demonstration. In this method of instruction, learners view a real or lifelike example of the skill or procedure to be learned (Figure 1.12). Demonstrations may be recorded and played back by means of media such as video. If two-way interaction or learner practice with feedback is desired, a live instructor or a tutor is needed.

The objective may be for the learner to imitate a physical performance (such as swinging a golf club or changing the oil in a car) or to adopt the attitudes or values exemplified by someone who serves as a role model. In some cases the point is simply to illustrate how something works, such as the effect of heat on a bimetallic strip. On-the-job training often takes the form of one-on-one demonstration, with the experienced worker showing a new employee how to perform a procedure, such as operating a packaging machine. This arrangement allows questions to be asked and answered so that errors and misperceptions can be resolved.

Discussion. As a method, discussion involves the exchange of ideas and opinions among students or among students and teacher. It can be used at any stage of the instruction/learning process, and in small or large groups. It is a useful way of assessing the knowledge, skills, and attitudes of a group of students before finalizing instructional objectives, particularly if it is a group the instructor has never taught before. In this context, discussion can help the instructor establish the

kind of rapport with and within the group that fosters collaborative and cooperative learning.

Discussion can be used to prepare learners for a presentation by arousing their curiosity or by directing their attention to key points. Some media forms are more conducive to discussion during their use than others. For example, viewing a videotape provides a common experience and if it raises appropriate issues gives students something to discuss.

Postpresentation discussions are essential as a forum for questions and answers and for ensuring that all students understand what the instructor intended. They are also critical in helping each learner to internalize the message—to incorporate it into his mental framework. Discussion and student projects are techniques for evaluating the effectiveness of instruction. Although such techniques are useful with all age groups, adult learners in particular welcome the opportunity to participate in sharing experiences with other adults.

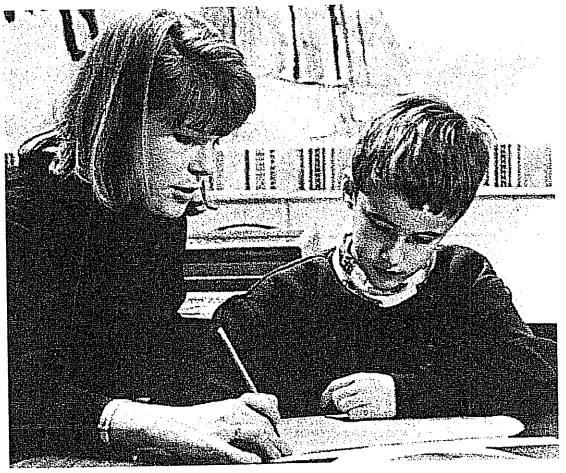
Drill-and-Practice. In drill-and-practice learners are led through a series of practice exercises designed to increase fluency in a new skill or to refresh an existing one. Use of the method assumes that learners previously have received some instruction on the concept, principle, or procedure that is to be practiced. To be effective, the drill-and-practice exercises should include feedback to reinforce correct responses and to remediate errors learners might make along the way.

Drill-and-practice is used commonly for such tasks as studying math facts, learning a foreign language, and building a vocabulary. Certain media formats and delivery systems—such as learning-laboratory instruction and computer-assisted instruction—lend themselves particularly well to student drill-and-practice exercises. Also, audiocassettes can be used effectively for drill-and-practice in spelling, arithmetic, and language instruction.

Tutorial. A tutor—in the form of a person, computer software, or special printed materials—presents the content, poses a question or problem, requests a learner's response, analyzes her response, supplies appropriate feedback, and provides practice until the learner demonstrates a predetermined level of competency (Figure 1.13). Tutoring is most often done one on one and is frequently used to teach basic skills, such as reading and arithmetic.

Tutorial arrangements include instructor-to-learner (e.g., Socratic dialog), learner-to-learner (e.g., tutoring or programmed tutoring), computer-to-learner (e.g., computer-assisted tutorial software), and print-to-learner (e.g., branching programmed instruction). These formats are discussed further in Chapters 2, 9, and 10. The computer is especially well suited to play the role of tutor because of its ability to deliver speedily a complex menu of responses to different learner inputs.

FIGURE 1.13
Tutorials are one of the most effective instructional methods but one of the most expensive if the tutor's time is included as a cost.



Cooperative Learning. A growing body of research supports the claim that students learn from each other when they work on projects as a team (Slavin, 1989–1990). Two or three students at a computer terminal learn more as they carry on discussions while working through the assigned problem. Some computer programs, such as *SimEarth: The Living Planet,* make it possible for several students to work interactively at separate computers.

Many educators have criticized the competitive atmosphere that dominates many classrooms in public schools and higher education. They believe that pitting student against student in the attainment of grades is contrary to the societal requirements of cooperation in life and in most on-the-job situations. Teacher and students often find themselves in a situation where the main emphasis is on test taking and grading. There are other ways to assess student learning, such as the portfolios described earlier in this chapter. Competition in the classroom also interferes with students learning from each other.

Critics of competitive learning urge instead an emphasis on **cooperative learning** as an instructional method. They argue that learners need to develop skills in working and learning together because their eventual workplaces will require teamwork. A common complaint of graduates is that they did not experience working in teams while in school.

Students can learn cooperatively not only by discussing texts and viewing media but also by producing media. For example, the design and production of a video or a slide set as a curriculum project presents an opportunity for cooperative learning. The teacher should be a working partner with the students in such learning situations.



FIGURE 1.14
Games can be a way for students to be active learners.

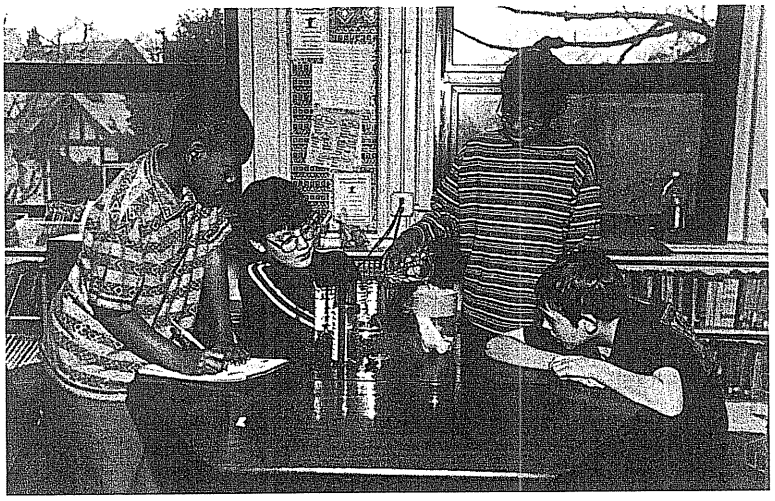


FIGURE 1.15
The discovery method involves students in hands-on learning.

Gaming. Gaming provides a playful environment in which learners follow prescribed rules as they strive to attain a challenging goal. It is a highly motivating technique, especially for tedious and repetitive content. The game may involve one learner or a group of learners (Figure 1.14). Games often require learners to use problem-solving skills or to demonstrate mastery of specific content demanding a high degree of accuracy and efficiency (see Chapter 2).

One common type of instructional game is related to learning about business. Participants form management teams to make decisions regarding a mythical corporation. The team with the highest corporate profits is the winner.

Simulation. Simulation involves learners confronting a scaled-down version of a real-life situation. It allows realistic practice without the expense or risks otherwise involved. The simulation may involve participant dialog, manipulation of materials and equipment, or interaction with a computer (see Chapter 2).

Interpersonal skills and laboratory experiments in the physical sciences are popular subjects for simulations. In some simulations learners manipulate mathematical models to determine the effect of changing certain variables, such as controlling a nuclear power plant. Role playing is another common example of the simulation method.

Discovery. The discovery method uses an inductive, or inquiry, approach to learning; it presents problems to be solved through trial and error (Figure 1.15). The aim of the discovery method is to foster a deeper understanding of the content through involvement with it. The rules or procedures that learners discover may be derived from previous experience, based on information in reference books, or stored in a computer database.

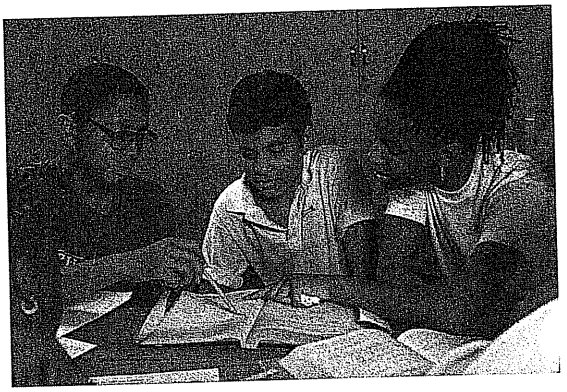
CLOSE-UP

THE EBOLA PROBLEM

High school students walked into class recently and found this memo on their desks: You are a United Nations' doctor stationed in Brazzaville, Congo. When you arrived at your office this morning a message marked "Urgent" was on your desk from a tribal chieftain in a village 100 miles west of your clinic.

The message read: "Come quickly! This village has been stricken with something no one has seen before. Twenty villagers have terrible fevers, diarrhea, and have become demented. Four have already died a terrible death. The other sixteen sick people have been placed in a hut where we will keep them until you get here. Please help!"

After forming hypotheses about the possible illness that could be affecting the village, the students left their classroom and walked to a darkened classroom, the village hut, where they found fourteen bodies on the floor, cut out of brown wrapping paper. (Yes, the apparent poor arithmetic skills of someone does mean something. An additional death had occurred and a person had left the hut to rejoin the general population.) On each body was a card that listed that person's symptoms. The students had to design a data-gathering plan, establish appropriate precautions for themselves regarding their examination of the afflicted, and organize the data to determine what the villagers might be facing and how far the outbreak had progressed. With



help from Tierney's *Current Medical Diagnosis and Treatment* (available in most bookstores), the class decided it was facing an outbreak of ebola and a case of malaria that had been mistakenly grouped with the other sick villagers. The students were then faced with determining what to do for the afflicted and how to prevent the outbreak from spreading.

Source: Consortium for Problem-Based Learning

Instructional media can help promote discovery or inquiry. For example, videotapes or videodiscs may be used for discovery teaching in the physical sciences. Students view a video to observe the relationships represented in the visuals and then attempt to discover the principles that explain those relationships. For example, by viewing something as simple as a balloon being weighed before and after being filled with air, students discover that air has weight.

Discovery learning can also assume the form of helping students to seek the information they wish to know about a topic of specific interest to them. Student inquiry, or information research, is a time-consuming but effective method for students to explore knowledge beyond the limits of their textbooks. Such information searches generally lead to the discovery of information that is new to both student and teacher. The library media specialist is an essential ally in guiding students and teachers through their information inquiries, providing assistance on search procedures and guidance in interpreting the information. The library media center provides both content-related materials and media production facilities for students who wish to produce an alternative presentation of what they have learned.

Problem Solving. Lifelike problems can provide the starting point for learning. In the process of grappling with real-world challenges, students can acquire the knowledge and skills needed in the real world after graduation. The technique has evolved from medical education and has moved down through graduate school programs to colleges and now is being used at the high school level and even with elementary students.

Problem solving involves placing students in the active role of being confronted with a novel problem situated in the real world (see "Close-Up: The Ebola Problem"). Students start with limited knowledge, but through peer collaboration and consultation they develop, explain, and defend a solution or position on the problem. It uses reality-based, problem-centered materials that are often presented by media (e.g., written cases, computer-based situations, and videotaped vignettes). As a part of solving the problem, students go to the library media center and/or access computer databases through the Internet.

Learners take more responsibility for their learning as they are placed in the "shoes" (role) of someone facing a real-world problem. The teacher does not present content. Through questioning, the teacher promotes and models practical reasoning and critical thinking. The teacher also facilitates group process and monitors individual learning while being an unobtrusive "guide on the side."

Outcomes include analyzing, problem-framing, problem-solving, and critical-thinking skills. Content knowledge is "learned" so that students can employ it

to solve authentic problems. Other outcomes include collaborative learning skills and group skills that are so important in the world of work today.

TECHNOLOGY

The word **technology** has always had a variety of connotations, ranging from mere hardware to a way of solving problems. The latter is exemplified in the often-quoted definition given by economist John Kenneth Galbraith: "The systematic application of scientific or other organized knowledge to practical tasks" (Galbraith, 1967, p. 12).

The notion of technology being a process is highlighted in the definition of instructional technology given by the leading professional association in that field: "the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning" (Seels & Richey, 1994, p. 9). The developers of programmed instruction called it a **technology for learning.** They believed that what was really important was the *process* of analyzing learning tasks, breaking them down into their components, and then devising the steps necessary to help learners master those tasks.

In this book we reconsider this notion in light of today's understanding of human learning. We use the term *technologies for learning* to refer to both the *products* and the *process* of technology as they are applied to human learning. We use the plural, *technologies,* because there are many different manifestations of technology. We use the word *learning* instead of *instruction* because it is both possible and common for people to learn without instruction, and we want to put the spotlight on the learning process rather than on the teaching process.

Over time, many technologies for learning have been developed. Some, such as interactive video, computer-based instruction, and hypermedia, rely on mechanical and electronic devices for their delivery. Others, such as programmed instruction, self-instructional modules, and simulation games, do not. We use the term *technologies for learning* to refer to the latter type. They are treated in detail in Chapter 2.

The ASSURE model described in Chapter 3 was developed as a planning aid to help ensure that media are used to their maximum advantage, not just as interchangeable substitutes for printed or oral messages. Contrary to the requirements of research, the requirements of practice demand that the conditions surrounding the use of the materials not be held constant. Indeed, one of the most important roles of media is to serve as a catalyst for change in the whole instructional environment. The effective use of media demands that instructors be better organized in advance, think through their objectives, alter the everyday classroom routine, and evaluate broadly to determine the impact of instruction on mental abilities, feelings, values, interpersonal skills, and motor skills.

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the Classroom Link Portfolio CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 1 of the Companion Website (http://www.prenhall.com/heinich).

1. *Psychological Analysis of a Lesson.* Select a lesson from the CW, the ASSURE Blueprints on the "Classroom Link Portfolio" CD-ROM, or from the Web. List the elements of the lesson. Indicate how specific portions of the lesson illustrate, if present, the psychological perspectives addressed in this chapter (behaviorist, cognitivist, constructivist, and social psychology perspectives). Cite the source of the lesson. Reflect on this analysis, providing strengths, weaknesses, and recommendations for teaching this lesson to a specific group of students. (ISTE NETS-T III-B)
2. *Written Reflection.* Reflect on the four psychological perspectives discussed in the chapter. Give examples of technology lessons based in each from the perspective of a teacher/trainer and as a learner. Which best fits you as a teacher/trainer? As a learner? Why? (ISTE NETS-T IV-B)

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 1 of the Companion Website (http://www.prenhall.com/heinich).

1. Prepare a report on a topic in the chapter, using references beyond this chapter. The report may be either written or recorded on audiotape.
2. Prepare a 10-minute presentation on your reaction to a topic in the chapter.
3. Analyze an instructional situation (either real or hypothetical) and identify the features of the instructional process (see p. 8).
4. Prepare a short paper on one of the learning theories described in this chapter. Use additional references.
5. Prepare a position paper on the role of humanistic versus technological issues in education.
6. Describe an actual use of instructional media in an education or training setting based on your experiences or readings.

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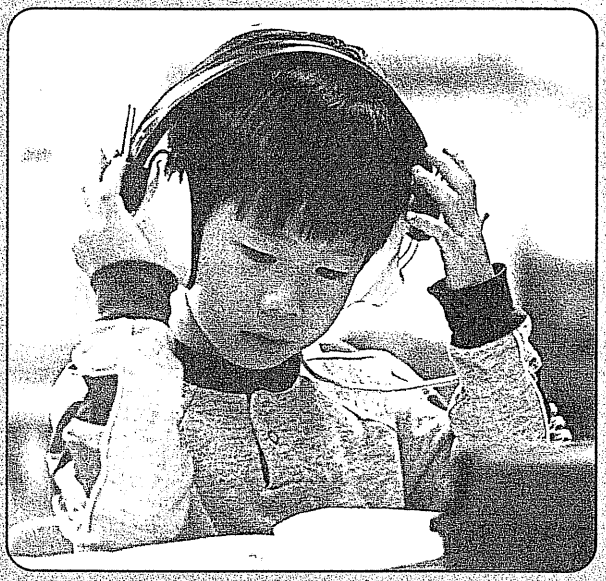
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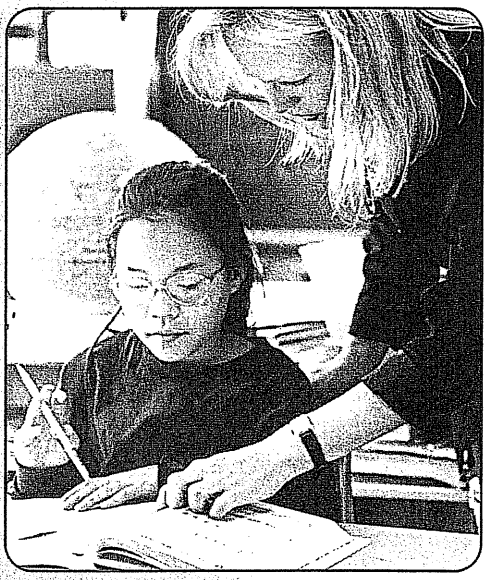
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One of your biggest challenges as a teacher is to get learners actively engaged in the lesson; another is to provide for individual differences. The techniques that we refer to as technologies for learning can be of great assistance in achieving these goals. Learning centers, cooperative groups, games, and simulations are examples of technologies for learning.









A great advantage of these technologies is that they provide ready-made frameworks around which you can develop lessons. These frameworks revolve around active practice and feedback, so it is no surprise that research shows that technologies for learning rank among the most powerful instructional methods.

CHAPTER 2

Technologies for Learning

OUTLINE

- What Are Technologies for Learning?
- Cooperative Learning
- Games
- Simulations
- Simulation Games
- Learning Centers
- Programmed Instruction
- Programmed Tutoring
- Programmed Teaching
- Personalized System of Instruction

KNOWLEDGE OBJECTIVES

1. Define *technology for learning,* including four critical attributes.
2. Relate practice and feedback to technologies for learning.
3. Compare and contrast two different types of cooperative learning technologies.
4. Define *game* and *simulation* and properly classify examples of each.
5. Discuss four types of learning centers, including one specific example of each.
6. Describe programmed instruction and distinguish it from other technologies for learning.
7. Generate five guidelines for using programmed instruction in the classroom.
8. Describe programmed tutoring and distinguish it from other technologies for learning.
9. Identify two advantages of programmed tutoring that distinguish it from programmed instruction.
10. Describe programmed teaching, including at least four critical attributes.
11. Describe the Personalized System of Instruction and relate it to other individualized instruction systems.

LEXICON

technologies for learning
hard technology
soft technology
cooperative learning
game
frame game
simulation
simulator
role play
simulation game
cooperative game
learning center
instructional module
programmed instruction
linear programming
branching programming
programmed tutoring
programmed teaching
Personalized System of Instruction (PSI)
debriefing

WHAT ARE TECHNOLOGIES FOR LEARNING?

The concept of **technologies for learning** was introduced in Chapter 1. Let's explore it together in more detail now. You may want to reread the descriptions of *learning* and *technology* in that chapter. We define *technologies for learning* as specific teaching-learning patterns that serve reliably as templates for achieving demonstrably effective learning.

As mentioned in Chapter 1, successful instruction, regardless of the psychological perspective—behaviorist, cognitivist, constructivist, or social-psychologist—includes a number of common features:

- Active participation and interaction
- Practice
- Individualized instruction
- Reinforcement or feedback
- Realistic context
- Cooperative groups

In Chapter 1 we provided a definition of technology that differentiated between **hard technology**—*products* such as computers and satellites, and **soft technology**—*processes* or ways of thinking about problems. This chapter focuses on technology as a process. What would *instruction* look like if it were designed according to this definition? We propose that a number of successful efforts have been made to do this. These efforts share certain characteristics necessary to be considered a systematic application of scientific knowledge.

First, to be a "systematic application," the technique must have a carefully designed framework that provides a *total system* of teaching–learning. Next, to be an "application of scientific knowledge," the technique must embody ideas (theories) that have been tested and found successful, and the application itself should have been validated through testing. Finally, the framework or template must be sufficiently structured so that other teachers can reliably repeat the teaching-learning pattern. Validity and reliability are key elements of any scientific application.

For those familiar with computers, the concept of an operating system (*Windows,* for example) might be a helpful analogy. An operating system consists of a package of rules and procedures that provides a standardized, consistent pattern for using the computer. Once this template is installed, the user doesn't have to rethink and reinvent procedures for processing data. In a similar way, technologies for learning are packages of tested and proven procedures, ready to be "loaded" with some specific content and to lead learners through a particular kind of learning experience.

An important element of being a "scientific" application is that of being validated by research. Each of the technologies discussed in this chapter has been subjected to extensive testing, both in the form of formal "method A versus method B" experimental comparisons and in the form of qualitative observations. We will discuss the specific research in conjunction with each of the technologies. What is notable is that the technologies discussed here have demonstrated the most dramatic positive outcomes of any ideas ever studied in educational research. Innovative pedagogical techniques (e.g., text-embedded questions, advance organizers, supplementary media) typically demonstrate an improvement in average student achievement of a few points in percentile rank. But these technologies for learning typically show an increase of 15, 20, or more points; that is, the average student scores at the 50th percentile in conventional instruction but scores at the 65th percentile in the group taught with technologies for learning.

Each of these technologies is designed to overcome one or more of the shortcomings of traditional whole-class instruction. All of them directly address the problem of passivity in that they place the learner in direct, active engagement with the subject matter. The whole point of these technologies is to require learner participation.

Technologies for learning combat boredom by providing a change of pace from lecture and seatwork and by adding motivational features that excite learner interest. They also provide a means for individualizing instruction to a greater degree. Some of the technologies discussed in this chapter are specifically designed as independent study methods, allowing individuals to progress at their own pace. Others are designed to be used in small groups; as such, they enlist the energies of students to assist those who need extra explanation, coaching, and practice.

All of these technologies for learning center on the provision of ample opportunities for practice, as discussed in Chapter 3. Their creators were guided by different theoretical perspectives, so they have different rationales for doing so. All the technologies discussed here emphasize active and continuous practice of relevant knowledge, skills, and attitudes, and all, as part of the total system, provide for rapid, effective feedback. Many of them are driven by the search for ways to build interpersonal feedback into all instruction.

Organization of This Chapter

We look here at several technologies for learning and identify which of the above features each incorporates. We will describe each, list each's advantages and limitations, and look at ways to integrate it into the curriculum. We will emphasize certain technologies because they are most accessible—individual teachers may adopt them without changing the overall structure of the school or classroom, and they can be used on an occasional basis as a change of routine regardless of the classroom structure (e.g., self-contained, team teaching, individualized).

Virtually all of these technologies for learning originated and evolved before computers were widely available on the educational scene, so they are not dependent on computers for implementation. However, each can be transformed into a computer-mediated form. We will discuss these transformations in conjunction with each technology.

COOPERATIVE LEARNING

Cooperative learning involves small heterogeneous groups of students working together to achieve a common academic goal or task while working together to learn collaboration and social skills. Group members are *interdependent*—that is, each is dependent on the others for achieving their goal. As a technology for learning, cooperative learning involves active participation by all students. Individual differences among students are minimized as they practice the content and social skills. These should be practiced in a realistic, often simulated context while receiving feedback from peers, the teacher, or a computer.

Cooperative learning has gained momentum in both formal and informal education from two converging forces: first, the practical realization that life outside the classroom requires more and more collaborative activity, from the use of teams in the workplace to everyday social life, and second, a growing awareness of the value of social interaction in making learning meaningful.

Advantages

- *Active learning.* Cooperative learning "requires" students to actively interact with others.
- *Social skills.* Students learn to interact with others developing their interpersonal, communication, leadership, compromise, and collaboration skills.
- *Interdependence.* Positive interdependence and accountability are developed as students interact to reach a common goal.
- *Individual accountability.* When a group's success depends on the input of each individual in it, individuals learn to be accountable for their actions.

Limitations

- *Student compatibility.* It is sometimes difficult to form groups of students who will work together well. The teacher must know her students well to form groups that will function effectively.
- *Student dependency.* If you allow the best students to "carry" the others, you may create dependency and defeat the purpose of cooperative learning. The challenge is to devise management systems that require learners to truly collaborate.
- *Time consuming.* Cooperative learning requires more time to cover the same amount of content than do some other methods.
- *Individualists.* Individuals who prefer to work independently do not like cooperative learning.
- *Logistical obstacles.* The teacher must arrange a lot of information, student responsibilities, and assessment activities.

Integration

Students can learn cooperatively not only by being taught with materials but also by producing materials themselves. For example, elementary students can work together to design and produce a videotape or a *PowerPoint* presentation on a topic related to historical content being studied. The students can share their cooperatively developed materials with the rest of the class.

In a science lab, middle school students work together as detectives to determine the nature of an unknown substance. In each group, one student is assigned to search the Internet, another goes to the library for background research, and others design and conduct experiments on the substance. Together they pool their information to come to a combined, cooperative solution.

High school students in an art appreciation course work together in cooperative groups to learn about the different forms of creative art. Each group is composed of three students. One is accomplished at a musical instrument, another has the ability to paint, and a third has the ability to sculpt. The group's task is to learn about the different art forms and their relationships.

The notion of students working together in small groups is not new, but ensuring that their efforts are truly collaborative has recently become a point of emphasis. For example, in the past five students might have been assigned to a project team to prepare a report on Peru. One researched the pre-Columbian Incas, another gathered pictures of llamas, the third prepared a report on the Peru Current and fishing, and the others gathered clothing and food items to give atmosphere to their final presentation. Note that although their efforts were pooled at the end, most of the work was done independently. Today's notion of cooperative learning entails a deeper level of interaction, based on the principle that articulating and negotiating your ideas with others forces you to process information in a way that improves meaningfulness and retention. We can define this new concept of *cooperative learning* as the instructional use of small groups so that students work together to maximize their own and each other's learning.

Research by Robert Slavin, Spencer Kagan, and David and Roger Johnson has revealed that not only does cooperative learning yield better acquisition and retention of lesson content, but it also promotes better interpersonal and thinking skills. This research has highlighted

the importance of *interdependence* as the key to success in cooperative learning. That is, group members must have a stake in each other's understanding and mastery of the material.

Researchers have devised and validated various specific cooperative learning formats. They are discussed here as technologies for learning because they fit the definition: each provides a specific template, expressed in the form of operating rules, procedures, and materials; these templates are structured enough that teachers working in different circumstances can implement them successfully; and they have been validated through field testing. We discuss here two particular formats as examples of cooperative learning technologies: Johnson and Johnson's Learning Together model and Slavin's Team-Assisted Individualization (TAI).

Learning Together Model

Johnson and Johnson (1993) have determined that feedback about your performance—knowing what is working well and what is not—is a critical factor in successful learning. Further, their research indicates that the most powerful and effective source of feedback is another person. For this reason, they have developed a specific format for cooperative learning that maximizes interpersonal feedback.

Johnson and Johnson's interdependent learning group, known as the Learning Together model, requires four basic elements:

1. Positive interdependence. Students must recognize that all the members of the group are dependent on each other to reach success: "We are going to sink or swim together." First, the teacher creates positive *goal* interdependence by requiring teammates to agree on objectives. Second, the teacher structures *role* interdependence by assigning each student a role: for example, in a math lesson the "reader" reads the problem aloud to the group; the "checker" monitors to make sure that each group member can explain how to solve the problem; and the "encourager" prompts all members to participate. *Reward* interdependence is established by giving each group five points if all members score above 90 percent on the end-of-unit test.
2. Face-to-face helping interaction. After silently working on the problem on scratch paper, the learners teach each other and discuss any confusion or misconceptions.
3. Individual accountability. Students know that they will be tested individually, with the results given back to the individual and the group. One way to reinforce individual accountability is to randomly select one student's test to represent the whole group.
4. Teaching interpersonal and small-group skills. Students cannot just be thrown together and told to cooperate. To function effectively as a group, they must be taught the skills of communication, leadership, and conflict management and must learn to monitor the processes in their group, making corrections if there are shortcomings.

FIGURE 2.1
Team-Assisted Individualization encourages students to help each other learn.



Team-Assisted Individualization (TAI)

Robert Slavin (1985) and his colleagues have developed a different format for cooperative learning, Team-Assisted Individualization (TAI), which they developed for mathematics instruction in grades three to six. TAI was specifically intended to avoid some of the problems encountered with individualized programmed instruction. It incorporates features that allow students to proceed more efficiently and effectively on their own with fewer demands on the teacher for individual checking and motivating. The format includes direct instruction to small groups, individual followup practice using programmed materials, and team study techniques (Figure 2.1). TAI has achieved impressive results in field tests. Not only do TAI students score higher on computation and application skills, they also show better social relations with students with disabilities and with students of other ethnic and cultural origin.

TAI follows this pattern:

1. Teaching groups. The teacher gives short lessons to small homogeneous groups—learners who are at about the same point in the curriculum. These lessons prepare students for major concepts in upcoming units.
2. Team formation. Every eight weeks, students are assigned to four-member teams that are as heterogeneous as possible in terms of achievement levels, gender, and ethnic background.



FIGURE 2.2
Increasingly, computer-mediated instruction is treated as a cooperative learning activity.

3. Self-instructional materials. Students work independently using self-instructional materials, which include step-by-step procedures for solving problems, a set of problems, self-test items, and a summative test.
4. Team study. Students work in pairs within their assigned team, working on problems and having their partner check their solutions. When they have four correct in a row they take a quiz. If they succeed on the quiz they go to a monitor on another team to take a final test. Remedial instruction and practice continue if needed until each student passes the final test.
5. Team scores and team recognition. Team scores are computed at the end of each week; certificates are given to those who greatly exceed the criterion level.

Computer-Based Cooperative Learning

Computer assistance can alleviate some of the logistical obstacles to using cooperative learning methods, particularly the tasks of managing information, allocating different individual responsibilities, presenting and monitoring instructional material, analyzing learner responses, administering tests, and scoring and providing remediation for those tests (Figure 2.2).

Mentioned earlier was the critical problem of ensuring that learners recognize their interdependence. Some software programs parcel out different information to different individuals so that they have to constantly check with each other and pool their information to make good decisions. Other programs provide information or give feedback only in displays that are flashed for a limited period of time. Group members are forced to delegate responsibility for watching for certain kinds of messages if they are to succeed. Each member has something different and essential to contribute to the group deliberations.

Group-oriented programs of this sort can also deal with the logistical problems of assisting a number of groups simultaneously, as is necessary in the single-computer classroom. The software manages a rotation of the teams so that there is little time lost waiting in line.

Decisions, Decisions (see the "Media File" in Chapter 9) is a series of role-playing software packages by Tom Snyder Productions designed specifically to generate informed discussion and decision making in the classroom using only one computer. The program has a mode for whole-class discussion with the teacher leading the entire group, as in a traditional classroom. In addition, it offers a small-group option for managing a cooperative learning environment.

GAMES

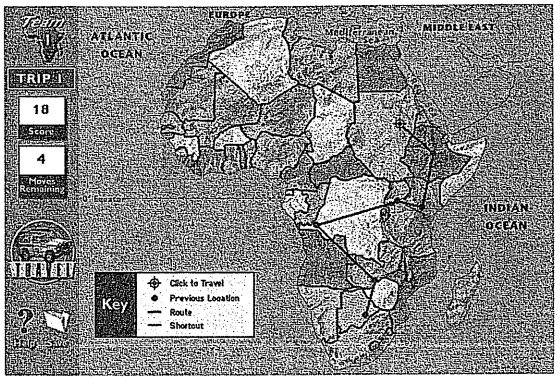
The terms *game, simulation,* and *simulation game* are often used interchangeably. But because these terms have different meanings, we will discuss them separately here (Figure 2.3). A **game** is an activity in which participants follow prescribed rules that differ from those of real life as they strive to attain a challenging goal.

The distinction between play and reality is what makes games entertaining. Most people seem to enjoy setting aside the logical rules of everyday life occasionally and entering an artificial environment with different dynamics. For example, in chess the markers each have arbitrarily different movement patterns based roughly on the military potentials of certain societal roles in some ancient time. Players capture each other's markers by observing elaborate rules of play rather than simply reaching across the board to grab the marker.

MEDIA FILE

Inspirer Geography Series

Computer-Based Cooperative Learning

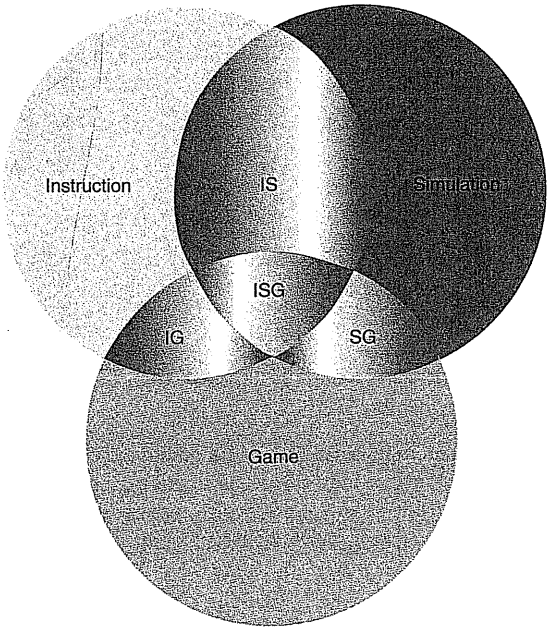


Source: Tom Snyder Productions.

The *Inspirer* Geography Series is a collection of exciting scavenger hunt software that inspires students to learn geography. Teams of students travel throughout an area of the world in search of important resources and commodities. Working in teams, students interpret maps, share information, and plan strategies. They have an opportunity to learn about and appreciate the diverse resources and geography of a specific region of the world. Titles include *National Inspirer, International Inspirer, Europe Inspirer, Africa Inspirer,* and *Asia Inspirer.*

FIGURE 2.3

Game, simulation, and instruction are separate concepts. However, they do overlap, so a particular activity could be an instructional simulation (IS), an instructional game (IG), a simulation game (SG), or even an instructional simulation game (ISG).



Attaining the goal usually entails competition—individual against individual, as in chess; group against group, as in basketball; or individual against a standard, as in golf (with "par" as the standard). With computer games, players typically are competing against their own previous scores and ultimately against the designer of the game as they approach mastery.

To be challenging, goals should have a probability of achievement of approximately 50 percent. A goal that is always or never attained presents no real challenge; the outcome is too predictable. People exhibit the most interest and motivation when the challenge is in the intermediate range.

On the other hand, striving to attain a challenging goal does not necessarily have to involve competition. Communication games, fantasy games, and encounter games exemplify a whole array of activities in which participants agree to suspend the normal rules of interpersonal communication to pursue such goals as self-awareness, empathy, sensitivity, and leadership development. These activities are considered games but do not entail competition. There is a movement today toward developing cooperative games designed to foster creativity and collaborative decision making. These games combine the elements of cooperative learning with the elements of games. We discuss cooperative simulation games later in this chapter.

Because individuals react differently to competitive environments, the element of competition must be handled very thoughtfully in choosing and using instructional games. Individual-versus-individual competition can be a highly motivating device as long as the contenders are fairly matched and the conflict does not overshadow the educational objective. Group-versus-group competition entails the same cautions, but it has the added attraction of providing practice in cooperation and teamwork. When you carefully organize competitions to ensure fair matches, you can foster highly successful and highly personalized learning.

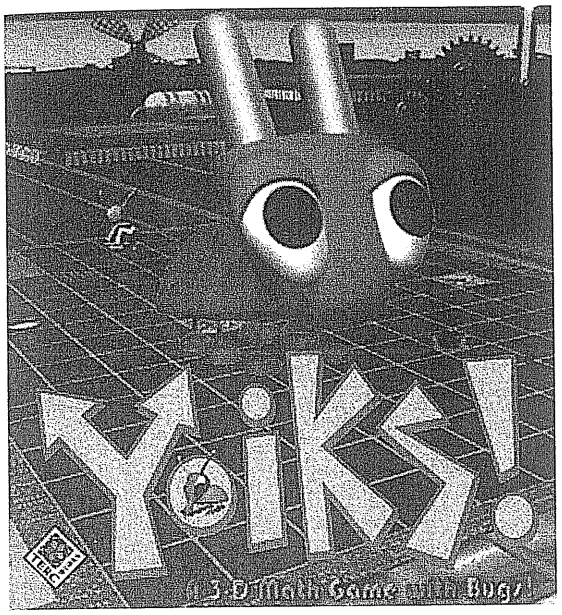
For instructional purposes, competition involving the individual or team against a given standard is often the safest approach. It allows individualization because different standards can be set for different players. In fact, one of the most effective standards can be the student's own past performance, the goal being to raise the level of aspiration continually.

In any event, in cases in which competition is an element, the scoring system provides a clue as to what type of competition you are fostering. Is one individual or team declared the winner? Or is it possible for all play-

MEDIA FILE

Yoiks

Computer-Based Game



Source: The Learning Company.

Students use trial and error and well-thought-out strategies to herd "computer bugs" through a series of mazelike grids in this challenging logic game. It includes 30 puzzles of increasing difficulty to challenge and build logical reasoning skills. Through playing games, students develop confidence in reasoning and experimentation.

ers to attain equally high scores, making everyone a winner? Some instructional games are designed to encourage players to decide among themselves what criteria to apply in determining success.

Games can incorporate the common features of behaviorism, cognitivism, constructivism, and social psychology. Students enjoy actively participating in games. Games provide the opportunity to practice content, e.g., math facts, vocabulary, and problem-solving skills. Individual differences are accommodated, particularly in team games. Students receive feedback based on the consequences of their actions, answers, and decisions. Games do not necessarily take place in realistic contexts. There is no real-world counterpart to tic-tac-toe or bingo. Games based on realistic contexts are called *simulation games*. Most games provide social interactivity. The exception is solitare-type games in which players compete against themselves or prescribed standards and do not interact with other players or team members. Games may be paper based or computer based (see "Media File: *Yoiks*" and Chapter 9).

Advantages

- *Attractive.* Games provide attractive frameworks for learning activities. They are attractive because they are fun! Children and adults alike tend to react positively to an invitation to play (Figure 2.4).
- *Novel.* As a departure from normal classroom routine, games arouse interest because of their novelty.
- *Atmosphere.* The pleasant, relaxed atmosphere fostered by games can be especially helpful for those (such as low achievers) who avoid other types of structured learning activities.
- *Time on task.* Games can keep learners interested in repetitious tasks, such as memorizing multiplication tables. What would otherwise be tedious drill becomes fun.

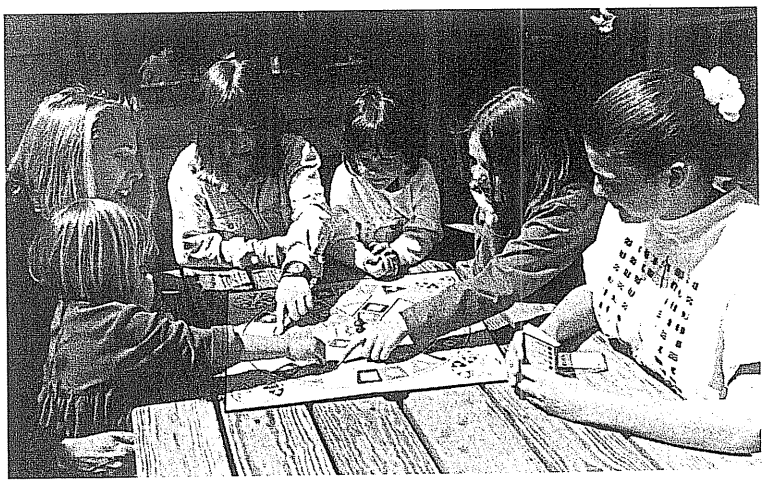


FIGURE 2.4
Game playing appeals to young and old alike.

CLOSE-UP

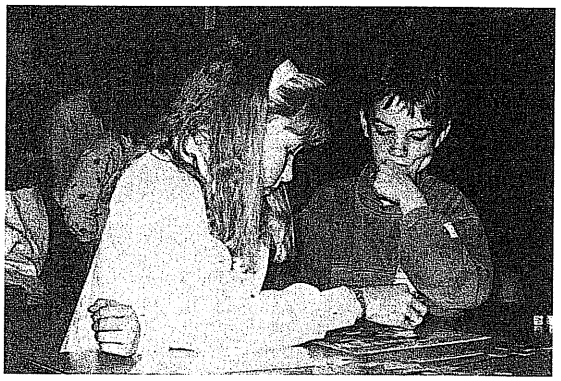
GAMES IN ELEMENTARY MATHEMATICS

Mathematics Pentathlon is a series of 20 instructional games that motivate the development and practice of mathematics concepts and skills. Designed for grades K–7, the games also promote active problem solving, especially the ability to solve problems that are continually undergoing change.

Classroom use of the program involves students in cooperative communication; in the integration of spatial, logical, and computational reasoning; and in the use of a variety of mathematics manipulatives to foster conceptual understanding.

The program also offers tournament competition. Tournaments are organized into four divisions combining two grade levels in each: Division I, K–1; Division II, 2–3; Division III, 4–5; and Division IV, 6–7. Within each division, individuals or teams compete in five different games; hence the name *pentathlon.* This phase of the program involves the entire educational community and offers students the unique opportunity to balance cooperation with constructive competition.

Mathematics Pentathlon relates to a mathematics curriculum and staff development program known as Mathematics Experience-Based Approach (MEBA). MEBA fosters mathematical understanding by building deliberate connections between physical models, pictures, and symbols and associated concepts and procedures. It also helps learners form and use mental images in solving problems.



MEBA and the associated games are designed to give students practice in nonroutine problem solving—that is, using heuristics to solve problems where known, routine procedures don't work. Examples of heuristics exercises include building a model or drawing a picture of the problem, finding a simple problem that is analogous to the one being studied, working backwards, and breaking the problem into its subcomponents.

For further information, contact Mary Gilfeather, Pentathlon Institute, Inc., P.O. Box 20590, Indianapolis, IN 46220.

Limitations

- *Competition.* Competitive activities can be counterproductive for students who are less interested in competing or who are weak in the content or skill being practiced.
- *Distraction.* Without careful management and debriefing, students can get caught up in the excitement of play and fail to focus on the real objectives.
- *Poor design.* To be instructionally meaningful the game activity must provide actual practice of the intended academic skill. A fatal shortcoming of poorly designed games is that players spend a large portion of their time waiting for their turn, throwing dice, moving markers around a board, and performing similar trivial actions.

Integration

Instructional games are particularly well suited to the following:

- Attainment of cognitive objectives, particularly those involving recognition, discrimination, or memorization, such as grammar, phonics, spelling, arithmetic skills, formulas (in chemistry, physics, logic), basic science concepts, place names, terminology, and so on
- Adding motivation to topics that ordinarily attract little student interest, such as grammar rules, spelling, and math drills
- Small-group instruction, providing structured activities that students or trainees can conduct by themselves without close instructor supervision
- Basic skills such as sequence, sense of direction, visual perception, number concepts, and following rules, which can be developed by means of card games.
- Vocabulary building. Various commercial games, such as *Boggle, Fluster, Scrabble,* and *Probe,* have been used successfully by teachers to expand spelling and vocabulary skills, although they were designed and are marketed primarily for recreational purposes.

Adapting the Content of Instructional Games

Although most teachers do not design new instructional games from scratch, they often adapt existing games by changing the subject matter while retaining the game's structure. The original game is referred to as a **frame game** because its framework lends itself to multiple adaptations. When one is modifying a frame game, the underlying structure of a familiar game provides the ba-

CLOSE-UP

GAMES FOR TEACHING READING

Reading is generally the most emphasized skill at the elementary school level. It is also a subject in which a great deal of practice and a high degree of individualization are necessary. For these reasons, reading teachers find game playing to be an especially valued method.

Featured here are several games involving decoding and comprehension skills. They have been reviewed and recommended by Dixie Lee Spiegel, instructional resources reviewer for *The Reading Teacher.*

Decoding

Road Race (Curriculum Associates) is a board game for two to six players. Players move markers around a track based on the number of words they have made and read. Players roll 10 dice with word parts on them (e.g., *-ight, -ake, -en*) and make words by matching the dice with the letters, digraphs, or blends written on the game board. Players who are waiting their turn can challenge words made by others.

Word Trek (DLM) is a board game for two to four players. In this game, players are dealt eight empty pockets for holding word-family cards. They draw cards containing blends and digraphs and try to form words; if not challenged, they place the words in the pocket until someone completes eight of them. The opportunity to challenge keeps other players involved.

Comprehension

Context Clues (Learning Well) provides practice in determining the meaning of a difficult word encountered in sentence context. The game comes in basic and intermediate versions.



Cause and Effect (Opportunities for Learning, Inc.) provides challenging practice in differentiating between causes and effects. The player reads a paragraph and chooses a cause for a given effect, or vice versa. The game comes in two levels: basic and intermediate.

Spiegel cautions that with many games of this type the teacher must anticipate modifying the materials to make them more instructionally effective. In *Cause and Effect,* players are not required to read at every turn. Because many of the squares on the game board are blank, players can advance without reading. Spiegel simply changed the rules of play so that every square required reading, and the originally designated reading squares were given double value.

Source: Dixie Lee Spiegel, "Instructional Resources: Decoding and Comprehension Games and Manipulatives," The Reading Teacher, *44(3) (November 1990), pp. 258–261.*

sic procedure of play, or the dynamics of the process. The designer loads the desired content onto a convenient frame (Stolovitch & Thiagarajan, 1980).

Familiar games such as tic-tac-toe, rummy, concentration, and *Jeopardy,* which were intended for recreation rather than instruction, can serve as potential frameworks for your own instructional content. Some television game shows have been modeled after such parlor games; they can suggest additional frameworks. Here are some sample adaptations:

- *Safety tic-tac-toe.* Use a three-by-three grid; each row represents a place where safety rules pertain to home, school, and street; each column represents the level of question difficulty. Teams take turns selecting and trying to answer safety-related questions, attempting to fill in three squares in a row.
- *Spelling rummy.* Using alphabet cards instead of regular playing cards, players attempt to spell short words following the general rules of rummy.
- *Reading concentration.* This game uses about a dozen matched picture–word pairs of flashcards. Cards are placed face down. On each turn the player turns over two cards, seeking to match a pair. This game exercises both reading ability and memorizing.
- *Word bingo.* Each player's card has a five-by-five grid with a vocabulary word (perhaps in a foreign language) in each square. The leader randomly selects words; players then seek the words on their boards, and if they are found, the square is marked. The winner is the first player with five correctly marked squares in a row.

SIMULATIONS

A **simulation** is an abstraction or simplification of some real-life situation or process. In simulations, participants usually play a role that involves them in interactions with other people or with elements of the

MEDIA FILE

Starpower

Instructional Simulation



Source: Simulation Training Systems.

Content areas: Social studies, government

Age level: High school and above

Starpower centers on the trading of tokens that have been distributed randomly at the start of the exercise. During each round, participants try to increase their wealth and move upward in the three-tiered class structure that evolves. Later in play, the rich players make the rules.

simulated environment. A business management simulation, for example, might put participants into the role of production manager of a mythical corporation, provide them with statistics about business conditions, and direct them to negotiate a new labor contract with the union bargaining team.

Simulations can vary greatly in the extent to which they fully reflect the realities of the situation they are intended to model. A simulation that incorporates too many details of a complex situation might be too complicated and time consuming for the intended audience. On the other hand, if the model is oversimplified, it may fail completely to communicate its intended point. A well-designed simulation provides a faithful model of elements that are most salient to the immediate objective, and it informs the instructor and participants about elements that have been simplified or eliminated.

Simulations are by design active. They are not a "spectator sport." Simulations provide realistic practice with feedback in a realistic context. Most simulations include social interaction. One type of simulation, role play (described following), provides relatively open-ended social interaction between and among individuals. However, there are some simulations, such as flight simulators (described following), in which there is no social interaction. Team simulations allow students to use their individual differences. Some computer-based simulations adjust their difficulty level based on the ability of the "player."

Simulation and Problem-Based Learning

One particular value of simulation is that it implements the problem-based learning method as directly and clearly as possible. In problem-based learning, the learner is led toward understanding principles through grappling with a problem situation. Most simulations attempt to immerse participants in a problem.

Through simulations, we can offer learners a laboratory in areas such as the social sciences and human relations as well as in areas related to the physical sciences, where laboratories have long been taken for granted. It tends to be more time consuming than the straightforward lecture approach, but the payoff is a higher level of comprehension that is likely to be long lasting.

The great advantage of this sort of firsthand immersion in a topic is that students are more likely to be able to apply to real life what they have practiced in simulated circumstances. This raises the issue of the degree of realism captured by a simulation. A common defect in poorly designed simulations is an overemphasis on chance factors in determining outcomes. Much of the reality is spoiled if chance-element cards cause players to gain or lose great quantities of points or other resources regardless of their strategic decisions. An overemphasis on chance or an overly simplified representation of real relationships might end up teaching lessons quite contrary to those intended.

Simulators

Competencies in the motor skill domain require practice under conditions of high feedback, which gives learners the feel of the action. Although it might be ideal to practice such skills under real-life conditions, some (e.g., piloting an airplane or driving a car) can be practiced much more safely and conveniently by means of simulated conditions. The device employed to represent a physical system in a scaled-down form is referred to as a **simulator.**

Simple simulators are in widespread use in applications such as training workers in a range of manual skills from CPR to welding. One familiar example of a simulator is the flight trainer, a mock-up of the interior of the cockpit complete with controls and gauges. Today the flight crews of most major airlines receive a large portion of their training in flight simulators, which are controlled by computers and offer highly realistic audiovisual effects. Besides eliminating the possibility of loss of life and aircraft, these simulators allow significant savings of energy, in millions of gallons of fuel annually, and other costs. One recent study estimated that in-air training costs about $4,000 per hour, compared with only $400 per hour on the flight simulator, with no loss in effectiveness.

Advantages

- *Realistic.* The prime advantage of simulations is that they allow practice of real-world skills under conditions similar to those in real life.
- *Safe.* Learners can practice risky activities—for example, cardiopulmonary resuscitation—without risking injury to themselves or to others.
- *Simplified.* Simulations are intended to capture the essential features of a situation without dwelling on details that might be distracting or too complex for the learner's current level of understanding.

Limitations

- *Time consuming.* Simulations are often used with problem-based learning methods, allowing learners to immerse themselves in a problematic situation and to experiment with different approaches. Such trial-and-error learning typically requires more time than more expositive methods.
- *Oversimplification.* Constructivists argue that learning should take place in fully realistic situations, with all the complexity of real life. They would be concerned that a simulation might give students a false understanding of the real-life situation.

Integration

Instructional simulations, including role plays, are particularly well suited for the following:

- Training in motor skills, including athletic and mechanical skills, and complex skills that might otherwise be too hazardous or expensive in real-life settings
- Instruction in social interaction and human relations, where displaying empathy and coping with the reactions of other people are major goals
- Development of decision-making skills (e.g., microteaching in teacher education, mock court in law school, management simulations in business administration)

Role Plays

Role play refers to a type of simulation in which the dominant feature is relatively open-ended interaction among people. In essence, a role play asks someone to imagine that she is another person or is in a particular situation; the person then behaves as the other person would or in the way the situation seems to demand. The purpose is to learn something about another kind of person or about the dynamics of an unfamiliar situation. The role descriptions may be very general, leaving participants great latitude. The purpose in many cases is to allow the person's own traits to emerge so that they can be discussed and possibly modified. In other simulations, such as historical recreations, highly detailed roles are described to project the realities of life in that period.

FIGURE 2.5
Role playing is an effective method for developing interpersonal skills.



The role-play simulation has proven to be a motivating and effective method of developing social skills, especially empathy (putting oneself in someone else's shoes). Our day-to-day social behavior tends to be governed by our assumptions about who we are, who our peers are, and why they act the way they do. A potent way of challenging, and thereby changing, these assumptions is to experience a slice of life from someone else's perspective.

The sorts of tasks that lend themselves especially well to role playing are counseling, interviewing, sales and customer services, supervision, and management (Figure 2.5). The settings most often simulated are committee meetings, negotiation sessions, public meetings, work teams, and one-on-one interviews.

SIMULATION GAMES

A **simulation game** combines the attributes of a simulation (role playing, a model of reality) with the attributes of a game (striving toward a goal, specific rules). Like a simulation, it may be relatively high or low in its modeling of reality. Like a game, it may or may not entail competition.

Because they combine the characteristics of both simulations and games, instructional simulation games have advantages, limitations, and applications in common with both formats. In this regard one of the major reasons for using simulation and gaming methods is that they provide conditions for *holistic learning*. That is, through the modeling of reality and through the players' interactions as they strive to succeed, learners *encounter a whole and dynamic view of the process they are studying*. Conventional instruction tends to segment reality into separate packages (e.g., biology, mathematics, psychology), but that is not how the real world is organized. Through participation in simulation games, players can see the whole process and

MEDIA FILE

The Green Revolution Game

Instructional Simulation Game



Source: Marginal Context Ltd.

Content areas: Community development, social studies

Age level: College and adult

The setting of this game is a village in contemporary India. Players attempt to manage their limited resources to provide for their families. Pests, drought, crop failures, shortage of cash and credit, and deaths of family members are among the realistic variables with which each player must contend.

FIGURE 2.6
A well-designed simulation game stirs emotions and generates classroom dynamics.

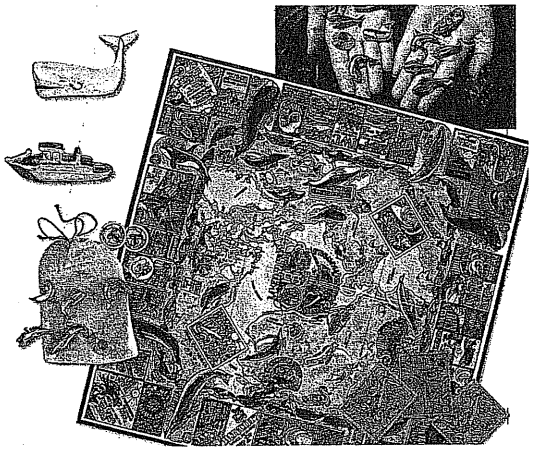


its dynamic interrelationships in action. In addition, emotions come into play along with the thinking process. Participants commonly experience excitement, elation, disappointment, even anger, as they struggle to succeed (Figure 2.6). This, of course, is how learning takes place in the world outside the classroom.

MEDIA FILE

Save the Whales

Cooperative Simulation Game



Source: Animal Town Game Company.

Content areas: Ecology, social development

Age level: Grade 3 through adult

Players learn to act cooperatively as they face oil spills, radioactive waste, and whaling ships in trying to save eight types of whales from extinction. Players earn "survival points" and make group decisions on protecting the whales. This is one of a family of cooperative games distributed by Animal Town Game Company. All aim to encourage cooperation rather than competition.

Integration

Instructional simulation games are found in curriculum applications that require both the repetitive skill practice associated with games and the reality context associated with simulations. Societal processes, cultural conflicts, historical eras, and ecological systems are popular topics.

In general, teachers frequently use instructional simulation games to provide an overview of a large, dynamic process. The excitement of play stimulates interest in the subject matter, and the holistic treatment of the game gives students a feel for the total process before they approach parts of it in a more linear way.

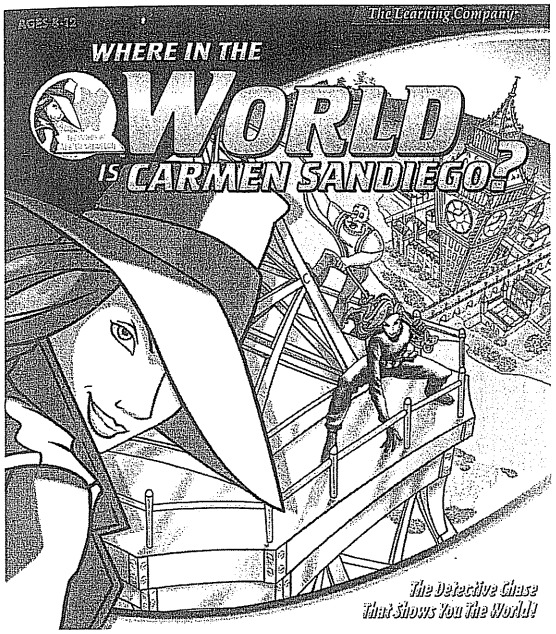
Cooperative Simulation Games

Traditionally, games—both athletic contests and tabletop board games—have emphasized competition among adversaries. In recent years, sports psychologists and educational psychologists have developed new theories questioning the value and necessity of competition in human development. They contend that if children

MEDIA FILE

Where in the World Is Carmen Sandiego?

Computer-Based Simulation Game



Source: The Learning Company.

Content areas: History, geography, culture

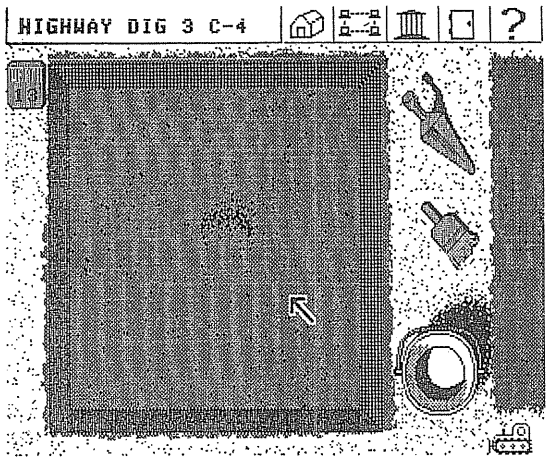
Age level: Grades 4 through 6

Learners play the role of detective as they follow a trail of clues to track down and apprehend one of the members of Carmen Sandiego's notorious band of thieves. The detective utilizes resource materials, problem-solving skills, planning methods, and organizational skills to catch the thief. Other variations are available, for example, *Where in the USA. . .,* and *Where in Time. . . .* Each employs different resource materials including an electronic reference database with maps, photos, and video clips. As the detective catches more thieves, the chase becomes more difficult.

MEDIA FILE

Longhouse

Computer-Based Cooperative Simulation



Source: Groupware Corporation.

Content areas: History, archeology

Age Level: Grades 4 through 8

Longhouse is a networked discovery-learning simulation based on actual archeological excavations. Students cooperatively learn about several different Native American cultures, within the Iroquois and Algonquian groups, by working in teams to dig up buried artifacts. They attempt to discover, piece together, and identify their finds. By means of a window they can communicate with teammates at different workstations as they explore different dig sites. They can compare artifacts with authentic items in an electronic museum. The simulation was developed in Ontario, Canada, for the Unisys Icon system. The cooperative simulations developed by Groupware have consistently won awards for excellence from the Association for Media and Technology in Education of Canada (AMTEC).

are nurtured on cooperation, acceptance, and success in a fun-oriented atmosphere they develop strong, positive self-concepts. Out of this new awareness has come the "new games" movement, generating hundreds of **cooperative games** that challenge the body and imagination but that depend on cooperation for success.

Instructional simulation games have been developed that pursue a similar philosophy. *Save the Whales* (see "Media File") demonstrates that these endangered species can be preserved only through human cooperation. In *Mountaineering,* players work as a team to ascend and descend the mountain depicted on the game board, complete with crevasses, avalanches, and blizzards. In *Sky Travelers,* players learn about the earth as they explore it as stranded aliens from outer space; only through teamwork and strategic decision making can they reunite with their mother craft.

The computer has opened up even wider possibilities for simulating problem situations elaborately. A number of development groups have made computer-based simulations that challenge participants to work together to unlock a mystery. One particularly successful collection of cooperative computer simulations has been developed by Groupware of Ontario, Canada (see "Media File: *Longhouse*"). The unique feature of these simulations is that they require a group of learners to work synchronously and cooperatively to arrive at a successful conclusion.

HOW TO . . . Conduct a Debriefing: The Four-D Procedure

GROUP DEBRIEFING

It is usually preferable to conduct a **debriefing** as a group discussion if time and conditions permit. As an aid in planning for this stage, follow the "Four Ds of Debriefing":

1. Decompressing
2. Describing
3. Drawing comparisons
4. Deriving lessons

Step 1: Decompressing (feelings)

You will want to relieve any tensions that may have built up during the simulation or game. Some situations may engender conflict and anger. Also, players who feel they did not do very well in the game may be experiencing anxiety and feelings of inadequacy. In any event, participants are not likely to be focusing on *your* questions and concerns until these pent-up feelings simmer down to a manageable level.

Start with some "safety valve" questions. In games, players will have attained some sort of score, so you can start simply by asking for and recording the scores. Jot down scores on a chalkboard or flip chart. Also note comments. These bits of information form a database you can refer to in later stages of debriefing.

After tabulating these scores you will be able to declare the winner(s) in cases of competitive games. Let the winner(s) show off a little bit by asking them to explain their strategy. Low scorers should also have a chance to tell what went wrong for them, if they wish.

At this point be sure to explain any hidden agendas or "tricks" the designer may have inserted to make a certain point. Explain how these may have affected the scores. Also, point out the role that chance can play in the scoring, as it does in real life.

To deal further with any emotional residue, ask several participants how they felt while playing. Did anyone else feel that way, too? Let those who want to chime in freely.

Step 2: Describing (facts)

You usually will have explained the nature and purpose of the activity before the beginning of play. But some students may not have fully appreciated the meaning or significance of the activity. Others may have lost track of it in the heat of play. For example, players of *Triangle Trade* might need to be reminded that it simulates the experiences of seventeenth-century British colonists. Ask basic questions such as, "What real-life situation was represented in this activity?" or "What was [x] intended to symbolize?"

Step 3: Drawing Comparisons (transfer)

Help the participants transfer the game experiences to reality. Encourage them to compare and contrast the game with reality by asking such questions as, "How does the scoring system compare with real-life rewards?" "What elements of reality were missing from or downplayed in the simulation?" "Would these solutions work in real life?"

Step 4: Deriving Lessons (application)

Get the participants to verbalize exactly what they have learned from the activity. Verbalization will bring to students' conscious awareness of what they have learned. Ask questions such as, "What conclusions can you draw from the experience?" "What did you learn about specific real-life problems?" "Did the activity change any of your previous attitudes or opinions?" "What do you plan to do differently tomorrow as a result of this activity?"

Individual Debriefing

In situations where participants finish simulation or game activities at different times or the schedule prevents immediate group discussion, you may use a form of individual debriefing. One method developed to help participants reflect on their feelings immediately after play uses a simple sentence-completion form to be filled out individually. Each participant writes a completion to each of the following sentences:

1. I was _____. [the role you played in the game]
2. I did _____. [actions you performed]
3. I felt _____. [emotions you felt during play]
4. I wish _____. [open response]

The reactions captured on this form can either substitute for group discussion or can supplement the later discussion, with participants referring back to their sheets to remind themselves of their reactions.

LEARNING CENTERS

Another technology for learning, the **learning center,** is a self-contained environment designed to promote individual or small-group learning around a specific task. A learning center may be as simple as a table and some chairs around which students discuss, or it may be as sophisticated as several networked computers used by a group for collaborative research and problem solving.

An individual teacher may use one learning center within one classroom as a way of breaking the class into small groups to perform hands-on activities (e.g., in a science class with a laboratory-type learning center). Or a whole school may be organized to incorporate learning centers into the daily mix of activities, as in the Project CHILD schools; see "Close-Up" on page 42.

APPRAISAL CHECKLIST

SIMULATIONS AND GAMES

KEY WORDS: _____, _____, _____

- ☐ **Game**
- ☐ **Simulation**
- ☐ **Simulation Game**

Title _____

Series Title (if applicable) _____

Source _____

Date _____ **Cost** _____ **Length** _____ **minutes**

Subject Area _____

Intended Audience _____

Brief Description

Objectives

Entry Capabilities Required (e.g., prior knowledge, reading ability, vocabulary level, math ability).

Rating	**High**	**Medium**	**Low**	**Comments**
Match with curriculum	☐	☐	☐	
Accurate and current	☐	☐	☐	
Clear and concise language	☐	☐	☐	
Arouse motivation/maintain interest	☐	☐	☐	
Learner participation	☐	☐	☐	
Technical quality	☐	☐	☐	
Evidence of effectiveness (e.g., field-test results)	☐	☐	☐	
Free from objectionable bias or advertising	☐	☐	☐	
User guide/documentation	☐	☐	☐	
Provides practice of relevant skills	☐	☐	☐	
Game: Winning depends on player actions rather than chance	☐	☐	☐	
Simulation: Validity of game model; realistic, accurate depiction of reality	☐	☐	☐	
Clear directions for play and debriefing	☐	☐	☐	

Strong Points

Weak Points

Recommended Action _____ **Name** _____ **Date** _____

Prentice Hall grants the reader permission to reproduce this checklist for personal use only. Heinich, Molenda, Russell, and Smaldino, *Instructional Media and Technologies for Learning* (2002).

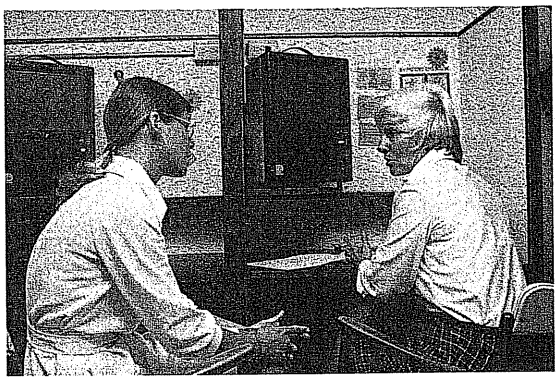
This Checklist is available on the "Classroom Link Portfolio" CD-ROM.

Learning centers should encourage active participation rather than just sitting and reading a book. Most learning centers provide student practice with feedback through individualized activities. Learning centers tend not to provide realistic contexts and not to provide social interaction. They tend to be designed for use by individuals, however, they can be designed for pairs or triads.

Learning centers may be set up in any suitable and available classroom space. They are also commonly found in school library media centers. Learning centers with many stations are found in business, industry, medical facilities, and the armed forces.

Learning center materials may include practically any or all of the media and multimedia formats mentioned in this text. Teachers or media specialists may purchase center materials and software from commercial producers or may create them themselves.

FIGURE 2.7
A "wet" carrel can be equipped with media hardware.



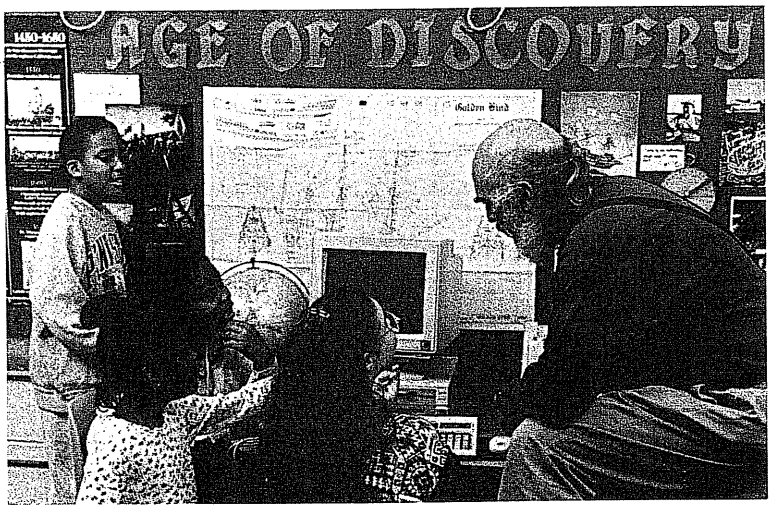
Although students may perform simple learning center activities at their desks or at some other open space, it is advisable that learning centers be confined to a clearly identifiable area and that they be at least partially enclosed to reduce distractions. Learning carrels, or booths, which may be purchased from commercial sources or made locally, provide a clearly defined enclosure. You can make carrels by placing simple cardboard dividers on classroom tables.

Carrels are often referred to as being either "dry" or "wet." A dry carrel provides private space for study or other learning activities but contains no electrical equipment. The typical library carrel is a dry carrel. A wet carrel, on the other hand, is equipped with outlets for audiovisual devices such as cassette recorders, projection screens, television monitors, or computer terminals (Figure 2.7). An extensive exploration of the possibilities of computer-based learning centers is found in Riedl (1995).

Advantages

- *Self-pacing.* Centers encourage students to take responsibility for their own learning and allow them to learn at their own pace, thus minimizing the possibility of failure and maximizing the likelihood of success.
- *Active learning.* Learning centers provide for student participation in the learning experience, for student response, and for immediate feedback to student response.
- *Teacher role.* Learning centers allow the teacher to play more of a coaching role, moving around the classroom and providing individual help to students when they need it (Figure 2.8).

FIGURE 2.8
Learning centers offer opportunities for informal teacher–student interaction.



Limitations

- *Cost.* A great deal of time must be spent in planning and setting up centers and in collecting and arranging for center materials. The equipment and materials used in the center, too, entail costs.
- *Management.* Teachers who manage learning centers must be very good at classroom organization and management.
- *Student responsibility.* Any form of independent study will be successful only insofar as students are able and willing to accept responsibility for their own learning.
- *Student isolation.* Learning centers need not be limited to individual student use; small groups can be assigned to work together. If students do work alone, you must make other provisions to provide for the social dimension of learning.

Integration

You can use learning centers for a number of specialized purposes (Figure 2.9). We describe here some of the specialized types of centers.

Skill Centers. These can provide students with an opportunity to do additional practice, typically to reinforce a lesson previously taught through other media or methods. Basic skills that are built up through drill-and-practice lend themselves to the skill center approach. For example, you might design a skill center to give practice in using prefixes for students who are learning to write.

Interest Centers. Interest centers can stimulate new interests and encourage creativity. For example, you might set up a get-acquainted center on insect life in the classroom before actually beginning a unit on specific insects.

Remedial Centers. Remedial centers can help students who need additional assistance with a particular concept or skill. A student who has difficulty determining the least common denominator of a group of fractions, for example, could receive the needed help in a remedial learning center.

FIGURE 2.9
An example of directions given at a learning center for elementary language arts.

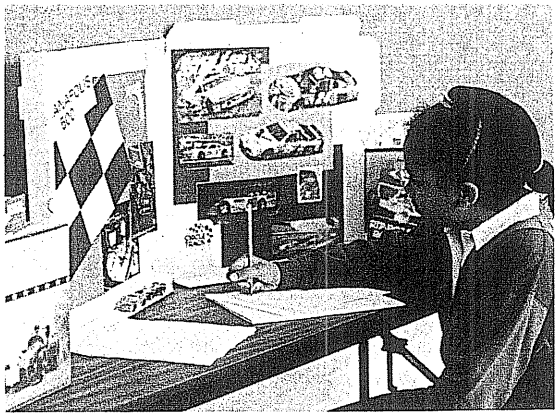
Listening Center

1. Sit down at the table—no more than six people at a time.
2. Pick one of the story cassettes to listen to. Everyone should help decide on the choice. Only one person should operate the cassette player.
3. Put on the headsets and listen to the story.
4. After listening to the story, form teams of two. Each team will write a new ending to the story. Use your imagination!
5. When your new ending is written, put it in the "In" basket at the writing center.

CLOSE-UP

DAYTONA 500 LEARNING CENTER

A fifth-grade teacher capitalizes on local enthusiasm for automobile racing by designing a math learning center based on car numbers and speeds. Center material includes a variety of questions, such as "What is the difference in speed between Car 20 and Car 14?" "How many cars have even numbers?" "If a race car gets 5.7 miles per gallon, how many miles can it go on one tank of fuel (22 gallons)?" The center has colorful pictures and souvenir postcards of the cars and drivers. Each student draws, colors, and numbers his or her own race car, which goes in the "victory circle" when the lesson is completed. The students complete worksheets, for which they are awarded "completed laps" rather than numerical points. When they have completed their 500 miles, they have "finished the race" and receive a miniature checkered flag. The center is designed so that all students can eventually master its content and be rewarded by receiving a flag.



CLOSE-UP

PROJECT CHILD—A NEW APPROACH TO INTEGRATED LEARNING SYSTEMS

Several dozen schools in Florida are involved in a research and development project to test and refine a computer-integrated instructional program for kindergarten through grade five.

In Project CHILD (Computers Helping Instruction and Learning Development), classrooms become learning resource rooms for three hours each day, each focused on one of the core subject areas: reading, language arts, mathematics, and science. Children move from classroom to classroom working at a variety of learning centers. A typical classroom has a half-dozen computers, a teacher station for small-group activities, and learning centers for hands-on activities and quiet reading and writing.

Students stay with the same team of teachers for three years in the primary cluster (K–2) or intermediate cluster (3–5). Each teacher has special training to use technology and cooperative learning techniques in his or her designated specialty area. Required curriculum content is covered in six-week thematic units, emphasizing whole language, writing, and problem solving across curricular areas.

For example, the Project CHILD reading and language arts curriculum is integrated through literature themes (fantasy, biographies, modern fiction, etc.). Students learn reading strategies in whole-class and small groups. Teachers plan reading lessons to include an array of materials, including newspapers, library books, song books, magazines, games, charts, reference books, and material written by students in the language arts center in the school. They use computers to write and to practice specific



language skills. The computer activities are based on a range of software from many different sources.

Formal evaluations indicate positive effects on academic achievement, attitude toward school, and self-esteem. Another indicator of success is that parent demand for entry is strong. Parents have moved across county lines and left private schools to get their children into Project CHILD schools.

For additional information on this topic, go to the Web Links module in Chapter 2 of the Companion Website (http://www.prenhall.com/heinich).

Source: Sarah M. Butzin, "Integrating Technology into the Classroom: Lessons from the Project CHILD Experience," Phi Delta Kappan, *December 1992, pp. 330–333.*

Enrichment Centers. Enrichment centers can provide stimulating additional learning experiences for students who have completed other classroom activities. You might, for example, allow students who have completed their assigned math activities to go to a center that features computer math games.

PROGRAMMED INSTRUCTION

Programmed instruction was chronologically the first technology for learning and is an explicit application of principles of learning theory—operant conditioning or reinforcement theory. Since reinforcement theory suggested that people have a tendency to learn behaviors that are followed by reinforcers, psychologist B. F. Skinner wanted to develop a method of instruction whereby students would spend most of their time performing the skills or displaying the knowledge being taught—not just sitting and listening. And each performance must somehow be followed by a reinforcer. Skinner decided that since humans were naturally curious, he could use "knowledge of the correct response" as the reinforcer that would follow the correct performance.

Skinner's initial inventions were elaborate machines that would mechanically present chunks, or "frames," of information; wait for a response to be written or a button to be pressed; then compare the response with the correct answer. If the answer was correct, the machine would display the next frame. Research and practical experience soon indicated, however, that students learned just as well when the sequence—information, question, response, answer—was presented in book form.

The earliest programmed instruction texts arranged the frames across the page in horizontal strips. The student could check the correct response for each question only by turning the page (Figure 2.10). Later, this method was relaxed, allowing the frames to be arranged vertically, as in conventional printed pages, and became known as **linear programming.** These programmed texts were meant to be read with a piece of paper covering the rest of the page while reading a frame. After writing an

HOW TO . . . Design Modules for Learning Centers

An **instructional module** is any freestanding, self-contained instructional unit designed for use by a single learner or a small group of learners without a teacher's presence. Since the whole purpose of modules is to facilitate learning without constant supervision, all the elements of a lesson a teacher usually provides have to be built into a set of printed, audiovisual, or computer-based materials (or a combination of all of these). That is, the module has to gain the student's attention, introduce the topic, present new content, provide practice-and-feedback activities, test for mastery, and assign followup remediation or enrichment. The main difference between a module and just a simple book, filmstrip, video, or computer lesson is that all of the instructional management procedures have to be built in.

Virtually all the individual and small-group techniques described in this chapter depend on instructional modules as the core of each individual or group activity.

COMPONENTS OF MODULES

There are many different formulas for designing instructional modules, but certain components are essential:

1. *Rationale.* Provide an overview of the content of the module and an explanation of why the learner should study it.
2. *Objective.* State in performance terms what the learner is expected to gain from studying the module.
3. *Entry test.* Determine whether the learner has mastered the prerequisite skills needed to enter the module.
4. *Multimedia materials.* Use a variety of media to involve learners actively and to utilize a number of their senses. Most media formats lend themselves to use in modules.
5. *Learning activities.* All the methods described in Chapter 1 may be incorporated into modules. Having a variety of methods and media increases student interest and meets student needs.
6. *Self-test.* Give students a chance to review and check their own progress.
7. *Posttest.* Assess whether students have mastered the objectives of the module.

MANAGING INSTRUCTION WITH MODULES

A module should include an introduction to the topic, preferably in the form of a question or a problem that will stimulate curiosity. It also must provide instructions or suggestions about how students are to use the components of the module. In most cases, a printed guide serves as the pathfinder through the various activities of the module. The printed guide may also contain questions and space for answers. (See "How to. . . Design Text," p. 134.)

Some teachers prefer to put their "user's guide" on audiotape, which can be helpful for those with reading problems. (See "How to. . . Record Audiocassettes," p. 182.)

When individuals or small groups are using modules on their own, the teacher needs a plan for monitoring their progress. Ideally, after finishing a module, the individual or small group meets with the teacher to discuss the content they were pursuing, their outcomes, and their understandings. They also report any difficulties they might have had in using the module. Such discussions, in addition to or instead of more conventional tests, provide valuable feedback about student progress and about the strengths and weaknesses of the module.

FIGURE 2.10
An early programmed textbook was The Analysis of Behavior, *by James B. Holland and B. F. Skinner (1961). Each frame required a written response, with the answer revealed on the next page, so the pages were read in "stripes."*

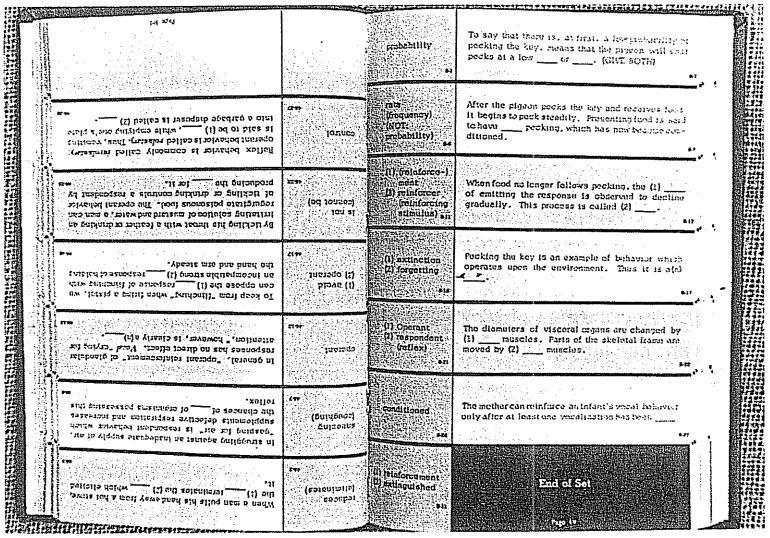


FIGURE 2.11
To use this example of programmed instruction, cover all of the page except the first frame with a piece of paper. Write your answer in the blank in the first frame. To verify your answer, slide the cover down to see the correct answer printed to the left of the second frame.

	1. Psychologists differ in their explanations of what learning is and precisely how it occurs. The series of statements or "frames" presented here deal with one particular explanation of the process of _____.
learning	2. We cannot observe learning directly, but we can infer that it has occurred when a person consistently makes a response that he or she previously was unable to make. For example, if a student says "nine" when asked "What is three times three?" she is making a _____ that was probably learned through practice in school.
response	3. If you read "kappa" when asked "What Greek letter is represented by K?" you are making a _____ that you learned through some prior experience.
response	4. The word or picture or other sensory stimulation that causes you to make a response is a stimulus (plural: *stimuli*). Therefore, if "kappa" is your response, "What Greek letter is represented by K?" would be the _____.
stimulus	5. To the stimulus "good," the student of Spanish responds "bueno"; the student of Arabic responds "gayid." To the stimulus "silver," the student of Spanish records "plata"; the student of Arabic responds "fida." They are responding to English words which are serving as _____.
stimuli	6. In these frames the written statements are the stimuli to which you are writing _____ in the blanks.
responses	7. We learn to connect certain verbal responses to certain stimuli through the process of forming *associations*. We say that the student associates "nine" with "three times three"; he learns to associate "kappa" with *K*; and he _____ "plata" with "silver."
associates	8. Much verbal learning seems to be based on the formation of associations between _____ and responses.
stimuli	etc.

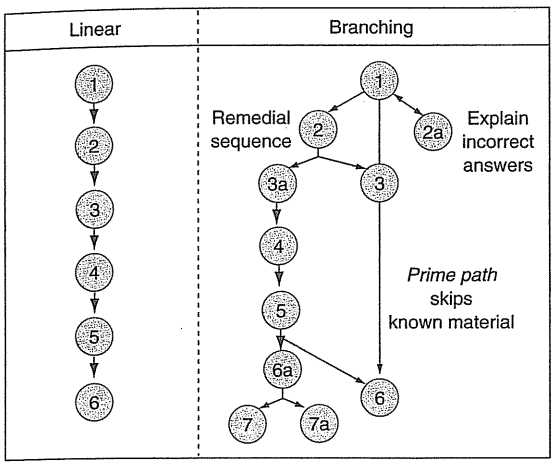
answer in the blank on the first frame, for example, the user moved the cover down to see the correct answer printed in the box to the left of the second frame. You will have a better idea of how programmed instruction works if you go through the example in Figure 2.11.

The framework of programmed instruction began with the linear format just described. Early research, however, cast doubt on the necessity or desirability of following this rigid format. An early and successful challenge to the linear convention came from Crowder (1963) in the form of "intrinsic programming." The basic method of intrinsic programming was to present a large block of information followed by a multiple-choice question requiring application of the facts or principles presented. Each answer choice directed the reader to a different page. Correct choices allowed the reader to go ahead to new material; incorrect choices led to remedial explanations and more questions.

Because the pattern of frames in intrinsic programming resembled the branches of a tree, it became known as **branching programming** (Figure 2.12). The major advantage of the branching format is that learners who catch on quickly can move through the material much more efficiently, following the "prime path."

Although this was largely forgotten later, programmed instruction played a unique pioneering role in the evolution of computer software. As the computer began to make its way into schools, little software was available. Many developers followed the example of programmed instruction materials and created computer-

FIGURE 2.12
Comparison of linear and branching formats of programmed instruction.



assisted instruction that would lead users through a series of exercises designed to teach the material.

Early work done by Suppes and Morningstar (1969) focused on using the computer to teach math skills. The lessons followed a drill-and-practice format similar to that found in the paperbound versions of similar materials. Practice and feedback were an integral part of the lesson designs.

These early attempts in using the computer to teach relied on a terminal attached via modem to a mainframe computer. Lessons were delivered to students whenever they logged on. Suppes found that students improved their math skills and enjoyed working on the computer. With the arrival of the microcomputer, the early work of Suppes and others made its way into the classroom. Early microcomputer software emulated these programmed instruction units designed to teach specific subjects. Thus, the computer became a delivery mechanism for programmed instruction.

Programmed instruction thus led to the development of computer-assisted instruction (CAI) and the same principles are currently incorporated in Web-based instruction. All of these formats provide for active learner participation including practice with feedback. The branching programmed instruction format, done so well by computers, was developed by Crowder to provide for individual differences.

Realistic contexts were not a characteristic feature of original programmed instruction or of the first CAI programs. Another limitation of programmed instruction and later CAI was the lack of social interaction. This was overcome with the introduction of programmed tutoring (see page 46) and programmed teaching (see page 47).

Programmed instruction usually refers to learning done by an individual using printed materials or a computer. *Programmed tutoring* involves a human tutor working one on one with a learner. *Programmed teaching* is a systematic procedure for a teacher to work simultaneously with a group of students or a whole class.

Advantages

- *Self-pacing.* Programmed instruction allows individuals to learn at their own pace at a time and place of their choice.
- *Practice and feedback.* It requires learners to participate actively in their learning and provides immediate feedback for each practice attempt.
- *Reliable.* This technology provides a reliable form of learning, in that the instructional routine is embodied in print so that it can be mass produced and experienced by many people in exactly the same form.
- *Effective.* Hundreds of research studies compare programmed instruction with conventional instruction. Summaries of these studies indicate slight superiority for programmed instruction.

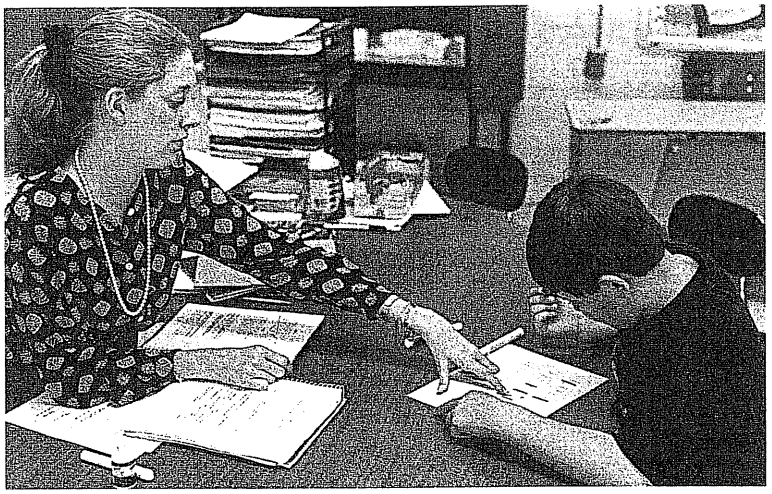
Limitations

- *Program design.* As with many other media and technologies, the quality of the software varies greatly. Some programmed materials are poorly designed and have little value.
- *Tedious.* The repetition of the same cycle and plowing through an endless series of small steps taxes the attention span and patience of many students. For highly motivated learners with the required reading skills and self-discipline, programmed instruction can give them a chance to go off on their own and progress as far and as fast as they like. For others, it can be tedious.
- *Lack of social interaction.* Most programmed materials are meant to be used by one individual at a time. Long periods of independent study are inappropriate for younger children. Even older students and adults prefer more social interaction in their learning. Some kinds of skills and understanding are enhanced by the social exchange of group-based instruction. Affective and interpersonal skills are unlikely candidates for programmed instruction.

Integration

Programmed materials have been used successfully from the elementary school through the adult education level and in almost every subject area. By itself or in conjunction with other strategies, a teacher can use a program to teach an entire course or a segment of a course. Many teachers use short programmed units to teach simple

FIGURE 2.13
A typical arrangement for a programmed tutoring lesson.



principles and terminology. Programmed instruction is particularly useful as an enrichment activity. It can help provide highly motivated students with additional learning experiences that the teacher might ordinarily be unable to provide because of classroom time pressures.

Programmed materials also have proven to be effective in remedial instruction. The program can function as a "tutor" for slow learners in situations where more personalized attention may be virtually impossible (in overcrowded classrooms, for example). Students can even take this particular tutor with them when they leave the classroom! Another reason for the success of programmed materials in remedial instruction is their "failure-proof" design. Because these materials break learning down into small steps and allow students to take as much time as needed for each step, and because the materials are tested, evaluated, and revised carefully prior to publication, they are more likely to provide slow learners with a successful experience.

Like any other instructional material, programmed texts need to be carefully appraised before selection. Also, the success of programmed materials, as with other materials, depends on the skills of the instructor in choosing materials appropriate for the audience and purpose and in integrating them into the instructional program.

PROGRAMMED TUTORING

Programmed tutoring (also referred to as *structured tutoring*) is a one-to-one method of instruction (Figure 2.13) in which the tutor's responses are programmed in advance in the form of carefully structured printed instructions. In a typical program the tutor and student go through the lesson material together. The tutor's book has the answers to the exercises; the student's book does not. An excerpt from a typical programmed tutoring tutor's book is shown in Figure 2.14. Note how the tutor's role in the program is set forth, step by step, to conform with learner responses to the materials.

FIGURE 2.14
The directions given in the tutor's guidebook structure the programmed tutoring lesson.

STEP 1	Tell the student that this exercise will help him learn to sound out new words.
STEP 2	Point to the first word and ask the student to *sound* it out. a. If the student reads the word correctly, praise him; then go on to the next word. b. If the student is unable to read the word or reads it incorrectly, have him make the individual sounds in the word separately and then assist him in blending the sounds. Example: Word: "THIN" *Tutor:* Place your finger over the last two letters in the word and ask "What sound does the *th* make?" If the student answers correctly, praise him and go to the next sound. If he answers incorrectly or fails to answer, tell him the sound and have him repeat it. Follow the same procedure for each sound in the word, and then show him how to blend the separate sounds.
STEP 3	Follow step 2 for each word on the sheet.
STEP 4	At the end of the session, praise the student.
STEP 5	Fill out your tutor log.

Source: Grant Von Harrison, *Beginning Reading 1: A Professional Guide for the Lay Tutor* (Provo, UT: Brigham Young University Press, 1972), p. 101.

Because the tutor goes to the next step on the basis of the learner's last response, programmed tutoring is a form of branching programming. As such, it shares the basic advantage for which branching was originally developed: the fast learner can skip quickly through the material without tedious and unnecessary repetition.

If the learner responds correctly, she is reinforced and goes on to a new item. If the response is incorrect, a series of increasingly clearer prompts or hints is given. For example, in teaching a beginning reader to follow written instructions, the student's book might say, "Point to your teacher." If the learner does not point to the teacher when first shown the instruction, the tutor might follow this sequence of prompts:

1. "Read it again." (Wait for response.)
2. "What does it say?"
3. "What does it tell you to do?"
4. "Do what it tells you to do."

The sequence of prompts would continue until the learner gives an acceptable response. Then the tutor would provide reinforcement. The idea is to lead the student toward the solution with hints but to avoid actually giving the correct answer.

Advantages

- *Self-pacing.* Programmed tutoring shares with programmed instruction the characteristic of individualized pacing.
- *Practice and feedback.* Like programmed instruction, programmed tutoring requires constant learner participation. The use of a live tutor as a mediator adds immensely to the flexibility of the feedback system, and it adds another major advantage over printed self-instructional material by employing social reinforcers in the form of praise ("That's great"; "Oh, what a good answer"; "You're really on the ball today") rather than just simple knowledge of results.
- *Reliable.* Like programmed instruction, programmed tutoring provides reliable instruction in that the teaching-learning pattern is embodied in a set of written instructions for the tutor. Compared with unstructured tutoring, programmed tutoring has higher reliability because there is a predetermined pattern to the tutor's action. With trained and motivated tutors, this has proven to be one of the most powerful technologies for learning. Administered flexibly and creatively by a live guide, this technology can overcome the monotonous pattern that sometimes results with other programmed formats.
- *Effective.* The effectiveness of programmed tutoring has been well established through the evaluation studies carried out by its originator, Douglas Ellson. The evidence from these was persuasive enough that in the early 1980s the U.S. Department of Education recognized programmed tutoring as one of the half-dozen most effective compensatory education programs. Summaries of research have also found structured tutoring, variously defined, to be among the most effective and cost-effective innovations, with tutees scoring from the 70th to the 79th percentile compared to the 50th percentile for conventional instruction (Levin, Glass, & Meister, 1987; Cohen, Kulik, & Kulik, 1982).

Limitations

- *Labor intensive.* Programmed tutoring depends on the availability of volunteer tutors. In schools, tutoring is usually done by peers, older students, or parents.
- *Development cost.* The success of programmed tutoring depends on the design of the tutoring guides; their development requires an investment of time and expertise.

Integration

Reading and mathematics have been by far the most popular subjects for tutoring. Being basic skills and highly structured by nature, these subjects lend themselves well to this approach. Remedial instruction is a typical application of tutoring programs.

In using programmed tutoring, keep in mind that research consistently indicates that tutors also learn from tutoring, sometimes more than their tutees! So give everyone a chance to be a tutor. You can do this effectively by using materials that are prestructured to make the tutor's job replicable.

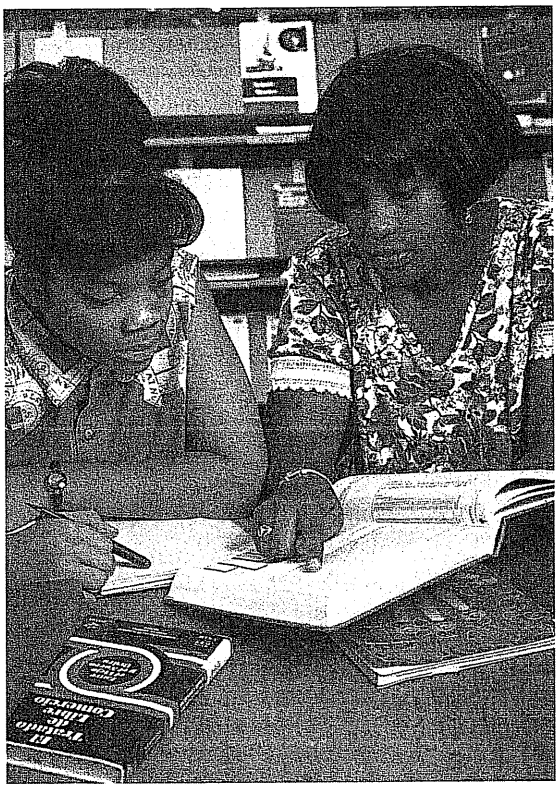
Consider using tutoring to make productive use of high-absence days. Train those who are present to tutor absentees when they return. Tutors will deepen their knowledge; absentees will catch up.

PROGRAMMED TEACHING

Programmed teaching, also known as *direct instruction,* is an attempt to apply the principles of programmed instruction in a large-group setting. In this approach, a whole class is broken into smaller groups of 5 to 10 students. These smaller groups are led through a lesson by a teacher, paraprofessional, or student peer following a highly prescriptive lesson plan. The critical features of these lessons include *unison responding* by learners to prompts (or cues) given by the instructor, *rapid pacing,* and procedures for *reinforcement* or *correction.*

The scripted lesson plans are developed by instructional designers and tested and revised before full-scale use. The scripting affords quality control, assists instructors who are weak in instructional design skills, and allows

FIGURE 2.15
With programmed teaching, older students can guide the work of younger ones.



the substitution of paraprofessionals, advanced students, or even student peers for teachers (Figure 2.15). The cost efficiency and educational effectiveness of programmed teaching has led some economists to recommend it as a way of improving education in situations in which cost reduction is a strong consideration.

Programmed teaching is seen by its proponents as a total system for organizing classroom instruction. However, in North America it has been adapted for use as one component of a whole-group classroom setting. It is particularly advocated for basic-skills acquisition at early grade levels, especially in reading and mathematics. It has been tested most in the teaching of disadvantaged children and those with disabilities. Although programmed teaching has yielded impressive achievement gains in its own right, it has proven to be especially beneficial when combined with other methods to carry students toward higher-level skills such as problem solving.

Programmed teaching lessons are designed to generate high rates of responding by all students. To avoid inattention or mere imitation of other students' responses, all are required to respond vocally at the same time, at a hand signal by the instructor. When the teacher detects an error, he follows the procedures specified in the protocol to correct and remediate it.

Programmed teaching can be regarded as a technology for learning in that it has a definite pattern: teacher cue, unison vocal response, and reinforcement or correction. Because this pattern is incorporated into the scripted lesson plan, a certain amount of quality control and reliability can be expected.

A wealth of research evidence supports programmed teaching in more than a dozen English-speaking countries (Binder & Watkins, 1990). One large-scale study compared 20 different instructional models; among them, programmed teaching was the most effective in building basic skills, cognitive skills, and self-concept (Watkins, 1988). Programmed teaching has been used successfully in the primary grades in numerous experimental programs in North America and many other parts of the world, including the Philippines, Indonesia, and Liberia (Thiagarajan & Pasigna, 1988).

PERSONALIZED SYSTEM OF INSTRUCTION

The final technology for learning that we will examine in this chapter is the **Personalized System of Instruction (PSI),** sometimes referred to as the Keller Plan after Fred Keller, who developed it. It can be described as a template for managing instruction. It is derived from the same roots as *mastery learning,* the idea that all students can succeed—achieve basic mastery—but need different amounts of time and practice to get there. A major principle of mastery learning is that students should not be permitted to go on to later units of study until they have demonstrated that they have mastered the prerequisite knowledge and skills.

PSI differs from the whole-class application of mastery learning in that it adheres to the notion of using individual self-study as the main form of learning activity. In many PSI courses there are *no* whole-class learning activities at all; in some cases, however, they are used for course orientation, guest speakers, and review sessions. Students work individually at their own pace using any of a variety of instructional materials—a chapter in a textbook, a computer-based module, a programmed instruction booklet, an interactive videodisc, and so on.

The essential idea of PSI is that the learning materials are arranged in sequential order and the student must demonstrate mastery of each unit before being allowed to move on to the next. Mastery is determined by means of a test taken whenever the student feels ready for it. Study help and testing are handled by proctors, usually more advanced students who volunteer to help others. Proctors are a critical component of PSI, for it is their one-to-one assistance that makes the system personalized. As illustrated in Figure 2.16, after scoring each test the proctor reviews it immediately with the

FIGURE 2.16
Guidance given by a proctor during independent study provides personalization in the PSI approach.



student, asking questions to probe weak points and listening to defenses of alternative answers. Such explanations can depict the learner's understanding of the content better than the test answers alone. If performance is below the mastery level, the student must return at a later time and take another form of the test.

Advantages

- *Self-pacing.* PSI allows students to progress at their own rate and to take full responsibility for determining when, where, and how they study. And, although this is not often done because of constraints of cost and convenience, students with differing learning styles and interests could be given study materials best suited to their needs.
- *Mastery.* The main claim of PSI is that it prevents the "accumulation of ignorance." Students are not allowed to go on to advanced units until they show that they have mastered the prerequisites. One of the most frequent causes of failure in conventional instruction is that students plunge ahead into new material without completely grasping prerequisite knowledge or skills.
- *Effective.* The effectiveness of PSI has been documented in a large number of studies comparing PSI and conventional versions of courses.

Limitations

- *Development cost.* PSI demands a great deal of time in planning and developing materials, since it is essentially an organizational framework and does not come with a given set of materials. Each course requires its own set of self-study materials. Even though lecture time is reduced or eliminated, instructors must be prepared to spend about half again as many hours conducting a PSI course as conducting a conventional course. The additional time is consumed in developing materials, training and supervising proctors, and meeting with individual students.
- *Behaviorist commitment.* The instructor adopting PSI must also be willing to adopt its behaviorist structure, including specification of precise performance objectives, derivation of tests from these objectives, and selection or design of material that leads learners efficiently to those objectives. The mastery perspective also requires abandoning norm-referenced testing and grading ("grading on the curve") in favor of criterion-referenced grading, expecting and demanding that all students persist until they reach the A or B level.
- *Self-discipline.* Dealing with the freedom of PSI can be a problem for students, especially younger learners who may need practice in the required self-discipline. Procrastination is allowed in PSI and students must learn to avoid it or suffer the consequences.

Integration

Fred S. Keller developed the first PSI course at the University of Brasilia in the mid 1960s (hence PSI's alternate name, the Keller Plan). Since then, this technology for learning has been applied most frequently to postsecondary education, particularly at the community college level. At that level it has been most successful in mathematics, engineering, and psychology and slightly less successful in the life sciences and social sciences. It has also been applied in elementary and secondary education, military training, and corporate education. More recently it has become a popular framework for structuring some computer-based courses and for distance education that relies on the World Wide Web for distribution.

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the Classroom Link Portfolio CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online, go to the Portfolio Activities module in Chapter 2 of the Companion Website (http://www.prenhall.com/heinich).

1. *Analysis: Technology for Learning.* Locate two examples of technology for learning from the CW, the "Classroom Link Portfolio" CD-ROM, or in your school's media center. Cite and/or describe the sources. Briefly describe each and tell how you would use them. List the strengths and weaknesses.

What recommendations would you make to the developer to improve each one (addressing needs of diverse learners)? Which would you choose to use? Why? (ISTE NETS-T II-A & C; VI A & B)

2. *Written Reflection.* Locate a cooperative learning activity lesson from the CW, the "Classroom Link Portfolio" CD-ROM, or on the Web. What do you like and not like about this activity as a teacher/trainer and as a learner? What do you like and not like about cooperative learning as a learner? How does this influence what you need to do as a teacher? (ISTE NETS-T IV-B)

INTEGRATION ASSESSMENTS

To complete the specified activities online, go to the Integration Assessments module in Chapter 2 of the Companion Website (http://www.prenhall.com/heinich).

1. Observe an actual class session (it may be the course you are taking, one taught where you work, or a class in another setting) and critique it in terms of the characteristics of a technology for learning as defined at the beginning of this chapter.
2. Generate two ideas for using learning centers in your own teaching.
3. Describe an instructional situation relevant to your own teaching that is appropriate for use of instructional games, simulations, or simulation games.
4. Review a game or simulation related to your own teaching interests and prepare an appraisal report using the "Appraisal Checklist: Simulations and Games."
5. Prepare a debriefing guide for a lesson utilizing a game or simulation.
6. Think about how you might use a game, simulation, or simulation game in your teaching or training. What would the content and/or objectives be? Would you use a game, simulation, or simulation game? How would you incorporate any of the following features of a technology for learning:

   Active participation/interaction
   Practice
   Individual differences
   Reinforcement/feedback
   Realistic context
   Cooperative groups/social interaction

7. Describe a real or hypothetical instructional situation in which you believe a technology for learning (or a combination of more than one) would be appropriate; justify your recommendation.
8. Review an example of programmed instruction, computer-assisted instruction, or Web-based instruction. What makes this example a technology for learning?

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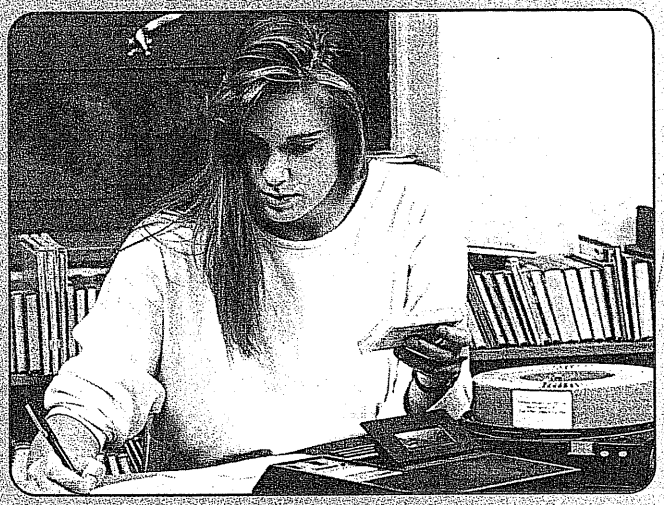
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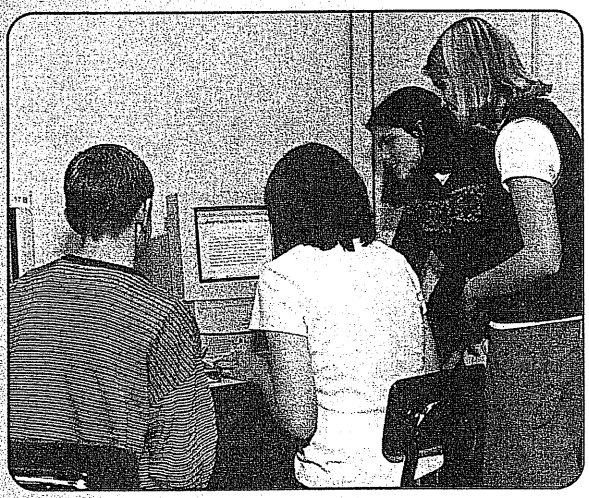


If you are going to use media and technologies effectively, you must plan systematically for their use. The ASSURE model is a guide to the major steps in the planning process. Following the ASSURE model, you begin instructional planning by assessing your students' characteristics and the learning objectives to be attained. With these in mind you are in a good position to select the types of media or delivery systems to be used and to consider specific materials that you might need.



Students' actual encounter with the media and materials also needs to be planned with care. What will they be doing? The ASSURE model puts a heavy emphasis on *active* student engagement in learning activities.

After instruction, how will you determine whether students have reached the goal? Both the learners and the instructional processes need to be evaluated. Were the materials effective? Were the activities engaging? Answering questions such as these closes the loop and brings you back to the beginning of another cycle.



CHAPTER 3

The ASSURE Model

OUTLINE

- The ASSURE Model
- Analyze Learners
- State Objectives
- Select Methods, Media, and Materials
- Utilize Media and Materials
- Require Learner Participation
- Evaluate and Revise

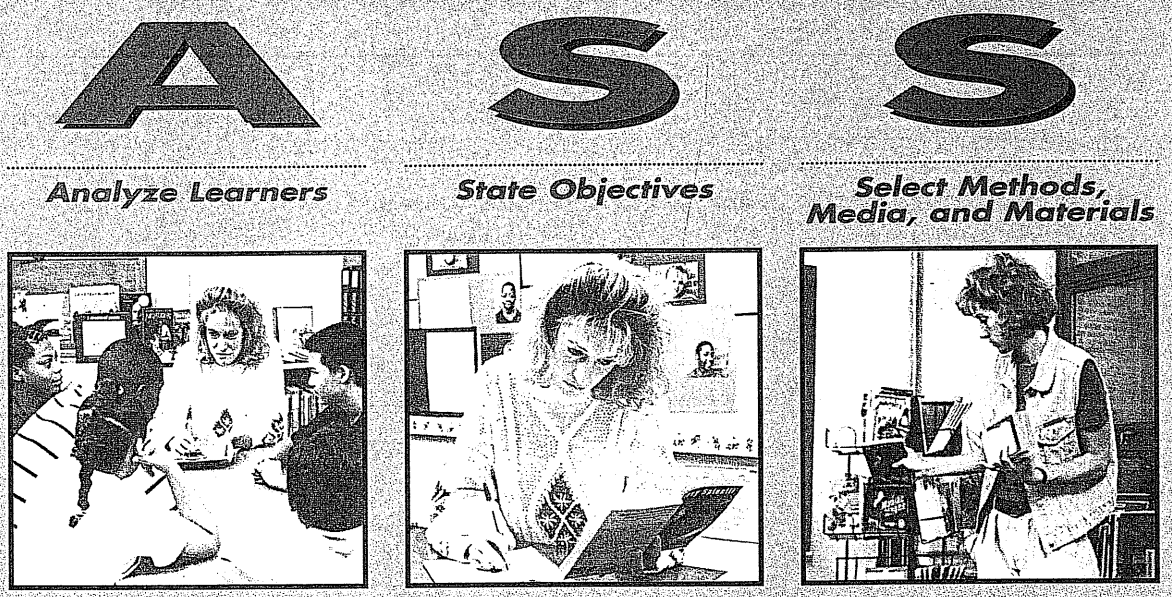
KNOWLEDGE OBJECTIVES

1. Demonstrate your ability to follow the steps involved in systematic planning for the use of media (the ASSURE model).
2. List general characteristics of learners and types of specific competencies that could affect media selection.
3. Describe learning style, including four types of traits that affect it.
4. Discuss the rationale for stating objectives for instruction. Your discussion should include purposes or uses of objectives.
5. Write objectives that refer to the audience, behavior, conditions, and degree of mastery.
6. Demonstrate your ability to follow the basic procedures for selecting, modifying, and designing materials, and indicate when each choice is appropriate.
7. Describe ways of modifying materials without actually altering the originals.
8. Create examples of the five basic steps in utilizing instructional materials.
9. Identify general showmanship techniques in reference to planning, practice, and presentation.
10. Describe methods for eliciting student response during and after using media.
11. Justify the requirement for learner participation when using media.
12. Compare and contrast the techniques for evaluating student achievement and the techniques for evaluating media and methods.

LEXICON

entry test
prerequisite
learning style
motivation
intrinsic motivator
extrinsic motivator
criterion
cognitive domain
affective domain
motor skill domain
interpersonal domain
media format
showmanship
feedback
practice
authentic assessment

A Model to Help Assure Learning



The first step in planning is to identify the learners. Your learners may be, for example, students, trainees, or members of an organization such as a Sunday school, civic club, youth group, or fraternal organization. You must know your students to select the best medium to meet the objectives. The audience can be analyzed in terms of (1) general characteristics, (2) specific entry competencies (knowledge, skills, and attitudes about the topic), and (3) learning style.

The next step is to state the objectives as specifically as possible. The objectives may be derived from a course syllabus, stated in a textbook, taken from a curriculum guide, or developed by the instructor. They should be stated in terms of what the learner will be able to do as a result of instruction. The conditions under which the student or trainee is going to perform and the degree of acceptable performance should be included.

Once you have identified your audience and stated your objectives, you have established the beginning points (audience's present knowledge, skills, and attitudes) and ending points (objectives) of instruction. Your task now is to build a bridge between these two points by choosing appropriate methods, technology, and media formats, then deciding on materials to implement these choices. There are three options: (1) select available materials, (2) modify existing materials, or (3) design new materials.

THE ASSURE MODEL

All effective instruction requires careful planning. Teaching with instructional media and technology is certainly no exception. This chapter examines how to plan systematically for the effective use of instructional media and technology. We have constructed a procedural model to which we have given the acronym *ASSURE*—it is intended to *assure* effective instruction.

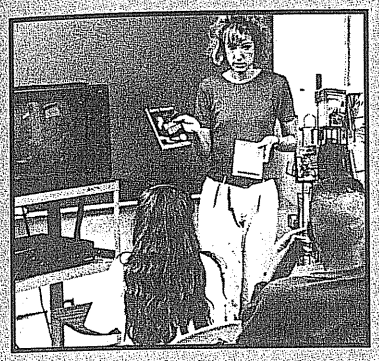
You can think of the teaching–learning process as progressing through several stages. Gagné (1985) refers to these stages as "events of instruction." Gagné's research revealed that well-designed lessons begin with the arousal of students' interest and then move on to present new material, involve students in practice with feedback, assess their understanding, and go on to followup activities. The ASSURE model incorporates these events of instruction.

The ASSURE model—a procedural guide for planning and conducting instruction that incorporates media and technology—assumes that training or instruction is required. A full-blown process of instructional development would begin with a needs assessment to determine whether instruction is the appropriate solution to a performance problem.

The ASSURE model focuses on planning surrounding the actual classroom use of media and technology. It is less ambitious than models of instructional devel-

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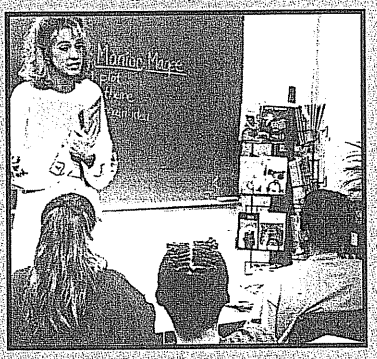
Utilize Media and Materials



Having either selected, modified, or designed your materials, you then must plan how the media, materials, and technology will be used to implement your methods. First, preview the materials and practice the implementation. Next, prepare the class and ready the necessary equipment and facilities. Then conduct the instruction using the utilization techniques described in this and later chapters.

Students may use the media and materials individually, as in self-instruction, or in small groups, as in cooperative learning. They may use printed materials, such as workbooks, or computer-based technology, such as the Internet.

Require Learner Participation



To be effective, instruction should require active mental engagement by learners. There should be activities that allow learners to practice the knowledge or skills and to receive feedback on the appropriateness of their efforts before being formally assessed.

Practice may involve student self-checks, computer-assisted instruction, Internet activities, or group games. Feedback may be provided by the teacher, a computer, other students, or self-evaluation.

Evaluate and Revise



After instruction, it is necessary to evaluate its impact and effectiveness and to assess student learning. To get the total picture, you must evaluate the entire instructional process. Did the learners meet the objectives? Did the methods, media, and technology assist the trainees in reaching the objectives? Could all students use the materials properly?

Wherever there are discrepancies between what you intended and what you attained, you will want to revise the plan for the next time.

opment, which are intended to guide the entire process of designing instructional systems. Such models include the procedures of the ASSURE model and the processes of needs analysis, subject matter analysis, product design, prototype tryout, system implementation, and the like. These larger-scale instructional development procedures typically involve teams of specialists and require major commitments of time and money. (Further information about instructional design can be found in the References and Suggested Readings at the end of this chapter.) The ASSURE model, on the other hand, is meant for the individual instructor to use when planning classroom use of media and technology.

To illustrate how to use the six steps of the ASSURE model, we will provide an example of a "Blueprint" for each step after it is described. These steps taken together constitute a "Blueprint"—or lesson plan—that describes the instructional planning used by a middle school math teacher who wanted to redesign a unit on statistics. The teacher felt that the mathematics textbook presented statistics (collecting data, interpreting data, and presenting data) very inadequately. One particularly disappointing aspect of textbook material covering this topic was that technology was not incorporated in the teaching. She believed that, considering today's technology-based world, this skill deserved more attention than it

traditionally received in schools. Therefore, she chose to develop a unit that addressed some of the basic statistical skills through the use of computer applications.

The "Classroom Link Portfolio" CD-ROM in the back of this book lets you use the ASSURE model to create your own lesson plans. The program presents each step of the model in a flexible format that allows you to develop your own lesson plans by entering them into a computer version of the ASSURE model. Instructions on how to use the "Classroom Link Portfolio" CD-ROM are found online at the Companion Website for this text (http://www.prenhall.com/heinich), and on the CD-ROM itself.

ANALYZE LEARNERS

If instructional media and technology are to be used effectively, there must be a match between the characteristics of the learner and the content of the methods, media, and materials. The first step in the ASSURE model, therefore, is analysis of your audience.

It is not feasible to analyze every trait of your learners. Several factors, however, are critical for making good methods and media decisions:

- General characteristics
- Specific entry competencies
- Learning styles

General characteristics include broad identifying descriptors such as age, grade level, job or position, and cultural or socioeconomic factors. Specific entry competencies refer to knowledge and skills that learners either possess or lack: prerequisite skills, target skills, and attitudes. The third factor, learning style, refers to the spectrum of psychological traits that affect how we perceive and respond to different stimuli, such as anxiety, aptitude, visual or auditory preference, motivation, and so on.

General Characteristics

Even a superficial analysis of learner characteristics can provide helpful leads in selecting instructional methods and media. For example, students with substandard reading skills may be reached more effectively with nonprint media. If you are dealing with a particular ethnic or cultural subgroup, you might want to give high priority to considerations of ethnic and cultural identity and values in selecting particular materials.

If learner apathy toward the subject matter is a problem, consider using a highly stimulating instructional approach, such as a dramatic videotape, a simulation game, or a technology-based activity.

Learners entering a new conceptual area for the first time may need more direct, concrete kinds of experiences, such as field trips or role-playing exercises (refer to Dale's Cone of Experience in Chapter 1). More advanced learners usually have a sufficient base for using audiovisual or even verbal materials.

Heterogeneous groups, which include learners varying widely in their conceptual sophistication or in the amount of firsthand experience they have with the topic, may profit from an audiovisual experience such as a videotape. Such media presentations provide a common experiential base that can serve as an important point of reference for subsequent group discussion and individual study.

For instructors dealing with a familiar audience, analysis of general characteristics will be something of a given. At times, however, audience analysis may be more difficult. Perhaps your students are new to you, and you have had little time to observe and record their characteristics. Or perhaps they are a more heterogeneous group than is ordinarily found in the classroom—business trainees, for example, or a civic club, youth group, or fraternal organization—thus making it more difficult to ascertain whether all or even a majority of your learners are ready for the methods and media of instruction you are considering. In such cases, academic and other records may be helpful, as well as direct questioning of and talking with learners and instructors or other group leaders. Seasoned public speakers—those who regularly address unfamiliar audiences—make it a practice to arrive early and strike up a conversation with audience members. In this way they can pick up valuable clues about the types of people in the audience, their backgrounds, their expectations, and their moods.

Specific Entry Competencies

When you begin to plan any lesson, your first assumption is that the learners lack the knowledge or skills you are about to teach and that they possess the knowledge or skills needed to understand and learn from the lesson. These assumptions are often mistaken. For example, a life insurance company used to routinely bring all its new sales associates back to the home office at the end of their first year for a course on setting sales priorities. Puzzled by the cool reaction of the agents, the trainer decided to give a pretest, which revealed that a majority of the trainees already knew perfectly well how to set sales priorities. The company shifted to a less expensive and more productive strategy of giving incentives to field representatives who sent in acceptable sales plans showing their priorities.

The assumption that learners have the prerequisite knowledge or skill to begin the lesson can seldom be accepted casually in school settings. Teachers of mixed-ability classes routinely anticipate that some students will need remedial help before they are ready to begin a particular unit of instruction. Furthermore, researchers studying the impact of different psychological traits on

learning have reached the unexpected conclusion that students' prior knowledge of a particular subject influences how and what they can learn more than does any psychological trait (Dick, Carey, & Carey, 2001). For example, students approaching a subject new to them learn best from structured presentations even if they have a learning style that would otherwise indicate more open-ended, unstructured methods.

These realizations suggest that instructors must verify assumptions about entry competencies through informal means (such as in-class questioning or out-of-class interviews) or more formal means (such as testing with standardized or teacher-made tests). **Entry tests** are assessments, both formal and informal, that determine whether students possess the necessary prerequisites. **Prerequisites** are competencies that learners must possess to benefit from the instruction but that you or the media are not going to teach. For example, in teaching an apprentice lathe operator to read blueprints, you might assume that she has the ability to make metric conversions—hence you would not teach this skill.

Prerequisites (specific entry competencies) should be stated in the same format as are objectives (described in the next section). In the situation involving the apprentice lathe operator, the prerequisites could be stated as follows: "Apprentice lathe operators are able to convert any given measurement up to one meter from the metric system to the English system equivalent or vice versa with 100 percent accuracy." Such previously acquired skills should be assessed before instruction.

Preassessment measures, such as discussions and pretests, are also given before instruction but are used to measure the content to be taught—the target skills. If learners have already mastered what you plan to teach, you are wasting your time and theirs by teaching it.

By analyzing what your audience already knows, you can select appropriate methods and media. For example, if you have a group diverging widely in entry competencies, consider self-instructional materials to allow for self-pacing and other aspects of individualization.

Learning Styles

Learning style refers to a cluster of psychological traits that determine how an individual perceives, interacts with, and responds emotionally to learning environments.

It is clear that certain traits dramatically affect our ability to learn effectively from different methods and media. However, it is not so clear which traits are most important. Gardner was dissatisfied with the concept of IQ and its unitary view of intelligence, noting that "not all people have the same abilities; not all of us learn in the same way" (Gardner, 1993, p. 21). He identified seven aspects of intelligence; subsequently revised to nine: (1) verbal/linguistic (language), (2) logical/mathematical (scientific/quantitative), (3) visual/spatial, (4) musical/rhythmic, (5) bodily/kinesthetic (dancing/athletics), (6) interpersonal (understanding other people), (7) intrapersonal (understanding oneself), (8) naturalist, and (9) existentialist.

Gardner's theory implies that teachers, curriculum planners, and media specialists should work together to design curricula in which students have the chance to develop these different aspects of intelligence. It also implies that students vary widely in terms of their strengths and weaknesses in each of these areas. A school adopting this approach would have students engaged in a much greater variety of methods and media than is typical now. Teacher talk and seatwork obviously are not sufficient. Because students have different mixes of strengths and weaknesses, their progress would have to be measured not by conventional grades in conventional subjects but by growth in each type of intelligence. The type of individualized instructional plans and records of progress implied in this approach lend themselves well to the active learning methods, interactive technologies, and information management systems described in later chapters. In fact, experimental schools based on this theory are now in operation.

Learning style variables discussed in the literature can be categorized as perceptual preferences and strengths, information processing habits, motivational factors, and physiological factors.

Perceptual Preferences and Strengths. Learners vary as to which sensory gateways they prefer using and which they are especially adept at using. The main gateways include auditory, visual, tactile, and kinesthetic. Proponents of the importance of this variable claim that most students do not have a preference or strength for auditory reception, casting doubt on the widespread use of the lecture method. They find that slower learners tend to prefer tactile or kinesthetic experiences; sitting and listening are difficult for them. Dependence on the tactile and kinesthetic modalities decreases with maturity.

Information Processing Habits. This category includes a range of variables related to how individuals tend to approach the cognitive processing of information.

Gregorc's model of "mind styles," elaborated by Butler (1986), groups learners according to concrete versus abstract and random versus sequential styles. It yields four categories: concrete sequential, concrete random, abstract sequential, and abstract random. Concrete sequential learners prefer direct, hands-on experiences presented in a logical order. They learn best with workbooks, programmed instruction, demonstrations, and structured laboratory exercises. Concrete random learners lean toward a trial-and-error approach, quickly reaching conclusions from exploratory experiences. They prefer methods such as games, simulations, independent study projects, and discovery learning. Abstract sequential learners decode

verbal and symbolic messages adeptly, especially when presented in logical sequence. Reading and listening to presentations are preferred methods. Abstract random learners are distinguished by their capacity to draw meaning from human-mediated presentations; they respond to the tone and style of the speaker as well as the message. They do well with group discussion, lectures with question-and-answer periods, videotapes, and television.

Motivational Factors. Various emotional factors have been found to influence what we pay attention to, how long we pay attention, how much effort we invest in learning, and how feelings may interfere with learning. Anxiety, locus of control (internal/external), degree of structure, achievement motivation, social motivation, cautiousness, and competitiveness are variables frequently cited as critical to the learning process.

Motivation is an internal state that leads people to choose to work toward or against certain goals and experiences. It defines what people *will* do rather than what they *can* do (Keller, 1987). Motivation influences learning by determining which instructional goals students attend to and which they choose to ignore. It also determines the effort they will expend to reach certain goals.

Motivators can be categorized as either intrinsic or extrinsic. **Intrinsic motivators** are generated by aspects of the experience or task itself, such as challenge or curiosity. A student who has a "short attention span" may spend hours playing computer games, but have trouble spending 10 minutes reading a textbook. **Extrinsic motivators** are generated by factors not directly related to the experience or task, such as grades or recognition. Students may work long and hard to "please" a favorite teacher. Researchers have found that intrinsic motivators are generally more effective. Students who are intrinsically motivated will work harder and learn more because of their personal interest in the material. Whenever possible, it is best to develop a student's intrinsic motivation.

A helpful approach to describing student motivation is Keller's (1987) ARCS model. Keller describes four essential aspects of motivation:

- *Attention* refers to whether students perceive the instruction as interesting and worthy of their consideration.
- *Relevance* refers to whether students perceive the instruction as meeting some personal need or goal.
- *Confidence* refers to whether students expect to succeed based on their own efforts.
- *Satisfaction* refers to the intrinsic and extrinsic rewards students receive from the instruction.

Physiological Factors. Factors related to gender differences, health, and environmental conditions are among the most obvious influences on the effectiveness of learning. Boys and girls tend to respond differently to various school experiences. For example, boys tend to be more competitive and aggressive than girls and consequently respond better to competitive games. Hunger and illness clearly impede learning. Temperature, noise, lighting, and time of day are everyday phenomena that affect our ability to concentrate and maintain attention. Individuals have different preferences and tolerances regarding these factors.

Dunn and Dunn (1992) have developed standardized instruments to measure the learning styles and environmental preferences of learners that cover these and other physiological factors. They are among the best known and most widely used instruments in school applications. Teachers who have prescribed individual learning programs based on analysis of these factors feel that they have practical value in improving academic achievement, attitude, and discipline.

The intent in using information about a student's learning style is to adapt instruction to take advantage of a particular style. Many students in a class may have the same or similar learning styles. Using learning styles in teaching can be compared to designing a house for a specific person. The components of houses are basically uniform—kitchen, living room, dining room, bedrooms, baths. However, they can be arranged in an unlimited number of configurations. They may need to be structured to accommodate hobbies, individuals with disabilities, or persons working at home. Furthermore, there are many different styles of architecture, colors, textures, materials, and so on. An architect skillfully selects and arranges all these elements to meet the needs and preferences of the inhabitants—an individual, a couple, a family. In a similar manner, a teacher chooses different methods, media, and materials to meet the needs of students with different learning styles and physiological factors. (See ASSURE Blueprint for Analyze Learners, page 59.)

STATE OBJECTIVES

The second step in the ASSURE model is to state the objectives of instruction. What learning outcome is each learner expected to achieve? More precisely, what new capability should learners possess at the completion of instruction? An objective is a statement not of what the instructor plans to put into the lesson but of what learners ought to get out of the lesson. An objective is a statement of *what* will be achieved, not *how* it will be achieved.

Your statement of objectives should be as specific as possible. For example, "My students will improve their mathematical skills" is far too general to qualify as a specific lesson objective. It does, however, qualify as a *goal*—a broad statement of purpose. Such a goal might serve as the umbrella for a number of specific objectives, such as, "The second-grade students will be able to solve accurately seven out of eight single-digit addition problems."

Why should you state instructional objectives? First, you must know your objectives in order to make appro-

ASSURE BLUEPRINT

Middle School Mathematics

Analyze Learners

General Characteristics

The students for whom this lesson is intended are seventh graders enrolled in a general mathematics class geared toward the average learner. The students range in age from 12 to 14 years. Several students have identified learning disabilities, whereas others are on the edge of consideration for the advanced mathematics track. They come from various socioeconomic environments; however, the majority of the students are white, middle-class Americans who live in a rural setting. Generally, the students are well behaved; problems tend to arise, however, when activities are textbook and paper-and-pencil oriented.

Entry Competencies

The seventh-grade mathematics students are able to do the following:

- Select, locate, and utilize appropriate reference materials when preparing research projects, using the school library media center
- Locate and identify bar, line, and circle graphs when examining books and other forms of media
- Read and interpret all the statistical or numerical information given to them on a bar, line, or circle graph
- Construct a graph (bar, line, or circle) when given a set of data, colored pencils/pens, a compass, a ruler, and graph paper
- Define and interpret a given example of percentage, mean, median, and mode without aids or references
- Demonstrate standard keyboarding skills, utilizing *AppleWorks* on the *iMac* computer, with an average typing speed of 35 words per minute

Learning Styles

The students dislike the monotony of mathematics textbook assignments. These assignments are usually centered on paper-and-pencil calculation problems. Persistent use of the textbook often results in the students becoming bored and restless. They appear to learn best from activities that incorporate the use of manipulatives. Using the computer and the Internet provides intrinsic motivation. In addition, they like group-oriented learning activities. Regarding testing, many of the students tend to experience difficulty and anxiety during written exams. As a result, the class prefers to be evaluated using methods other than paper-and-pencil tests (e.g., reports, application projects, etc.).

This Blueprint was developed by Mary Ann Ferkis, Purdue University. All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

priate selection of methods and media. Your objectives will, in a sense, guide your sequence of learning activities and your choice of media. Knowing your objectives will also commit you to create a learning environment in which the objectives can be reached. For example, if the objective of a unit of a driver's training course is "To be able to change a flat tire within 15 minutes," the learning environment must include a car with a flat tire.

Another basic reason for stating your instructional objectives is to help ensure proper evaluation. You won't know whether your learners have achieved an objective unless you are absolutely sure what that objective is.

Without explicit objectives, your students won't know what is expected of them. If objectives are clearly and specifically stated, learning and teaching become objective oriented. Indeed, a statement of objectives may be viewed as a type of contract between teacher and learner: "Here is the objective. My responsibility as the instructor is to provide learning activities suitable for your attaining the objective. Your responsibility as the learner is to participate conscientiously in those learning activities."

The ABCDs of Well-Stated Objectives

A well-stated objective starts by naming the *A*udience for whom the objective is intended. It then specifies the *B*ehavior or capability to be demonstrated and the *C*onditions under which the behavior or capability will be observed. Finally, it specifies the *D*egree to which the new skill must be mastered—the standard by which the capability can be judged.

Audience. A major premise of systematic instruction is to focus on what learners are doing, not on what the teacher is doing. Learning is most likely to take place when learners are active, either mentally processing an idea or physically practicing a skill. Because accomplishment of the objective depends on what learners do, the objective begins by stating whose capability is going to be changed—for example, "ninth-grade algebra students" or "newly hired sales representatives." Of course, if you are repeating the objective in material written for student use, the informal "you" is preferable.

Behavior. The heart of the objective is the verb describing the new capability that the audience will have after instruction. This verb is most likely to communicate your intent clearly if it is stated as an observable behavior. What will learners be able to do after completing instruction? Vague terms such as *know, understand,* and *appreciate* do not communicate your aim clearly. Better words include *define, categorize,* and *demonstrate,* which denote observable performance. The Helpful Hundred list in Table 3.1 offers verbs that highlight performance.

TABLE 3.1
The Helpful Hundred: Suggested performance terms

SUGGESTED PERFORMANCE TERMS					
Add	Compute	Drill	Label	Predict	State
Alphabetize	Conduct	Estimate	Locate	Prepare	Subtract
Analyze	Construct	Evaluate	Make	Present	Suggest
Apply	Contrast	Explain	Manipulate	Produce	Swing
Arrange	Convert	Extrapolate	Match	Pronounce	Tabulate
Assemble	Correct	Fit	Measure	Read	Throw
Attend	Cut	Generate	Modify	Reconstruct	Time
Bisect	Deduce	Graph	Multiply	Reduce	Translate
Build	Defend	Grasp (hold)	Name	Remove	Type
Carve	Define	Grind	Operate	Revise	Underline
Categorize	Demonstrate	Hit	Order	Select	Verbalize
Choose	Derive	Hold	Organize	Sketch	Verify
Classify	Describe	Identify	Outline	Ski	Weave
Color	Design	Illustrate	Pack	Solve	Weigh
Compare	Designate	Indicate	Paint	Sort	Write
Complete	Diagram	Install	Plot	Specify	
Compose	Distinguish	Kick	Position	Square	

The behavior or performance stated in the objective should reflect the real-world capability learners need, not some artificial ability needed for successful performance on a test. As a surgical patient, would you want a surgeon who is "able to select the correct answers on a multiple-choice test on appendectomies"? Or would you want the surgeon to be "able to perform an appendectomy"?

Conditions. A statement of objectives should include the conditions under which the performance is to be observed. For example, are students allowed to use notes in describing the consequences of excessive use of alcohol? If the objective of a particular lesson is for students to be able to identify birds, will identification be made from color representations or black-and-white photographs? What tools or equipment will students be allowed or not allowed to use in demonstrating mastery of the objective? Thus, an objective might state, "Given a political map of Europe, the student will be able to mark the major coal-producing areas." Or it might say, "Without notes, textbook, or any library materials, the student will be able to write a 300-word essay on the relationship of nutrition to learning."

Degree. The final requirement of a well-stated objective is that it indicates the standard, or **criterion,** by which acceptable performance will be judged. What degree of accuracy or proficiency must learners display? Whether the criteria are stated in qualitative or quantitative terms, they should be based on some real-world requirement. For example, how well must the machinist be able to operate a lathe in order to be a productive employee?

Time and accuracy are meaningful dimensions in many objectives. How quickly must the observable behavior be performed? For example, should students be able to solve five quadratic equations in five minutes, or ten minutes? How accurate must a measurement be—to the nearest whole number, or within one-sixteenth of an inch, or plus or minus one millimeter?

Quantitative criteria for judging acceptable performance sometimes are difficult to define. For example, how can an English instructor state quantitative criteria for writing an essay or short story? He might stipulate that student work will be scored for development of theme, characterization, originality, or the like. A model story might be used as an example.

The important consideration in appraising your objectives is whether you communicate the intent of the objectives, regardless of their format. If your objectives meet all the criteria in the "Appraisal Checklist" on page 61 but still do not communicate accurately your intentions to your colleagues and students, they are inadequate. The final judgment on any objectives must be determined by their usefulness to you and your learners. Guidelines for writing objectives are discussed in Gronlund's *How to Write and Use Instructional Objectives* and Mager's *Preparing Instructional Objectives* (see this chapter's References).

The wording of objectives appearing in instructional materials is often modified. The conditions and degree are often omitted to focus learners' attention on the specific behavior they are to learn. Instructors may specify their own conditions and criteria (degree), ensuring appropriateness for the students and the subject area.

APPRAISAL CHECKLIST

OBJECTIVES

	Appropriately stated	Partly stated	Missing
Audience			
Specifies the learner(s) for whom the objective is intended	❑	❑	❑
Behavior (action verb)			
Describes the capability expected of the learner following instruction	❑	❑	❑
• stated as a learner performance			
• stated as observable behavior			
• describes a real-world skill (versus mere test performance)			
Conditions (materials and/or environment)			
Describes the conditions under which the performance is to be demonstrated	❑	❑	❑
• equipment, tools, aids, or references the learner may or may not use			
• special environmental conditions in which the learner has to perform			
Degree (criterion)			
States, where applicable, the standard for acceptable performance	❑	❑	❑
• time limit			
• range of accuracy			
• proportion of correct responses required			
• qualitative standards			

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Classification of Objectives

Classifying objectives is much more than an academic exercise for educational psychologists. It has practical value because the selection of instructional methods and media, as well as evaluation methods, depends on the types of objectives being pursued.

An objective may be classified according to the primary type of learning outcome at which it is aimed. Although there is a range of opinion on the best way to describe and organize types of learning, three categories (or *domains*), of learning are widely accepted: cognitive skills, affective skills, and motor skills. To these we add a fourth, interpersonal skills, because of the importance of such skills in teamwork.

In the **cognitive domain,** learning involves an array of intellectual capabilities that may be classified either as verbal/visual information or as intellectual skills. Verbal/visual skills require learners to provide a specific response to relatively specific stimuli. They usually involve memorization or recall of facts. Intellectual skills, on the other hand, require thinking and manipulating information.

The **affective domain** involves feelings and values. Affective objectives range from, for example, stimulating interest in a school subject, to encouraging healthy social attitudes, to adopting a set of ethical standards.

In the **motor skill domain,** learning involves athletic, manual, and other such physical skills. Motor skill objectives include capabilities ranging from simple mechanical operations to those entailing sophisticated neuromuscular coordination and strategy, as in competitive sports.

Learning in the **interpersonal domain** involves interaction among people. Interpersonal skills are people-centered skills that require the ability to relate effectively with others. Examples include teamwork, counseling techniques, administrative skills, salesmanship, discussion, and customer relations.

Objectives and Individual Differences

Objectives in any of the domains just discussed may, of course, be adapted to the abilities of individual learners. The stated philosophy of most schools and colleges is to help students fulfill their full potential. In a physical education class with students of mixed ability, for instance, the midsemester goal might be for all students to be able to complete a run of 100 meters outdoors, but the time standards might vary. For some, 12 seconds might be attainable; for many others, 16 seconds; and for some, 20 might be realistic. For a student with physical disabilities, it might be a major victory to move 10 meters in one minute (Figure 3.1).

Objectives are not intended to limit what students learn but rather to provide a minimum level of expected achievement. Serendipitous or incidental learning should be expected to occur (and should be encouraged) as students progress toward an objective. Each learner has different characteristics (as discussed earlier in this chapter). Because of such individual differences, incidental learning takes different forms with different students. Class discussions and other kinds of student involvement in the instructional situation, therefore, should rarely be rigidly limited to a specific objective. Student involvement should allow for incidental learning to be shared and reinforced. Indeed, to foster incidental learning and provide for individual differences, it is sometimes advisable to have students specify some of their own objectives. (See ASSURE Blueprint for State Objectives, page 63.)

FIGURE 3.1
When teaching learners who have disabilities, there may be as many different standards for each objective as there are individuals.



SELECT METHODS, MEDIA, AND MATERIALS

A systematic plan for *using* media and technology certainly demands that the methods, media, and materials be *selected* systematically in the first place. The selection process has three steps: (1) deciding on the appropriate method for the given learning tasks, (2) choosing a media format that is suitable for carrying out the method, and (3) selecting, modifying, or designing specific materials within that media format.

Throughout the selection process, the school library media specialist and/or technology coordinator can be a helpful partner in considering possible methods and media and in sorting through the particular materials available.

ASSURE BLUEPRINT

Middle School Mathematics

State Objectives

The objectives for this lesson are as follows:

1. Given a bar, line, or circle graph, the seventh-grade mathematics student will be able to verbally present all the statistical or numerical information shown on the graph with 100% accuracy.
2. Given a set of data, the seventh-grade mathematics student will be able to accurately construct and produce a printout of a graph (bar, line, or circle) using *AppleWorks* software according to established criteria.
3. Working in small groups of three or four, the seventh-grade mathematics students will be able to propose, discuss, and agree on a topic for a group presentation. The presentation topic must incorporate data collection techniques (survey, observation, and/or interview) and the use of graphs (bar, line, and/or circle) to present statistical or numerical information.
4. Using *AppleWorks* software and working in small groups, the seventh-grade mathematics students will be able to write and produce a printout of a written report regarding the data collection techniques associated with the topic of their presentation. Reports will be evaluated based on the quality of the survey, observation sheet, or interview form; the steps taken to collect the data; and the rationale for choosing the specific data collection technique.
5. The seventh-grade mathematics students will be able to present their chosen topic in front of the class. Performance will be evaluated based on general content accuracy, specific use of graphs, and cohesiveness of the presentation.

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Choosing a Method

First, it would be overly simplistic to believe that there is one method that is superior to all others or that serves all learning needs equally well. As mentioned in Chapter 1, any given lesson will probably incorporate two or more methods to serve different purposes at different points in the progression of the lesson. For example, one might conduct a simulation activity to gain attention and arouse interest at the beginning of the lesson, then use a demonstration to present new information, and then arrange computer-based drill-and-practice activities to provide practice in the new skill. As indicated earlier in this chapter, teachers often structure assignments to allow students with different preferred learning styles to pursue their individual practice through different methods (e.g., having "abstract random" thinkers use a role-play simulation while "concrete sequential" thinkers use a lab manual for structured problem solving). It is beyond the scope of this book to give detailed guidelines on choosing methods.

Choosing a Media Format

A **media format** is the physical form in which a message is incorporated and displayed. Media formats include, for example, flip charts (still images and text), slides (projected still images), audio (voice and music), video (moving images on a TV screen), and computer multimedia (graphics, text, and moving images on a monitor). Each has different strengths and limitations in terms of the types of messages that can be recorded and displayed. Choosing a media format can be a complex task—considering the vast array of media and technology available, the variety of learners, and the many objectives to be pursued. Over the years many different formulas have been proposed for simplifying the task. They are referred to as *media selection models,* and they usually take the form of flowcharts or checklists.

Within most media selection models the instructional situation or setting (e.g., large group, small group, or self-instruction), learner variables (e.g., reader, nonreader, or auditory preference), and the nature of the objective (e.g., cognitive, affective, motor skill, or interpersonal) must be considered against the presentational capabilities of each of the media formats (e.g., still visuals, motion visuals, printed words, or spoken words). Some models also take into consideration the capability of each format to give feedback to the learner.

The limitation of such media selection models is their emphasis on simplicity. Reducing the process to a short checklist may lead one to ignore some possibly important considerations.

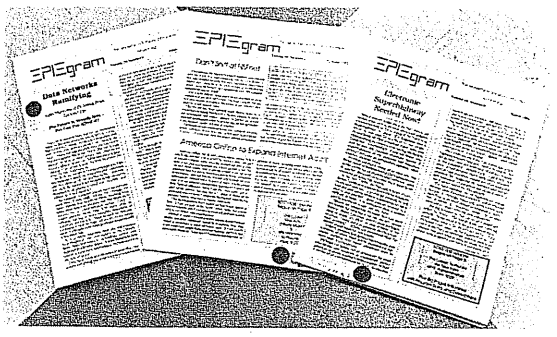
Our approach in this book is to give you the tools to construct your own schema for selecting appropriate media formats. We accept the desirability of comparing the demands of the setting, learner characteristics, and objectives against the attributes of the various formats. But only you can decide how to weight these considerations: what options you have in terms of setting, which learner characteristics are most critical, and what elements of your objectives are most important in your own situation. You will need to balance simplicity and comprehensiveness in any schema you decide to employ.

CLOSE-UP

CONSUMER TESTING OF EDUCATIONAL PRODUCTS

As the Consumers Union provides objective evaluative information about household products to general consumers, the Educational Products Information Exchange (EPIE) Institute provides educational software evaluations to the education and training communities.

The EPIE Institute is a nonprofit agency that has been in operation since 1967. Its purpose is to "gather and disseminate descriptive and analytical information—along with empirical information on performance and effects on learners—about instructional materials and systems." P. Kenneth Komoski has been executive director of EPIE since its founding.



EPIE accepts no advertising or commercial sponsorship of any kind. All income is derived from subscriptions, contract services from state and local education agencies, and grants. EPIE offers the following evaluation services to teachers and school systems.

The Education Software Selector (*TESS*) is a comprehensive database of educational software at every level from preschool to college. Over the years TESS has been available in a variety of formats, most recently on CD-ROM.

Eight major integrated instruction systems (or integrated learning systems) are evaluated in *The EPIE Report on Computer-Based Integrated Systems,* which draws on extensive research by experts in software evaluation and curriculum.

EPIE's Curriculum Analysis Services for Education (CASE) provides schools with a means of analyzing, designing, and aligning their stated curriculum outcomes, textbooks, and other instructional resources. A school's testing program can be compared with state and national programs and curriculum priorities. The service provides grade-by-grade printed reports that are useful for understanding and improving a school's curriculum and instructional program.

To learn more about the institute and its services, contact EPIE Institute, 103-3 W. Montauk Highway, Hampton Bays, NY 11946.

Obtaining Specific Materials

Obtaining appropriate materials will generally involve one of three alternatives: (1) selecting available materials, (2) modifying existing materials, or (3) designing new materials. Obviously, if materials are already available that will allow your students to meet your objectives by all means use them, thus saving work, time, and money. When the materials available do not completely match your objectives or are not entirely suitable for your audience, an alternative approach is to modify them. If this is not feasible, the final alternative is to design your own materials. Even though this is more expensive and time consuming, it allows you to prepare materials to serve your students and meet your objectives.

Selecting Available Materials

The majority of instructional materials used by teachers and trainers are "off the shelf"—that is, ready-made and available from school, district, or company collections or other easily accessible sources. So, how do you go about making an appropriate choice from available materials?

Involving the Media/Technology Specialist.

The media/technology specialist can be an important resource for you. You may need new materials to update the content of a unit. The media/technology specialist can tell you about materials housed in a local resource center or school library media center. Identify and discuss your options. As the specialist gains a better idea of your needs, arrangements can be made to contact area media collections (public, academic, or regional) to borrow potentially useful materials. Most school library media centers participate in regional cooperatives, which share materials. If you and the media/technology specialist collaborate with other teachers in your school or district who desire similar materials, you may have an easier time in acquiring materials from national museums or organizations. An appointed group of teachers may review selection and evaluation guides and identify new materials to be purchased for future use. Involving other teachers in the preview process also allows you to compare ideas and available materials. Teachers tend to become more critical and selective as they increase their collective knowledge of media and material alternatives.

Surveying the Sources.

You might survey some of the published media reference guides or the Internet to get a general idea of what is available. Unfortunately, no single comprehensive guide exists for all audiovisual materials available in all media formats in all subjects; you may have to consult several sources.

There are three types of guides that can help you select media—comprehensive guides, selective guides, and evaluative guides. Comprehensive guides, such as "A-V Online" and *Bowker's Complete Video Guide,* help you identify the scope of possibilities. However, since they may include items of poor quality and difficult-to-locate titles, you should use these guides only to locate materials for preview. (*Always* preview materials before using them with your students.)

Selective guides, such as *Only the Best Computer Programs, Best Videos for Children and Young Adults,* and *The Elementary School Library Collection,* are a compilation of the "best" instructional materials. An advantage of these selective guides is that time has allowed the "best" to surface from a comparison of similar products on the market. A disadvantage is that during the time required for this process to take place, some items may have become outdated and newer items of good quality may not have been included.

Evaluative guides, such as *Booklist, School Library Journal, Choice,* and *Video Rating Guide,* are current and will keep you up to date about new materials. Although they are evaluative, they usually include just one person's opinion; that person's needs and audience may be different from yours.

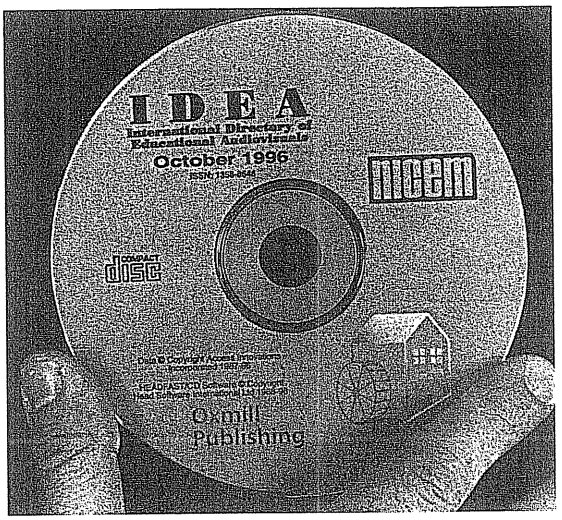
One of the more comprehensive sources is a set of two indexes published by NICEM (National Information Center for Educational Media): *Film & Video Finder* and *Audiocassette & Compact Disc Finder.* These do not include evaluations. "A-V Online" is a CD-ROM that lists thousands of educational, informational, and documentary materials along with their sources. The disc includes a variety of media formats, such as video, audio, film, filmstrips, slides, slide–tape programs, overhead transparencies, and multimedia kits (Figure 3.2).

In addition to materials themselves that are available on the Internet, listings appear there of materials available elsewhere. Many companies, government agencies, and commercial publishers list materials on the Internet. The majority of vendors now have their catalogs on their websites. Most of these materials are for purchase. Some are free and inexpensive. See Chapter 4 for guidelines about securing and using free and inexpensive materials.

If you are working in elementary or secondary education, you might consult several additional sources that cover a range of media formats, such as *Core Media Collection for Elementary Schools* and *Core Media Collection for Secondary Schools.* These books recommend specific audiovisual titles as core materials for elementary and secondary school media collections.

For general and adult audiences, a major guide is the *Reference List of Audiovisual Materials,* produced by the U.S. government. It describes all the training and educational materials produced by the armed forces and other government agencies that are available for general purchase. For additional information on this topic, go to the Web Links module in Chapter 3 of the Companion Website (http://www.prenhall.com/heinich).

FIGURE 3.2
"A-V Online" compact disc. The complete NICEM indexes are on a single compact disc.



Beyond the sources just described, there are more specialized guides and indexes that are limited to specific media formats or specific subjects. These are too many and too diverse to list here, but some are mentioned in the individual chapters dealing with different media formats, and others are gathered under the heading "Specialized Information Sources" on our Companion Website.

Selection Criteria. The decision about whether to use a particular piece of instructional material depends on several factors. Recent research confirms that certain criteria are critical in the appraisal of materials (McAlpine & Weston, 1994). Among the questions to be asked about each specific piece of media are the following:

- Does it match the curriculum?
- Is it accurate and current?
- Does it contain clear and concise language?
- Will it motivate and maintain interest?
- Does it provide for learner participation?
- Is it of good technical quality?
- Is there evidence of its effectiveness (e.g., field-test results)?
- Is it free from objectionable bias and advertising?
- Is a user guide or other documentation included?

Over the years, scholars have debated about what criteria should be applied in selecting materials. Studies have been conducted to quantify and validate various criteria. The net result is an understanding that different

criteria are suitable for different situations. For example, a remedial reading teacher might decide to use a particular computer program primarily because its vocabulary level is just right, regardless of any other qualities. On the other hand, an elementary school teacher with an ethnically diverse class might sort through materials to find those with a special sensitivity to racial and ethnic issues.

Other selection criteria vary with different media formats. Video materials, for example, raise the issue of the pace of presentation, whereas this would not be relevant for overhead transparencies. In examining computer-assisted instruction courseware, one would look for relevant practice and remedial feedback, but these would not be expected in a videotape. To account for these differences, this book provides a separate Appraisal Checklist for each media format. You will notice that certain criteria appear consistently in each checklist (they are the ones listed here). These are the criteria that we think have the securest basis in research and real-life experience. The Appraisal Checklists provide a systematic procedure for judging the qualities of specific materials. But it is up to you to decide which criteria are most important to you in your own instructional setting. The Appraisal Checklists are printed in the appropriate chapters and are available on our Companion Website (http://www.prenhall.com/heinich) and on the "Classroom Link Portfolio" CD-ROM.

The Instructor's Personal File. Every instructor should develop a file of media references and appraisals for personal use. An excellent way for you to begin is to develop your own personal file of Appraisal Checklists by using the "Classroom Link Portfolio" CD-ROM. Each type of Appraisal Checklist in this text has a computer template on the software into which you can enter your own information for future reference.

Modifying Existing Materials

If you cannot locate entirely suitable materials and media off the shelf, you might be able to modify what is available. This can be both challenging and creative. In terms of time and cost, it is a more efficient procedure than designing your own materials, although the type and extent of necessary modification will, of course, vary.

For example, perhaps the only available visual showing a piece of equipment being used in a middle school woodworking class is from a repair manual and contains too much detail and complex terminology. A possible solution to the problem would be to use the picture but modify the caption and simplify or omit some of the labels.

Or let's say there is just one video available that shows a needed visual sequence, but the audio portion of the video is inappropriate because it is at too high or too low a conceptual level or discusses inappropriate points. A simple solution in such a case would be to show the video with the sound turned off and provide the narration yourself. Another modification technique, which many instructors overlook, is to show just a portion of a video, stop the VCR, discuss what has been presented, then continue with another short segment followed by additional discussion. Modification also can be made in the audio portion of foreign-language materials or English-language materials used in a bilingual classroom. Narrations can be changed from one language to another or from a more advanced rendition of a foreign language to a simpler one.

Videocassette recorders provide teachers with the opportunity to modify television programs that previously were available only as shown on the air. You may also record programs off the air for replay later. You may then show them at whatever time best suits the instructional situation and to whatever student group(s) can profit most from viewing them.

One frequently modified media format is a set of slides with an audiotape. If the visuals are appropriate but the language is not, it is possible to change the language. It is also possible to change the emphasis of the narration. For example, an original audiotape might emphasize oceans as part of an ecosystem, whereas you may want to use the slides to show various types of fish found in oceans. By rewriting the narration, you could adapt the material to your purpose while using the same slides. Redoing the tape can also change the level of the presentation. A slide–tape presentation produced to introduce a new product could have three different audiotapes. One tape could be directed toward the customer, another could be prepared for the sales staff, and the third could be used for service personnel.

Some instructional games can be readily modified to meet particular instructional needs. It is possible to use a given game format and change the rules of play to increase or decrease the level of sophistication. Many instructional games require the players to answer questions. It is relatively easy to prepare a new set of questions at a different level of difficulty or even on a new topic.

If you try out modified materials while they are still in more or less rough form, you can then make further modifications in response to student reaction until your materials meet your exact needs.

A word of caution about modifying commercially produced materials (and, indeed, about using commercial products in general): be sure your handling and use of such materials does not violate copyright laws and restrictions. If in doubt, check with your school administration or legal adviser. Copyright concerns and guidelines are discussed in later chapters. The general guidelines are on page 87.

Designing New Materials

It is easier and less costly to use available materials, with or without modification, than to start from scratch. There is seldom justification for reinventing the wheel.

ASSURE BLUEPRINT

Middle School Mathematics

Select Methods, Media, and Materials

The teacher first selects a teaching method, followed by materials and equipment that are available at the school. She also modifies and develops other materials. The method she chooses to use is large-group instruction with small groups.

- *Overhead Projector.* The teacher needs to show the class some graphs. She selects the overhead projector to introduce the lesson topic. She will use transparencies with different types of graphs (bar, line, and circle) to review the concept of graphs with students. The overhead projector is available in the classroom, transparencies are easy to prepare, and they may be reused throughout the course of the lesson.
- *iMac Computers.* The school has both PC and *iMac* computers. The teacher needed to choose between the two. Because she was not familiar with the *iMac* computer, she evaluated it using the "Appraisal Checklist: Computer Hardware," in Appendix B. She also considered the software that is available for each computer system. She selected the *iMac* because it was available to use during her class time and her selected software, *AppleWorks,* would run on it.
- *AppleWorks*. The teacher is familiar with several software packages containing graphing capabilities. She talked with other teachers to get their input regarding a program suitable for her activity. *AppleWorks* was recommended by two of her colleagues. Consequently, she obtained *AppleWorks* installed on an *iMac* from the Instructional Materials Center. She evaluated it using the "Appraisal Checklist: Computer Software" in Chapter 9. This particular software package meets all the activity needs, whereas others do not have specific necessary features (e.g., pie graphing capability).
- *Video Camera and Tape Recorder.* The teacher has observed that the students enjoy watching/listening to videotapes and audiotapes of their work. They provide a motivational aspect to the assignment. She believes that this assignment lends itself nicely to this application. The video camera and tape recorder were selected to satisfy the objectives and assignment requirements. Additionally, the teacher likes to use the tapes to assist her in evaluating the students and for the students to evaluate themselves.
- *Data Projector.* The teacher needs a way to show students how to make graphs on the computer. In addition, the students need to present their computer-generated graphs. The teacher could make handouts, use an opaque projector to show handouts, or use a document camera. The teacher selected the use of the data projector because the cost of producing about a hundred handouts would be expensive, and using an opaque projector would require a darkened room when the students need to operate computers, whereas all the information could be effectively presented using a data projector.
- *Flip Chart.* The teacher plans to design graphs to present to the class. The graphs will contain titles and labeled axes. In addition, they must be easy to read. She can use the *iMac* and *AppleWorks* to create graphs for the flip chart. She chooses a flip chart with laminated pages so that the students can write on the pages; their marks can be erased and the flip chart pages reused. The flip chart will also provide a change of pace from the overhead projector.
- *Handouts.* Using the *iMac* and *AppleWorks,* the teacher will create a set of handouts that coincide with the flip chart graphs. The instructor chooses to create a set of handouts so that each student will have a set of graphs on which to record notes for future reference. In addition, the handouts will keep all the students involved during the learning activity.

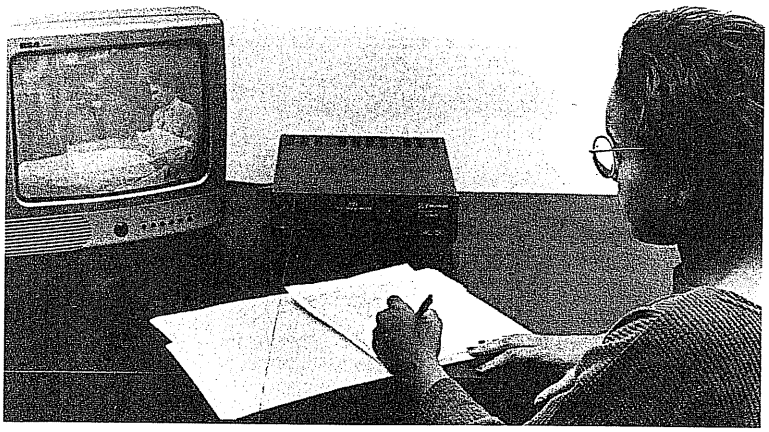
This Blueprint was developed by Mary Ann Ferkis, Purdue University. All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

However, there may be times when your only recourse is to design your own materials. As is the case with selecting from available materials, you must consider certain basic elements when designing new materials:

- *Objectives.* What do you want your students to learn?
- *Audience.* What are the characteristics of your learners? Do they have the prerequisite knowledge and skills to use or learn from the materials?
- *Cost.* Is sufficient money available in your budget to meet the cost of supplies (videotapes, audiotapes, etc.) you will need to prepare the materials?
- *Technical Expertise.* Do you have the necessary expertise to design and produce the kind of materials you wish to use? If not, will the necessary technical assistance be available to you? Try to keep your design within the range of your own capabilities. Don't waste time and money trying to produce slick professional materials when simple inexpensive products will get the job done.
- *Equipment.* Do you have the necessary equipment to produce or use the materials you intend to design?
- *Facilities.* If your design calls for use of special facilities for preparation or use of your materials, are such facilities available?
- *Time.* Can you afford to spend whatever time necessary to design and produce the kind of materials you have in mind?

(See ASSURE Blueprint for Select Methods, Media, and Materials, above.)

FIGURE 3.3
Preview the materials.



UTILIZE MEDIA AND MATERIALS

The next step in the ASSURE model is the use of media and materials by the students and teacher. The recommended utilization procedures are based on extensive research. The general principles have remained remarkably constant. The main difference has to do with who is using the materials. The increased availability of media and the philosophical shift from teacher-centered to student-centered learning increases the likelihood that students will be using the materials themselves—as individuals or in small groups—rather than watching as the teacher presents them to a whole class.

The following "5 Ps" apply to either teacher-based or student-centered instruction.

Preview the Materials

You should never use instructional materials without previewing them first. During the selection process you should determine that the materials are appropriate for your audience and objectives. Published reviews, distributor's blurbs, and colleagues' appraisals contribute information about the material; however, you should *insist* on previewing the materials yourself. Only a thorough understanding of the contents will enable you to use the media and materials to their full potential (Figure 3.3).

A recent incident in a Florida high school underscores the importance of previewing materials. A teacher with 32 years of experience showed the videotape *I Spit On Your Grave* to his advanced-placement social studies students. Students, parents, and school administrators were outraged by the sexually explicit content of the video. When questioned about the showing, the teacher said he was unaware that the video contained scenes of a woman being gang-raped and beaten. Obviously, he had not previewed the video!

In other cases, sensitive content may need to be eliminated or at least discussed prior to showing the materials to prevent student embarrassment or upset. In one case, an elementary teacher and her young students were horrified to find that an unpreviewed and ostensibly unobjectionable film on Canada's fur seals contained a sequence showing baby seals being cold-bloodedly clubbed to death by hunters.

If you do feel that some sensitive material fits with your objectives, then a letter home is in order. By letting parents know about the material in advance you may avoid potential problems. Also, encourage parents to visit with you and discuss the material, or even arrange a special viewing.

Prepare the Materials

Next, you need to prepare the media and materials to support the instructional activities you plan to use. This is true whether you are presenting the materials or your students are using them. The first step is to gather all the materials and equipment that you and the students will need. Determine in what sequence you will use the materials and media. What will you do with them as the presenter? What will the students do as learners? Some teachers keep a list of the materials and equipment needed for each lesson and an outline of the presentation sequence of the activities.

For a teacher-based lesson, you may want to practice using the materials and equipment. For a student-centered lesson, it is important that students have access to all the materials, media, and equipment that they will need. The teacher's role becomes one of facilitator. You should anticipate what materials students will need and be prepared to secure any necessary additional materials.

Prepare the Environment

Wherever the learning is to take place—in the classroom, in a laboratory, at the media center, on the ath-

letic field—the facilities will have to be arranged for proper student use of the materials and media. Certain factors are often taken for granted for any instructional situation—comfortable seating, adequate ventilation, climate control, suitable lighting, and the like. Some media require a darkened room, a convenient power source, and access to light switches. You should check that the equipment is in working order whether it is to be used by you or by your students. Arrange the facilities so that all the students can see and hear properly (Figure 3.4). Arrange the seating so students can see each other if you want them to discuss a topic. (More specific information on audiovisual and computer setups appears in Chapter 9 and in Appendix B.)

Prepare the Learners

Research on learning tells us very clearly that what is learned from an activity depends highly on how learners are prepared for the lesson. We know that in show business entertainers are obsessed with having the audience properly warmed up. Preparing learners is just as important when you are providing a learning experience (Figure 3.5).

A proper warmup, from an instructional point of view, may be similar to one of the following:

- An introduction giving a broad overview of the content of the lesson
- A rationale telling how it relates to the topic being studied
- A motivating statement that creates a need to know by telling learners how they will profit from paying attention
- Cues directing attention to specific aspects of the lesson

Several of these functions—directing attention, increasing motivation, providing a rationale—apply whether the lesson is teacher based or student centered.

In some cases you may want to inform students of the objectives. In certain cases, other steps will be needed. For example, you may need to introduce unfamiliar vocabulary or explain special visual effects, such as time-lapse photography. Other preparation steps relevant to particular media will be discussed in later chapters.

Provide the Learning Experience

Now you are ready to provide the instructional experience. If the materials are teacher based, you should present like a professional. One term for this is **showmanship** (see "AV Showmanship: Classroom Presentation Skills"). Just as an actor or actress must control the attention of an audience, so must an instructor be able to direct attention in the classroom. Later chapters describe showmanship techniques relevant to each specific media format (Figure 3.6).

FIGURE 3.4
Prepare the environment.

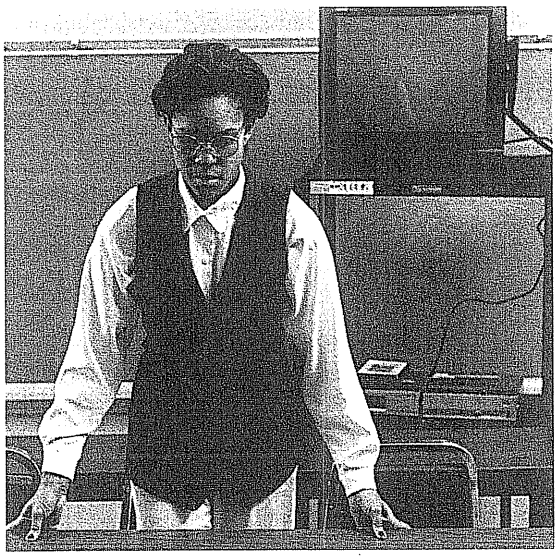


FIGURE 3.5
Prepare the learners.

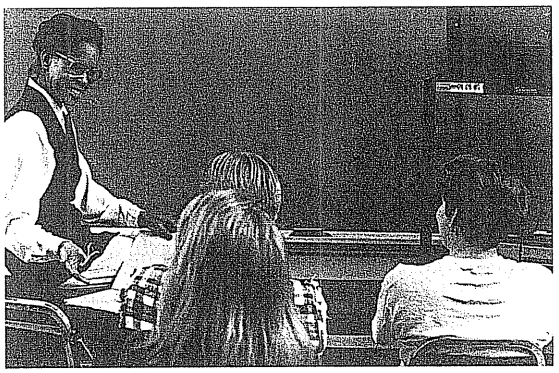
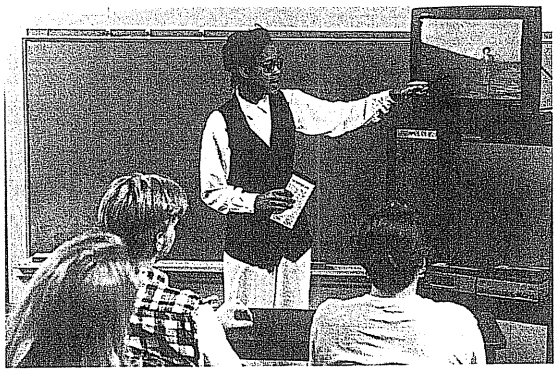


FIGURE 3.6
Provide the learning experience.



AV SHOWMANSHIP Classroom Presentation Skills

GETTING READY

Planning

An effective presentation begins with careful and thorough planning. These guidelines apply to classroom instruction as well as to more formal presentations.

1. *Analyze your learners.* What are their needs, values, backgrounds, knowledge levels, and misconceptions?
2. *Specify your objectives.* What should students do? How much time do you have to present? Limit your objectives and content to the time available.
3. *Specify benefits and rationale for the learners.* Why is the message important for them? If you cannot answer this question, perhaps you should not give the presentation.
4. *Identify the key points to cover.* Brainstorm the main ideas. Put them on note cards or stick-on notes. Most presentations will have from five to nine main points.
5. *Identify the subpoints and supporting details.* Again use note cards or stick-on notes. Try to limit yourself to five to nine subpoints for each main point.
6. *Organize the entire presentation in a logical and sequential order.* One organizing strategy is this:

Preview/Overview:	Tell them what you are going to tell them.
Present:	Tell them.
Review:	Tell them what you told them.

Rehearsing

1. Use keyword notes, not a script. Print keywords on an index card. Never read from a script; written language is different from spoken language.
2. Mentally run through the presentation to review each idea in sequence.
3. Do a standup rehearsal of your presentation. Try to practice in the room where you will be presenting or one similar to it.
4. Give a simulated presentation, idea for idea (not word for word), using all media. (Note: This is not usually done for classes but for formal presentations.)
5. Practice answers to questions you anticipate from learners.
6. Videotape (or audiotape) yourself or have a colleague sit in on your rehearsal and give you feedback.

Setting Up

1. Check your equipment in advance of your presentation. Change the arrangements, if necessary, to meet your needs. When the equipment is in place, make sure everything operates properly.
2. For slides and video projection, place the screen front and center (Figure A).
3. Place the overhead projector screen or flip chart at a 45-degree angle and near the corner of the room. Place the overhead screen to your right if you are right handed. Place flip chart to your left if you are right handed. Each should be reversed if you are left handed (Figure B).
4. Position objects being studied in the front and center. Remove them when they are no longer being studied.

PRESENTING

Anxiety

1. Nervousness and excitement are normal before and during a presentation. Some anxiety and concern are important for an enthusiastic and dynamic presentation.
2. Proper planning and preparation should reduce your anxiety.
3. Harness your nervous energy and use it positively with body movement, supporting gestures, and voice projection.
4. Breathe slowly and deeply. Your cardiovascular system will slow down and ease the symptoms of anxiety.

Delivery

1. Stand up when presenting. When you stand, you and your message command more attention.
2. Face the learners. Place your feet 10 to 12 inches apart and distribute your weight equally on both feet. Your knees should be unlocked, with hands out of your pockets and

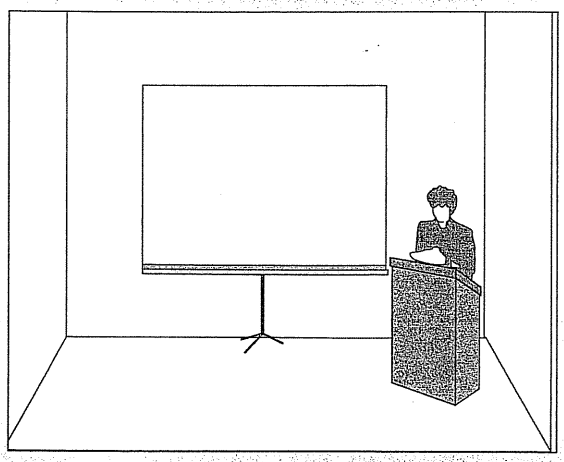


Figure A

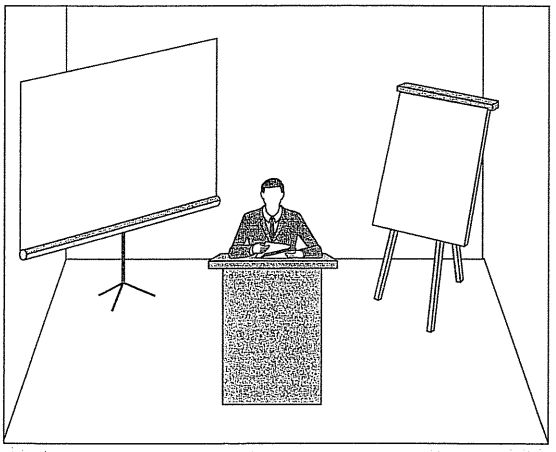


Figure B

arms at your side. Facing the learners gives you eye contact with them and allows them to see your facial expressions.
3. When using chalkboards or wall charts, don't talk with your back to the learners. In this position you lose eye contact and may not be heard as well. Write on the chalkboard, then talk (Figure C).
4. Stand to one side of the lectern (if you must use one). Stepping to the side or in front of it places you on more personal terms with the learners. It allows you to be seen and to be more natural.
5. Move while you speak. Instructors who stand in one spot and never gesture experience tension. Move and gesture, but don't overdo it.

Voice

1. Use a natural, conversational style. Relate to your learners in a direct and personal manner.
2. Don't read your presentation. Don't read from your overheads or handouts. If part of your presentation is just information transfer, give the students a copy and let them read it.
3. Use vocal variety. A monotone is usually caused by anxiety (rehearsal should help this). Relax with upper and lower body movements.
4. Use a comfortable pace. When you are anxious, your rate of speaking usually increases. Relax and speak in a conversational tone.
5. Speak up so you can be heard in the back of the room. If you speak up, your rate will slow down—solving two problems! Ask people in the back row if your volume is appropriate.
6. A pause (silence) after a key point is an excellent way to emphasize it. The more important the idea, the more important it is for you to pause and let the words sink in before going on to the next idea.

Eye Contact

1. Don't speak until you have established eye contact with your audience. Eye contact will make your presentation similar to a one-on-one conversation.

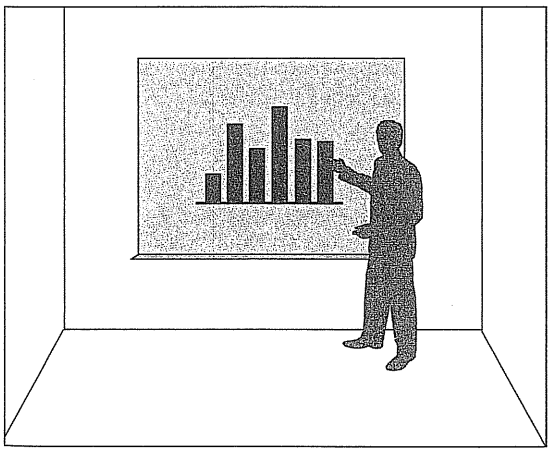


Figure C

2. An excellent way to keep your learners' attention is to look eye to eye at each person for at least three seconds. Don't quickly scan the learners or look at the back wall, screen, or notes for long periods of time.
3. Maintain eye contact with your learners. If you must write something on a flip chart, overhead, or chalkboard, stop talking while you write.

Gestures

1. Use natural gestures. Learn to gesture in front of a class as you would if you were having an animated conversation with a friend.
2. Don't put your hands in your pockets. Don't clasp your hands behind your back. Don't wring your hands nervously. Don't play with a pen or other object.

Visuals

1. Visuals help to attract and hold learners' interest. People like to see keywords, diagrams, and drawings.
2. Reinforce and clarify verbal concepts with visuals. A picture is worth a thousand words.
3. Make key points memorable, and help the listener remember your message. Most people remember visuals longer than they remember words and numbers.
4. Visuals lose their effectiveness if overused. A guideline is to use about one visual per minute.
5. In designing visuals:
   - Use headlines only.
   - Eliminate unnecessary words.
   - Write large so words can be read from the back of the room.
   - Use drawings and diagrams whenever possible.
   - Limit to 36 words per visual (6 lines of 6 words each).
6. After using visuals, redirect learners' attention back to you:
   - Shut off the overhead projector when there is a lengthy explanation and there is no need for the audience to see the transparency. Don't turn the machine off and on so frequently that it becomes distracting (30 seconds is a guideline).
   - Turn a flip chart page to a blank one when you are finished referring to it. If the flip chart pages have been prepared in advance, leave blank pages between each prepared sheet so the next prepared page will not show through.
   - Erase any writing on the chalkboard or whiteboard when you no longer need it.
   - Break up slide presentations by inserting a black or translucent slide at points where an explanation is needed or where questions will be asked or answered.
   - Show or demonstrate an object by revealing it when needed and covering it when it is no longer in use. Otherwise, your audience will look at the object and be distracted from your presentation. Avoid passing an object around the audience. Instead, walk around the audience and show the object to everyone briefly and make it available at the end of the presentation.

ASSURE BLUEPRINT

Middle School Mathematics

Utilize Media and Materials

Preview the Materials

The teacher previews *Microsoft Works, Cricketgraph, AppleWorks,* and some student-produced videotapes.

Prepare the Materials

The teacher makes a set of note cards outlining her lesson. In addition, she prepares the handouts and graphs on flip chart pages using *AppleWorks* and the *iMac.* She also prepares transparencies for use with the overhead projector.

Prepare the Environment

Because the primary portion of the lesson is small-group work, the teacher arranges the student desks in the classroom to form table areas. This will prepare the students for the group work when they come into the room so the lesson will not need to be interrupted. Some of the lesson takes place in the computer lab. Because this activity takes several days to complete, each day may require specific equipment setups. Generally, the overhead projector and flip chart are used for introductory purposes only. The next phase requires the use of a computer lab to teach the students how to use *AppleWorks.* Additionally, an overhead projector, data projector, and demonstration computer will also need to be set up. The regular classroom will be utilized for the students to conduct their small-group planning and for student presentations. There must be an overhead projector, a data projector, and a computer to view student work. In addition, the students will use a VCR with a monitor to play back their tapes for the class. After setting up the equipment, the teacher will also check that it is all in working order.

Prepare the Learners

To prepare the students, the teacher presents the overall plan and objectives for the lesson. Each student receives a handout describing the small-group activity. In addition, the evaluation procedures are given to each student. The teacher presents important aspects of the requirements and evaluation standards using the overhead projector.

Provide the Learning Experience

During the introductory phases of this lesson, the teacher presents materials using the overhead projector, a data projector, computer, flip chart, and VCR. General showmanship techniques and those specific to each of these media are followed:

- *General Techniques.* The only place in the classroom with a screen is front and center. It is used for the overhead projector. When presenting information on the flip chart, the teacher places the chart in the front and to the left of center, since she is right handed. The VCR and monitor are located to the right of the screen.
- *Overhead Projector.* Use an outline to introduce and summarize the material. Turn off the projector when not referring to what is on it. Place notes for each transparency on its frame or cover sheet. Use a pencil as a pointer. Mask unwanted information.
- *Flip Chart.* Use lettering and figures large enough for all to see. Face the class when speaking. Stand out of the students' line of vision. Secure all pages firmly to the flip chart. Provide summary sheets at the end instead of flipping back through the pages.
- *Video.* Check lighting, seating, and volume. List on chalkboard the main points to be covered. Preview new vocabulary. Be a good role model—watch the program yourself. Provide appropriate followup activities and discussion.

This Blueprint was developed by Mary Ann Ferkis, Purdue University. All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

If the experience is student centered, you must play the role of guide or facilitator, helping students to explore the topic on the Internet, discuss the content, prepare materials for a portfolio, or present information to their classmates. Guidelines in some of the following chapters will assist students in the production of mediated materials. (See ASSURE Blueprint for Utilize Media and Materials, above.)

REQUIRE LEARNER PARTICIPATION

Educators have long realized that active participation in the learning process enhances learning. In the early 1900s John Dewey urged reorganization of the curriculum and instruction to make student participation central. Later, in the 1950s and 1960s, experiments employing behaviorist approaches demonstrated that instruction providing for constant reinforcement of desired behaviors is more effective than instruction in which responses are not reinforced.

More recently, cognitive theories of learning, which focus on internal mental processes, have also supported the principle that effective learning demands active manipulation of information by learners. Gagné has concluded that there are several necessary conditions for effective learning of each type of objective; the one condition that pertains to all objectives is practice of the desired skill (Gagné, 1985) (Figure 3.7).

The behaviorist perspective proposes that individuals learn what they *do*—that is, learning is a process of try-



FIGURE 3.7
Practicing a desired skill promotes the effectiveness of the learning experience.

ing various behaviors and keeping those that lead to favorable results. If this is so, the instructional designer must find ways to constantly keep the learner *doing* something. Cognitivists propose that learners build up and enrich their mental schemata when their minds are actively engaged in struggling to remember or apply some new concept or principle. The constructivist, like the behaviorist, views learning as an active process. But the emphasis is on active *mental* processing, not physical activity. Knowledge is built on the basis of experience. Student autonomy and initiative are stressed within the context of relevant authentic experiences. The sociopsychological perspective stresses the importance of interpersonal communication as the social basis for knowledge acquisition.

All perspectives also emphasize the importance of **feedback** (productive critical evaluative response):

- Behaviorists, because knowledge of correct response serves as a reinforcer of appropriate behaviors
- Cognitivists, because information about results helps to enrich learners' mental schemata
- Constructivists, because meaning (and knowledge) is enhanced with each personal experience
- Social psychologists, because interpersonal feedback provides both corrective information and emotional support

Feedback can come from oneself (e.g., experiencing the "feel" of swinging a golf club), from print sources (e.g., turning to the back of the book to find the correct answer to a practice exercise), from a device (e.g., the computer gives a corrective statement after you choose an answer to a multiple-choice question), or from other people (e.g., another member of your group agrees with your solution to a problem). Research indicates that the most powerful is interpersonal feedback because face-to-face reactions are more vivid than printed or graphic information, such reactions are more personalized (giving specific performance correction), and group discussion can continue as long as necessary (Johnson & Johnson, 1993).

The implication for designers and instructors is clear. The most effective learning situations are those that require learners to **practice** skills that build toward the objective. The form of the participation may include practicing new spelling or vocabulary words, solving math problems on a worksheet, rehearsing a basketball play, or creating an original product, such as a term paper. Responses may be either observable or unobservable. An example of an observable performance is manipulation of task cards illustrating the stages of mitosis. An unobservable performance is silent repetition of phrases heard on a French language tape.

In all cases, learners should receive feedback on the correctness of their response. The feedback may come from the teacher, or students may work in small groups and give one another feedback. Feedback may also be achieved through a self-check activity or may come from a computer or mentor. Regardless of the source, the important thing is that students receive helpful feedback (Figure 3.8).

Some media formats lend themselves to participation more than others, at least on the surface. For example, student response to projected still pictures is easier to manage than response to a video. Learners can participate in and respond to the showing of a video. Overt written responses during the showing of a video have been shown to facilitate learning, unless the responses are so involved that students are prevented from watching the video.

Immediate confirmation of a correct response is particularly important when working with students of lower-than-average abilities. For such students, evidence of immediate success can be a strong motivating force for further learning.

Discussions, short quizzes, and application exercises can provide opportunities for practice and feedback during

FIGURE 3.8
Feedback from the learners informs the instructor how they respond to the message.



instruction. Followup activities can provide further opportunities. Teacher guides and manuals written to accompany instructional materials often suggest techniques and activities for eliciting and reinforcing student responses.

Research on the internationally renowned television series *Sesame Street* and *Electric Company* demonstrates impressively the importance of following up a media presentation with practice activities. Research on *Sesame Street* showed that frequent viewers not only learned the specific skills presented but also had higher scores on a test of verbal IQ and more positive attitudes about school. Johnston (1987) pointed out, though, that "parental encouragement and supplementary materials were essential to achieving the effects observed" (p. 44). In the case of *Electric Company,* children with low reading ability who watched the programs in school under teacher supervision showed significant reading improvement. Johnston concluded that "learning definitely did occur when viewing was insured, and when teachers supplied additional learning materials and helped the children to rehearse the materials presented on television" (Johnston, 1987, p. 44). (See ASSURE Blueprint for Require Learner Participation, page 75.)

EVALUATE AND REVISE

The final component of the ASSURE model for effective learning is evaluation and revision. Often the most frequently misused aspect of lesson design, evaluation and revision is an essential component to the development of quality instruction. There are many purposes for evaluation. Often the only form seen in education is the paper-and-pencil test, claimed to be used for assessment of student achievement. We will discuss two purposes here: assessing learner achievement and evaluating methods and media.

Although ultimate evaluation must await completion of the instructional unit, evaluation is ongoing. Evaluations are made before, during, and after instruction; for example, before instruction, you would measure learner characteristics to ensure that there is a fit between existing student skills and the methods and materials you intend to use. In addition, materials should be appraised prior to use. During instruction, evaluation may take the form of student practice with feedback, or it may consist of a short quiz or self-evaluation. Evaluation during instruction usually has a diagnostic purpose; that is, it is designed to detect and correct learning/teaching problems and difficulties with the instruction that may interfere with student achievement.

Evaluation is not the end of instruction. It is the starting point of the next and continuing cycle in our systematic ASSURE model for effective use of instructional media. (For a comprehensive general discussion of evaluation and assessment, see the Stiggins reference in this chapter's Suggested Readings.)

Assessment of Learner Achievement

The ultimate question regarding instruction is whether students have learned what they were supposed to learn. Can they display the capabilities specified in the original statement of objectives? The first step in answering this question was taken near the beginning of the ASSURE model, when you formulated your objectives, including a criterion of acceptable performance. When developing assessment tasks, start with your objective and design an activity, which calls for the behavior, stated in the objective. The objective's statement of acceptable perform-

ASSURE BLUEPRINT

Middle School Mathematics

Require Learner Participation

Large-Group Activities

As a review, introduction, and practice exercise, each student in the class reads and interprets a graph (bar, line, or circle) presented to him/her on the flip chart. Each student writes his/her findings directly on the laminated flip chart page. Using this method the teacher provides practice with feedback to each individual in the class. During the "mini-presentations" the class has handouts that include the same graphs as the flip chart. This enables them to have a record of the exercises for future reference. In addition, it involves the entire class in the learning. The students learn how to utilize the computer lab to practice construction and produce printouts of graphs (bar, line, circle, and others if appropriate) with *AppleWorks*.

Small-Group Activities

Following the large-group activity, the students participate in a small-group activity. Assignments require the students to collect, interpret, and present basic data. Initially, the groups work together to propose, discuss, and agree on a topic for a group presentation. The presentation topic must incorporate data collection techniques (survey, observation, and/or interview) and the use of graphs to present numerical information.

The students collect data in their school for a small-group presentation. The groups choose whether to collect their data through surveys, observations, or personal interviews. Each group uses *AppleWorks* to write and produce a written report regarding the data collection techniques associated with the topic of their presentation.

Survey

The small groups choosing to conduct a survey could use *AppleWorks* to create and write their survey. The group must submit an audiotape of each member administering the survey to a group or individual.

Observation

The small groups electing to use observation techniques use *AppleWorks* to create and write an observation sheet to use when they make their observations. The group must submit a videotape of each member conducting an observation.

Personal Interview

The small groups choosing to conduct personal interviews use *AppleWorks* to create and write an interview form to use when they conduct their interviews. The groups must also submit a videotape or an audiotape of each member conducting an interview.

In each case the school media specialist arranges time in the library or in another classroom to help the groups with the audiotapes and videotapes. During the group presentations, the teacher provides the equipment necessary to play back each group's audio- and videotapes.

Reporters from each group present their data on a chart or a graph. The students must accurately construct and produce a printout of a graph (bar, line, or circle) using *AppleWorks*. During the group presentations, the teacher prepares the equipment necessary to view each group's graphs using a data projector. The groups are required to accurately read, interpret, and verbally present all the statistical information shown on their graphs.

This Blueprint was developed by Mary Ann Ferkis, Purdue University. All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

ance will help you develop the criteria for evaluating the individual student or group's performance. If the objective lends itself only to paper-and-pencil evaluation of facts and information, perhaps you need to rewrite it.

The method of assessing achievement depends on the nature of the objective. Some objectives call for relatively simple cognitive skills—for example, recalling Ohm's law, distinguishing adjectives from adverbs, describing a company's absence policy, or summarizing the principles of the Declaration of Independence. Objectives such as these lend themselves to conventional written tests or oral examinations. Other objectives may call for process-type behaviors (e.g., conducting an orchestra, performing a forward roll on a balance beam, operating a metal lathe, or solving quadratic equations), the creation of products (e.g., a sculpture, a written composition, a window display, an account ledger, or a portfolio), or an exhibit of attitudes (e.g., tolerating divergent opinions, appreciating expressionist painting, observing safety procedures on the assembly line, or contributing to community charities).

The assessment procedures should correspond to the objectives stated earlier in the ASSURE model. For example, assume the objective is "Given a diagram of the human trachea, the student nurse will explain a bronchocele, describing the usual cause and the recommended treatment." A possible test question would be "What is a bronchocele? Describe the cause and treatment in your answer."

Assume students are learning to use Boolean logic in their Web searches. The objective might be "Using the *Yahooligans* search engine on the Internet, the middle school students will locate four references that include two key words provided by the teacher." The assessment could be "What are four references that discuss 'spiders' and 'poisonous?'" The teacher could provide different key words to each student.

For military training, an objective could be, "With the aid of a topographic map, the officer will call for field artillery fire using the four essential items of information in prescribed military sequence." An oral test

could ask, "Tell me how you would call for artillery fire on point X on the accompanying topographic map."

In schools, rising interest in **authentic assessment** is driven by commitment to competency-based instruction and to constructivist pedagogy. Authentic assessment is usually performance based and requires students to demonstrate what they have learned in a natural context, as opposed to just taking standardized paper-and-pencil tests. Some states have instituted more authentic forms of assessment in their state examination systems; some individual schools have experimented with such means as portfolio assessment (see Chapter 1). Schools and school systems are responding differently to this trend. Although authentic assessment strategies are still far from being the norm, they are increasing in popularity and use.

In educational settings, assessment is often used to measure student learning, to inform students and their parents/guardians of student progress, and to give grades. Authentic assessment is assessment of skills required in the "real world." How many people take paper-and-pencil tests as a part of their occupation? Authentic assessment focuses on the demonstration of mastery and the ability to transfer new knowledge and skills to different situations. Authentic assessment provides students opportunities to display knowledge and skills in a realistic situation, which accurately model the discipline. It is the difference between learning science facts and doing what scientists do.

The authentic assessment task should use processes (psychomotor and/or mental) appropriate to the content and skills being learned. The assessment task should represent the way the discipline is used in the real world. Media and technology can be used as part of authentic assessment, such as producing video productions and developing slide and audiotape presentations and computer-generated reports.

Authentic assessment tasks usually have the following characteristics:

- Have more than one correct approach
- Are thought provoking, not simply requiring recall of memorized facts
- Require decision making, rather than just rote memorization
- Develop thinking in a variety of ways
- Lead to other problems to be solved
- Raise other questions

Types of authentic assessments include the following:

- Student projects such as writing assignments, science projects, and posters
- Performances such as giving speeches, or demonstrating gymnastics or self-defense
- Oral questioning by both teachers and other students
- Discussions of controversial topics and current events
- Portfolios, including examples of student work with summaries and reflections

FIGURE 3.9
A performance-type skill should be judged by observation.



This trend toward more authentic assessment is important because assessment has long been understood to be the driving force for the rest of the instructional system, including media, methods, and technology. Authentic assessment focuses on demonstration of mastery and the ability to transfer new knowledge to new situations. This has led to the development of portfolio assessment, which has fueled interest in student production of media, including the compilation of electronic portfolios.

Capabilities of the process, product, or attitude type could be assessed to some extent by means of written or oral tests. But such test results would be indirect and weak evidence of how well learners have mastered the objectives. More direct and stronger evidence would be provided by observing the behavior in action. This implies setting up a situation in which learners can demonstrate the new skill and the instructor can observe and judge it (Figure 3.9).

In the case of process skills, a performance checklist can be an effective, objective way of recording your observations, as shown with the checklist for driving skills (Figure 3.10). Other types of activities that can be properly assessed through performance checklists are sales techniques, telephone-answering skills, and face-to-face customer relations. During instruction these types of activities may need to be evaluated in a simulated situation, with other learners or with the instructor role playing the customer or client.

Attitudes are admittedly difficult to assess. For some attitudinal objectives, long-term observation may be required to determine whether the goal has really been attained. In day-to-day instruction we usually have to rely on what we can observe here and now, however limited that may be. A commonly used technique for making attitudes more visible is the attitude scale (an example regarding biology is shown in Figure 3.11). A number of other suggestions for attitude measurement can be found in Robert Mager's *Developing Attitude Toward Learning* (see this chapter's Suggested Readings).

FIGURE 3.10
A sample performance checklist.

Performance Checklist: Driving Skills

Name _____ Class _____

Check yes or no with an X in the appropriate column.

Did the Student	Yes	No
1. Fasten seat belt before starting car?	___	___
2. Use the ten o'clock and two o'clock hand position on steering wheel?	___	___
3. Drive with the flow of traffic yet stay within the speed limit?	___	___
4. Come to full and complete stops at stop signs?	___	___
5. Keep at least a three-second interval behind the vehicle ahead?	___	___
6. Stay in the proper driving lane—not cross center line?	___	___
7. Obey all traffic signs and signals?	___	___
8. Negotiate all turns properly (according to driving manual)?	___	___
9. Avoid excessive conversation with passengers?	___	___
10. Display courtesy to other drivers?	___	___

Instructor's Name _____ Date _____

FIGURE 3.11
A sample attitude scale.

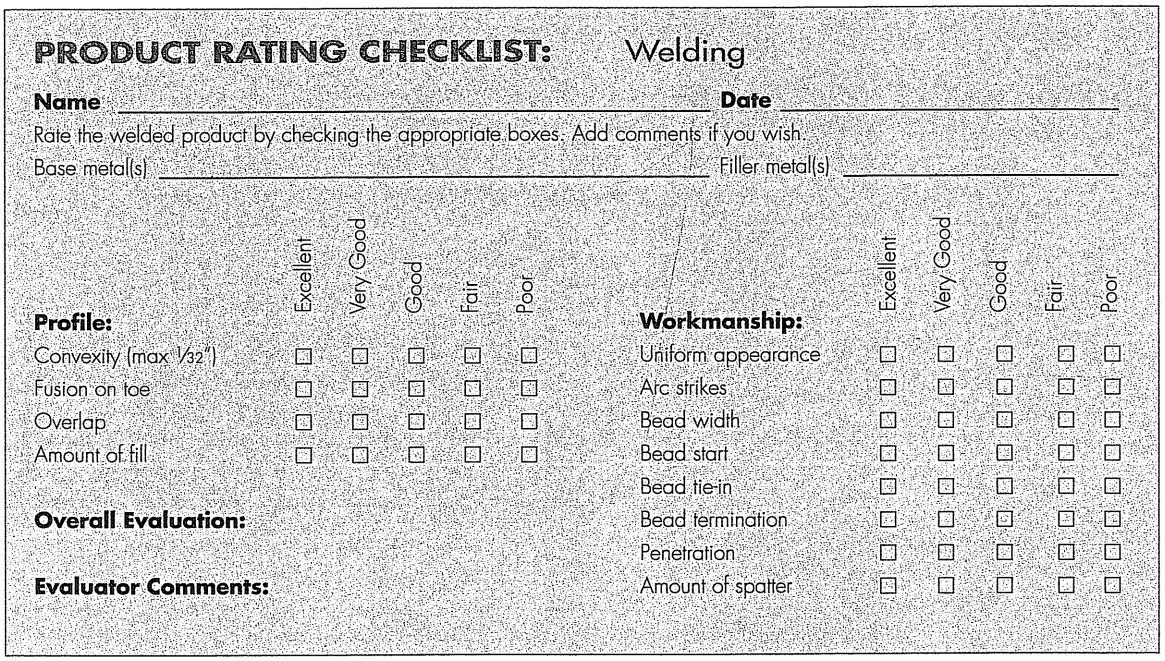
Attitude Scale: Biology

Each of the statements below expresses a feeling toward biology. Please rate each statement on the extent to which you agree. For each, you may (A) strongly agree, (B) agree, (C) be undecided, (D) disagree, or (E) strongly disagree.

A	B	C	D	E
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

___ 1. Biology is very interesting to me.
___ 2. I don't like biology, and it scares me to have to take it.
___ 3. I am always under a terrible strain in biology class.
___ 4. Biology is fascinating and fun.
___ 5. Learning biology makes me feel secure.
___ 6. Biology makes me feel uncomfortable, restless, irritable, and impatient.
___ 7. In general, I have a good feeling toward biology.
___ 8. When I hear the word *biology*, I have a feeling of dislike.
___ 9. I approach biology with a feeling of hesitation.
___ 10. I really like biology.
___ 11. I have always enjoyed studying biology in school.
___ 12. It makes me nervous to even think about doing a biology experiment.
___ 13. I feel at ease in biology and like it very much.
___ 14. I feel a definite positive response to biology; it's enjoyable.

FIGURE 3.12
A sample product rating checklist.



PRODUCT RATING CHECKLIST: Welding

Name _____ **Date** _____

Rate the welded product by checking the appropriate boxes. Add comments if you wish.

Base metal(s) _____ Filler metal(s) _____

Profile:	Excellent	Very Good	Good	Fair	Poor
Convexity (max 1/32")	☐	☐	☐	☐	☐
Fusion on toe	☐	☐	☐	☐	☐
Overlap	☐	☐	☐	☐	☐
Amount of fill	☐	☐	☐	☐	☐

Overall Evaluation:

Evaluator Comments:

Workmanship:	Excellent	Very Good	Good	Fair	Poor
Uniform appearance	☐	☐	☐	☐	☐
Arc strikes	☐	☐	☐	☐	☐
Bead width	☐	☐	☐	☐	☐
Bead start	☐	☐	☐	☐	☐
Bead tie-in	☐	☐	☐	☐	☐
Bead termination	☐	☐	☐	☐	☐
Penetration	☐	☐	☐	☐	☐
Amount of spatter	☐	☐	☐	☐	☐

For product skills, a product rating checklist can guide your evaluation of critical subskills and make qualitative judgments more objective, as in the accompanying example regarding welding (Figure 3.12). Other types of products that lend themselves to evaluation by a rating scale include pastry from a bakery, compositions in an English course, and computer programs.

Evaluation of Methods and Media

Evaluation also includes assessment of instructional methods and media. Were your instructional materials effective? Could they be improved? Were they cost effective in terms of student achievement? Did your presentation take more time than it was really worth? Particularly after first use, instructional materials need to be evaluated to determine whether future use, with or without modification, is warranted. The results of your evaluation should be entered on an Appraisal Checklist. Did the media assist the students in meeting the objectives? Were they effective in arousing student interest? Did they provide meaningful student participation?

You may solicit learner input on the effectiveness of specific media, such as a CD or videotape. You may design your own form or use one similar to the "Learner Reaction Form" shown in Figure 3.13.

Class discussions, individual interviews, and observation of student behavior should be used to evaluate instructional media and methods (Figure 3.14). Failure to attain objectives is, of course, a possible indication that something is wrong with the instruction. But analyzing student reaction to your instructional methods can be helpful in more subtle ways. Student–teacher discussion may indicate that your audience would have preferred independent study to your choice of group presentation. Or perhaps viewers didn't like your selection of overhead transparencies and feel they would have learned more if a videotape had been shown. Your students may let you know, subtly or not so subtly, that your own performance left something to be desired (Figure 3.15).

Conversations with the school media specialist concerning the value of specific media in an instructional unit will help to alert you both to the need for additional instructional materials to improve the lesson in the future.

Revision

The final step of the instructional cycle is to sit back and look at the results of your evaluation data gathering. Where are there discrepancies between what you

FIGURE 3.13
A sample learner reaction form.

Learner Reaction Form

User _____ Date _____

1. The objectives of this lesson were

Clear				**Unclear**
5	4	3	2	1

2. The learning activities were

Very interesting				**Dull**
5	4	3	2	1

3. The scope (coverage) was

Adequate				**Inadequate**
5	4	3	2	1

4. The lesson was

Difficult				**Easy**
5	4	3	2	1

5. Overall, I consider this lesson

Excellent				**Poor**
5	4	3	2	1

FIGURE 3.14
The ability to create a product should be evaluated by the quality of the product itself.



FIGURE 3.15
Analysis of student reactions to lessons is an integral part of the instructional process.



intended to happen and what did happen? Did student achievement fall short on one or more of the objectives? How did students react to your instructional methods and media? Are you satisfied with the value of the materials you selected? You should reflect on the lesson and each component of it. Make notes immediately following completion of the lesson, and refer to them before you implement the lesson again. If your evaluation data indicate shortcomings in any of these areas, now is the time to go back to the faulty

ASSURE BLUEPRINT

Middle School Mathematics

Evaluate and Revise

Assessment of Learner Achievement

The following rating form is used to evaluate students' knowledge of the "Information Statistics" unit. The form is designed for students to complete.

Collecting Data (20 points)

- Did each member of your group collect data at least once and record this on tape?
- Did your group create and write a data collection sheet (survey, observation, or interview)?
- Did your report accurately explain the steps taken to collect your data?
- Did your report state a sound rationale for choosing the specific collection technique?

Presenting the Data (20 points)

- Are your graphs easy to read?
- Do your graphs have appropriate titles?
- Are the components of your graphs labeled correctly?
- Did you provide a printout of your graphs?

Presentation Style (40 points)

- Did your group introduce your presentation topic and tell why you chose it?
- Did you explain your data collection method and give your rationale for its choice?
- Did you play back your data collection tape?
- Did you show your results in the form of graphs?
- Did your group leave time for questions?
- Did your group answer pertinent questions?

Interpretation (20 points)

- Did your group correctly read and interpret the graphs?
- Did your group explain all the statistical information shown on the graphs?

Evaluation of Media and Methods

To successfully evaluate the media and methods utilized, the teacher conducts debriefing activities after teaching the students how to make graphs and after the student presentations. In addition, she talks informally with students during the entire process.

The teacher conducts a debriefing immediately following the graph-making session. She addresses any issues that may have arisen during the instruction. Additionally, she provides time for the students to vent their frustrations and to share their excitement. Then, she reminds them of the purpose of the activity. She also invites comments that address the importance of learning how to make graphs using spreadsheet programs. Specific examples illustrating possible future uses for the skill are also discussed. The primary purpose of this debriefing session is to determine whether the students are comfortable making graphs using the computer.

The teacher conducts a second debriefing session after all the students have made their presentations. She specifically addresses each phase of the instruction: first, the review/introduction phase utilizing the mini-presentation with the flip chart; second, the graph-making session; third, the planning phase of the presentation; fourth, the use of the computer to develop reports; fifth, the student presentations. Student reaction to each of these phases is critical for possible revisions. In addition, evaluation techniques for learner achievement are discussed. To complete the debriefing exercise, the teacher asks students to write the purpose of the project. In addition, they are asked to write whether they liked the activities, and to state why or why not.

Evaluation of Overall Instruction

The students and teacher complete a teacher-developed form for an overall evaluation of learner achievement, media, and methods. The student average is compared with the teacher's *perceptions.* For items that appear discrepant, the teacher will address the need for revision in her choice of learning activities, media selections, methods, and evaluation materials.

This Blueprint was developed by Mary Ann Ferkis, Purdue University. All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

part of the plan and revise it. The model works, but only if you constantly use it to upgrade the quality of your instruction. (See ASSURE Blueprint for Evaluate and Revise, above.)

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 3 of the Companion Website (http://www.prenhall.com/heinich).

1. *Planning for Instruction.* Select a content area standard or topic you might like to teach. Use the Lesson Planning function on the "Classroom Link Portfolio" CD-ROM to create a lesson to address this topic and/or standard, addressing issues of diverse learners. (ISTE NETS-T II-A & C; III-A & B; VI-C & E)
2. *Written Reflection.* Briefly describe lesson planning using the ASSURE model. What do you see as the benefits and drawbacks of using this model? What works best for you? Why? (ISTE NETS-T II-B)

ASSURE BLUEPRINT

A Template for Planning

This is a description of the instructional situation.

Analyze Learners

General Characteristics

This is a description of the class as a whole (e.g., age, grade, etc.).

Entry Competencies

This is a description of the types of knowledge expected of the learners.

Learning Styles

This is a description of the learning stylistic preferences of individual members of the class.

State Objectives

Objectives are descriptions of the learning outcomes and are written using the ABCD format.

Select Methods, Media, and Materials

Include all the methods, media, and materials that are essential to the lesson.

Rationale

It is important to consider why certain media have been selected.

Evaluation of Commercial Materials

Appraisal Checklists are valuable when selecting commercial materials.

Utilize Materials

Preview Materials

It is essential to know the materials prior to teaching with them.

Prepare the Materials

Experience using the materials is important.

Prepare the Environment

Setting up the instructional environment helps to make the learning experience valuable.

Prepare the Learners

Knowing what is expected of them helps learners be involved in the learning.

Provide the Learning Experience

The actual presentation needs to be considered.

Require Learner Participation

A description of the activities designed to provide practice with feedback for the learners.

Evaluate and Revise

Assessment of Learner Achievement

How will the objectives be "tested"?

Evaluation of Instruction (including media and methods)

To ensure quality instruction, it is important to evaluate the experience for future planning.

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 3 of the Companion Website (http://www.prenhall.com/heinich).

1. Plan a presentation using the procedures described in this chapter. Your description must follow the "Assure Blueprint: A Template for Planning" in this chapter.
2. Write at least five objectives for a lesson you might teach. Choose a topic that allows you to write objectives in more than one domain.
3. Select a chapter from a textbook of interest to you and derive a set of at least five objectives that you feel the author intended.
4. Plan, prepare, and present a brief lesson incorporating two or more media. Have your audience (one person or more) give you feedback on your presentation skills.
5. Select a lesson you might teach, such as a chapter from a textbook, and develop a set of evaluation instruments (not necessarily all paper-and-pencil test items).
6. Locate a lesson plan on the Internet and evaluate it using the ASSURE model as a guideline.
7. Identify a group of learners (students or trainees) with which you are familiar. Describe the general characteristics and their specific entry competencies for a topic of your choice. Discuss their learning styles in terms of their

perceptual preferences/ strengths, information processing habits, motivational factors, and physiological factors.

8. Locate a set of objectives on the Internet, classify them, and critique them using the "Appraisal Checklist: Objectives" in this chapter.
9. Search the Internet and find some materials you could use in a lesson. Design a lesson around the materials using the "Classroom Link Portfolio" CD-ROM.
10. Locate a lesson, perhaps using the Internet, that does *not* provide learner practice and feedback. Design activities for that lesson that do provide practice and feedback.
11. Using the Internet, locate an article on authentic assessment or a constructivists view of student evaluation. Write a one- to two-page summary and one to two pages describing your reflection on or reaction to the article.

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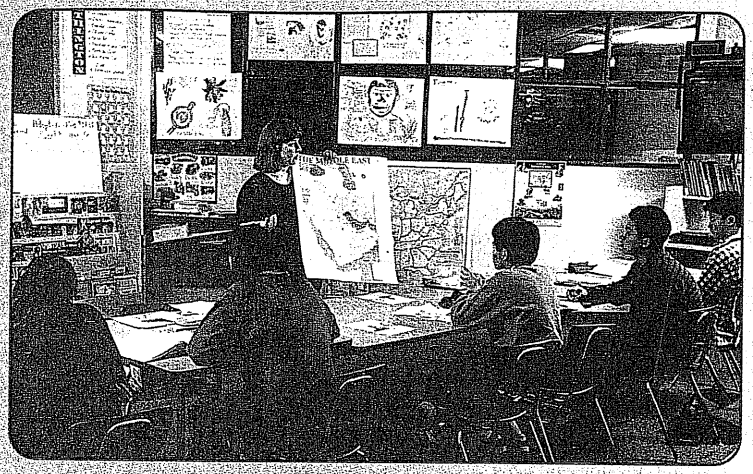
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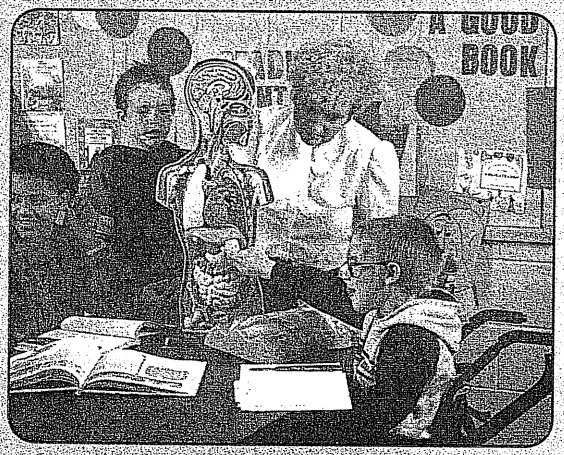
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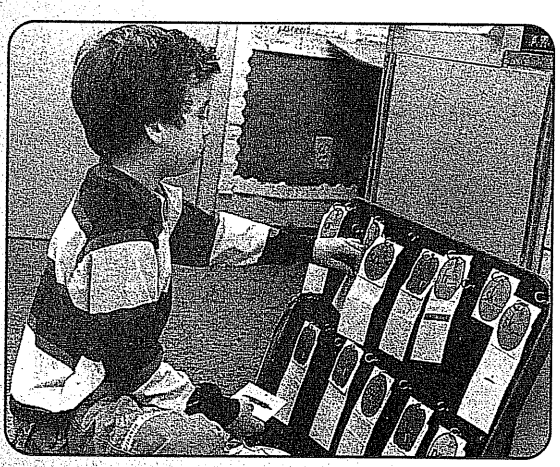
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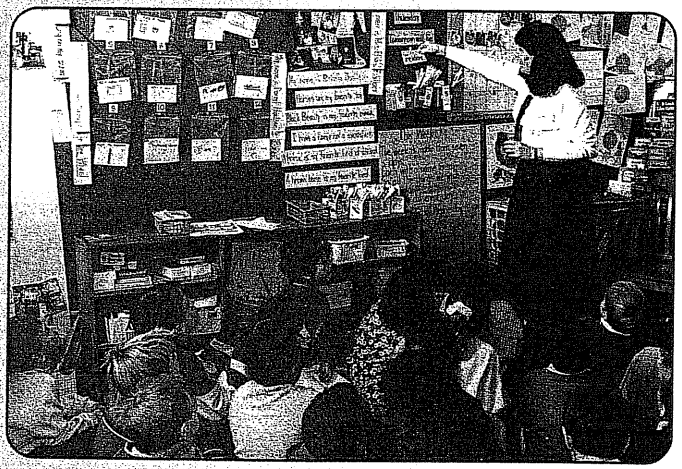


Not all media plug into an electrical outlet. A variety of media can make your instruction more realistic and engaging. Objects and models bring "the real thing" into the classroom. Students can vicariously explore other places and other times through books, other printed materials, and kits that combine objects, pictures, and text.





Pictures, charts, graphs, posters, and cartoons—including those that students themselves produce—can provide powerful visual support to abstract ideas. These media can be displayed in a variety of ways. You need to be able to use chalkboards, flip charts, bulletin boards, and other display formats confidently. Of course, students often construct such displays themselves as part of cooperative group projects.



CHAPTER 4

Media and Materials

OUTLINE

- Manipulatives
- Field Trips
- Printed Materials
- Free and Inexpensive Materials
- Display Surfaces

KNOWLEDGE OBJECTIVES

1. Describe instructional applications that are especially appropriate for manipulatives.
2. Justify the use of a field trip for a particular instructional purpose of interest to you and describe how you might introduce it and follow it up.
3. Explain why a virtual field trip might be an alternative to a regular field trip and describe how you might introduce it and follow it up.
4. Discuss the advantages, limitations, and applications of printed materials in instruction.
5. Demonstrate your ability to follow the proper procedures for locating, obtaining, appraising, and using free and inexpensive materials.
6. Compare the advantages and limitations of various types of display surfaces.
7. Describe instructional applications that are especially appropriate for exhibits, displays, and dioramas.

LEXICON

copyright
real object
manipulative
model
field trip
virtual field trip
multipurpose board
copy board
flip chart
exhibit
diorama

Many of the media and materials discussed in this chapter are so common that instructors are inclined to underestimate their instructional value. Materials don't have to be digital or expensive to be useful. Small can indeed be beautiful, and inexpensive can be effective! In fact, in some situations—for instance, isolated, rural areas; teaching locations that lack electricity; programs or schools with a low budget—these simpler materials may be the only media that make sense to use (Figure 4.1). In addition, many computer software packages include manipulatives and workbooks for students to use as part of their learning experience.

The focus in this chapter is on media and materials; the discussion includes real objects, models, printed materials, free and inexpensive materials, field trips, and the devices used to display visuals (chalkboards, multipurpose boards, copy boards, flip charts, and more).

MANIPULATIVES

Real objects—such as coins, tools, artifacts, plants, and animals—are some of the most accessible, intriguing, and involving materials in educational use (Figure 4.2). They are known as **manipulatives** because students may handle and inspect them. The gerbils that draw a crowd in the kindergarten, the terrarium that introduces middle schoolers to the concept of ecology, the collection of Colonial-era coins, the frogs dissected in the college

FIGURE 4.1
Nonprojected visuals are the most widely used media.

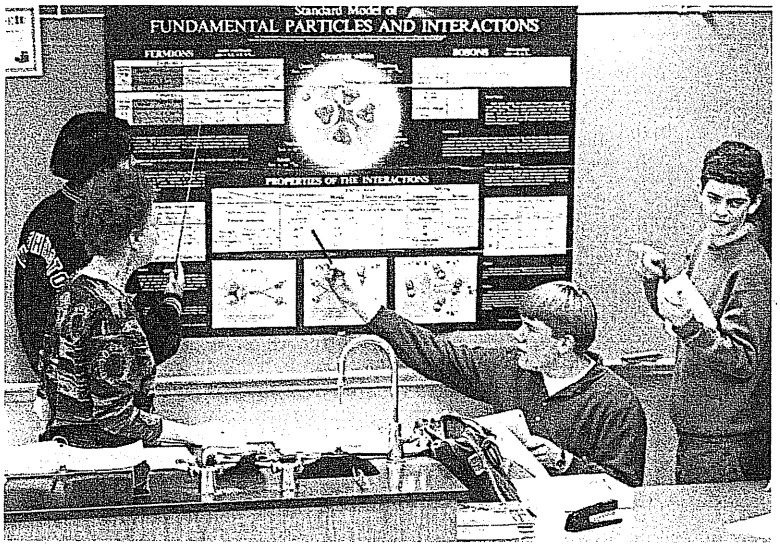
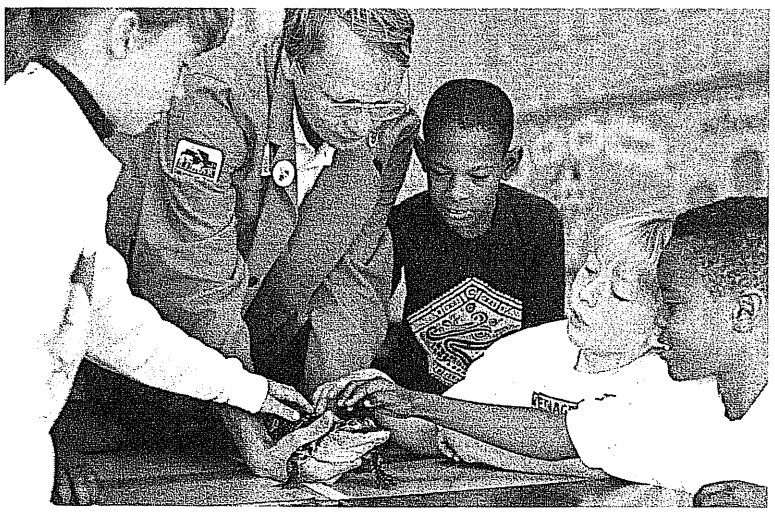


FIGURE 4.2
There is no substitute for the real thing when learning some content.



© COPYRIGHT CONCERNS: THE COPYRIGHT LAW

To protect the financial interests of the creators, producers, and distributors of original works of information and art, nations adopt what are referred to as *copyright laws.* **Copyright** refers to the legal rights to an original work. These laws set the conditions under which anyone may copy, in whole or part, original works transmittable in any medium. Without copyright laws, such professionals as writers, artists, and media producers would not "receive the encouragement they need to create the remuneration they fairly deserve for their creations," according to the legislative 1976 Omnibus Copyright Revision Act. The flow of creative work would be reduced to a trickle, and we would all be the losers. For more information, contact your school's library or media specialist or consult references on the subject.

FAIR USE

Fair use is one of the most important exceptions for teachers and students. There are no absolute guidelines for determining what constitutes fair use in an education setting. The law sets forth four basic criteria for determining the principle of fair use:

- The purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes (e.g., using a copyrighted work for an educational objective is more likely to be considered fair use than is using it for commercial gain)
- The nature of the copyrighted work (e.g., if the work itself is educational in character, this would tend to support a judgement of fair use)
- The amount and substantiality of the portion used in relation to the copyrighted work as a whole (e.g., using a smaller amount of the total work is more likely to be fair use than using a larger amount)
- The effect of the use on the potential market for or value of the copyrighted work (e.g., if the use negatively impacts potential sales of the original work, this weighs against fair use)

Until the courts decide otherwise, teachers (and media professionals) can use the fair use criteria to decide when to copy materials that would otherwise be protected. Examples follow.

Example 1

If the school media center subscribes to a journal or magazine to which you refer students and you make slides of several graphics or photos to help students understand an article, this would be fair use based on the following criteria:

1. The nature of the work is general, and its audience (and market) is not predominantly the educational community.
2. The character of use is nonprofit.
3. The amount copied is minimal.
4. There is no intent to replace the original, only to make it more useful in a class in conjunction with the copyrighted words.

Example 2

If you personally subscribe to a journal and include several pictures from it in a presentation in class, it would seem reasonable to do so for the same reasons given in Example 1.

For more information on this topic see the Copyright Concerns features that appear throughout this text. Suggested readings on copyright appear at the end of this chapter.

biology laboratory, the real baby being bathed in the parenting class—these are just a few examples of the potential of real objects to elucidate the obscure and to stimulate the imagination.

Being concrete, real objects fit near the bottom of Dale's Cone of Experience (see Chapter 1), meaning that they are especially appropriate for learners who are encountering a subject about which they have had little direct experience in their daily lives. Going back in time, at least to Comenius in the seventeenth century (see the "Classroom Link Portfolio" CD-ROM for more information), educators have understood the dangers of plunging into abstract concepts and principles without building a foundation in concrete experience. *Verbalism* is a term that refers to parroting words without meaningful understanding. To build schemata that have meaning and relevance in their lives, learners need a base in concrete experience, and bringing real objects into the classroom can help in this.

Real objects may be used as is, or you may modify them to enhance instruction. Examples of modification include the following:

- *Cutaways:* Devices such as machines with one side cut away to allow close observation of the inner workings (Figure 4.3)
- *Specimens:* Actual plants, animals, or parts thereof preserved for convenient inspection
- *Exhibits:* Collections of artifacts, often of a scientific or historical nature, brought together with printed information to illustrate a point (Figure 4.4)

Besides their obvious virtues as a means of presenting information, raising questions, and providing hands-on learning experiences, real objects can also play a valuable role in the evaluation phase of instruction. They can be displayed in a central location. Learners can identify them, classify them, describe their functioning, discuss their utility, or compare and contrast them. Such a testing situation

FIGURE 4.3
A cutaway of an engine reveals its hidden components.

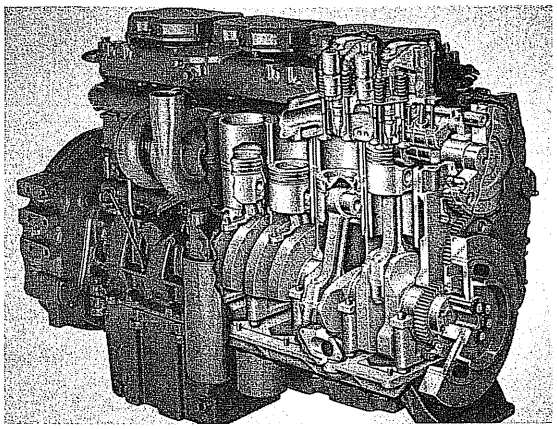
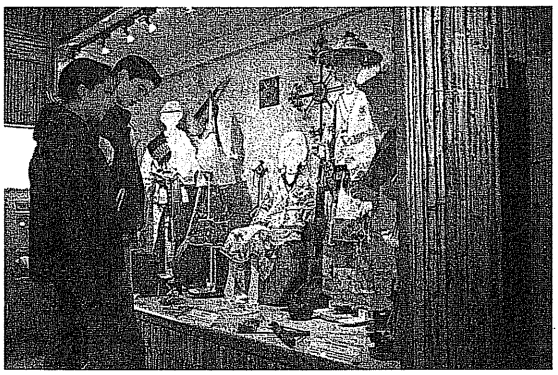


FIGURE 4.4
Cultural artifacts come to life when presented in a well-designed exhibit.



emphasizes the real-world application of the topic of study, aids transfer of training, and helps transcend the merely verbal level of learning.

Models are three-dimensional representations of real objects. A model may be larger, smaller, or the same size as the object it represents. It may be complete in detail or simplified for instructional purposes. Indeed, models can provide learning experiences that real things cannot provide (Figure 4.5). For example, important details can be accented with color. Some models can be disassembled to provide interior views not possible with the real thing.

Models of almost anything—from airplanes to zebras—can be purchased for classroom use. Providing collections of models is a standard service of most media centers. School district and regional media centers and museums often loan artifacts and models, usually as part of multimedia kits (we describe such kits in Chapter 10).

FIGURE 4.5
An anatomical model, being three-dimensional, is a more concrete referent than a photograph, drawing, or even a videotape.



FIGURE 4.6
Artifacts and models provide hands-on experiences.



A variety of model kits is also available for you or your students to assemble. Assembly itself can be instructional. Classroom construction of model kits appeals to children of all ages (and, indeed, to adults) and can stimulate inquiry and discovery. Assembly activities help sharpen both cognitive and psychomotor skills (Figure 4.6).

Mock-ups, which are simplified representations of complex devices or processes, are prevalent in industrial training. By highlighting essential elements and eliminating distracting details, mock-ups clarify the complex. They are sometimes constructed as working models to il-

FIGURE 4.7
A mock-up of an engine's electrical system provides the learner with a working model from which distracting details have been deleted.



lustrate the basic operations of a real device (Figure 4.7). Such a situation allows individuals or small groups to manipulate the mock-up at their convenience, working with the subject matter until they comprehend it. For example, a mock-up of a microcomputer might have the internal components spread out on a large board with the components labeled and the circuit diagrams printed on the board. The most sophisticated type of mock-up, the simulator, is a device that allows learners to experience the important aspects of a real-life process without the risks (simulators were discussed in detail in Chapter 2).

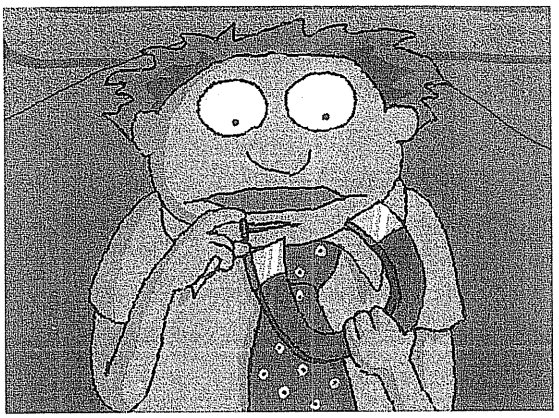
Models and real objects are the recommended media when realism is essential for learning. They provide concepts that involve three dimensions; tasks that require identification by size, shape, or color; and hands-on or laboratory practice.

Computer Programs and Manipulatives

The recent addition of manipulatives and student hands-on materials included in computer software packages is an

MEDIA FILE

Science Court™ Explorations™
CD-ROM Series



Source: Tom Snyder Productions.

An exciting science CD-ROM series that combines the power of technology with the effectiveness of hands-on manipulatives is available in an all-in-one easy-to-use kit. *Science Court Explorations,* designed for grades 2–4, is an extension of Tom Snyder Production's award-winning *Science Court™* series.

Science Court Explorations comes with a hybrid Mac/Win CD-ROM, a class set of manipulatives (enough for six cooperative learning teams), and a comprehensive teacher's guide with reproducible worksheets and take-home activities.

Science Court Explorations introduces and reinforces the scientific method and fundamental science concepts for young students. A funny and compelling animated story on CD-ROM introduces a scientific question. The CD-ROM then walks students step by step through the scientific process and illustrates how to set up the hands-on experiment. Working in teams, students use the experiment to test hypotheses and answer the question.

Titles include "Pendulums," "Rockets," "Flight," "Heat Absorption," "Magnets," and "Friction."

For additional information, visit the Tom Snyder Productions website (www.tomsnyder.com).

AV SHOWMANSHIP Manipulatives

- Familiarize yourself with the object or model before using it in classroom instruction.
- Practice your presentation. If your object or model is a working one, be sure you know how it works and what might go wrong.
- Be sure your audience does not get the wrong impression of the size, shape, or color of the real object, if the model differs from it in these respects.
- Whenever feasible, encourage students to handle and manipulate the objects and models under study.
- Store objects out of sight when not using them for instruction. Left standing around, they are likely to take students' attention away from other classroom activities.

example of how traditional nonprojected media are being incorporated into software programs to provide powerful learning experiences. Students learn about a problem from the software, use the manipulatives included in the package to experiment with possible answers, and then when they feel they have resolved it, they enter the information into the computer to see if they have the right answer to the problem. This seems to be the best of both worlds, efficient use of a single computer in a classroom and authentic learning experiences for students.

FIELD TRIPS

The **field trip,** an excursion outside the classroom to study real processes, people, and objects, often grows out of students' need for firsthand experiences. It makes it possible for students to encounter phenomena that cannot be brought into the classroom for observation and study.

Examples of field trips include a trip of a few minutes into the schoolyard to observe a tree, a trek across the street to see construction work, or a longer trip of several days to tour historical locations. Popular field trip sites include zoos, museums, public buildings, and parks. Dale's Cone of Experience (see Chapter 1) places field trips toward the middle of the cone because, although the experience is "real," students typically are only seeing and hearing the phenomena, not directly manipulating them.

The school media specialist can increase the chances for a successful field trip experience by maintaining a local resource file. This file includes lists of possible sites to visit and speakers to invite to classes for presentations. Usually the file record includes the name, address, and phone number of the person to contact. A good resource file will also include notes regarding the value of previous trips or the way a speaker was previously received. Some district media centers and public libraries maintain a local resource file as part of their electronic catalog.

Virtual field trips are an extension of actual field trips. Often the expense or the time to travel to a particular interesting location is not possible. But, with the World Wide Web, children may experience the sights and sounds of a faraway location from their home or school. For example, if you are studying Paris, France, it would be nearly impossible for the whole class to go there. However, with a few simple clicks of a mouse, the whole class can see and hear the sights of the city. Although it is not exactly the same as being there, it certainly makes it possible to learn about a location with some authenticity to the experience. See "Media File: Quest Interactive Expeditions."

For a field trip to be justified, it should grow out of and be directly related to the regular course of study. (See "How to . . . Conduct a Field Trip" and Figure 4.8.) You should devise lead-in as well as followup (including evaluation) activities. The lead-in prepares the students for the field trip; the followup helps them reflect on the experience and integrate it into their own schemata.

The followup is a vital aspect of a field trip. If the purpose for making the trip is to get additional factual information, the evaluation will be more formal. If the

MEDIA FILE

Quest Interactive Expeditions

Interactive Internet Activity



Source: Classroom Connect.

Classroom Connect is the innovator of the *Quest Interactive Expeditions* concept—using the Internet to provide collaborative and experiential learning experiences to K–12 school participants and general onlookers from around the world. Classroom Connect has guided students in many online Quests, including *AfricaQuest, GalapagosQuest, AsiaQuest, AmericaQuest, IslandQuest,* and *AustraliaQuest.* During *AmericaQuest,* approximately 6,000 classrooms registered to participate, with 240,000 school students involved and hundreds of thousands of additional onlookers logged in from around the world to follow the Quest team's journey.

Each Quest involves a team of 8 to 10 people riding mountain bikes through sometimes harsh and rugged environments—always with the goal to unravel some of the greatest mysteries of all time. This is a place where students can participate in online adventures around the world.

Quests allow students and teachers to explore math, science, language arts, social studies, geography, and much more. Students interact with other students and learn more about different cultures along the way. For example, in conjunction with *AustraliaQuest,* a special Aboriginal team was asked to connect the Quest team with Aboriginal culture in Australia. Through the knowledge and experience of this group, students and teachers were introduced to Aboriginal history and culture.

HOW TO . . . Conduct a Field Trip

PLANNING

1. Have a clear idea of the purpose and objectives of the trip.
2. Obtain materials about the location to use for a preview and followup of the trip.
3. Get a full overview of the content and procedures of the trip. Preview the trip yourself. Evaluate it for possible safety considerations.
4. Make arrangements with the school principal, the host, and other teachers (if they are involved). Secure consent of the parents for students to make the trip. Remind students and parents of appropriate dress.
5. Arrange transportation.
6. Establish rules for safety and security; for example, what students should do if they are separated from the group.
7. Provide sufficient supervision. Arrange for volunteers (e.g., parents) to accompany the class. Assign each volunteer to oversee a small group of students.

PREPARING

1. Clarify the purpose of the trip with the entire group. Build interest in the trip through lead-in activities such as the following (use materials obtained from the host):
   - Class discussion
   - Stories
   - Reports
   - Videos
   - Teacher–student planning
2. Give explicit directions to students regarding the following:
   - What to look for
   - Questions to ask
   - Information to gather
   - Notes to make
   - Individual or group assignments
   - How to behave

CONDUCTING

1. Arrive at the field trip site on time.
2. Encourage students to observe carefully and to ask questions.
3. Obtain available materials that you can use later. Examples include informational pamphlets, brochures, and souvenirs.
4. Account for all travelers before starting the return trip.

FOLLOWUP

1. Conduct followup of the field trip with these types of activities (use materials obtained from the host):
   - Discussion of the trip
   - Reports
   - Projects
   - Demonstrations
   - Creative writing
   - Individual research
   - Class experience stories
   - Exhibits of pictures, maps, charts, graphs, drawings, etc.
2. Write a thank-you letter to the host, guides, parent volunteers, drivers, and others who were instrumental in conducting the field trip. Everyone will appreciate receiving notes written by the class or a student committee.



FIGURE 4.8
Field trips provide students with opportunities for firsthand observation and participation, as in this trip to a nineteenth-century one-room schoolhouse.

objectives are the formation of attitudes and appreciation, followup activities might include discussion, role playing, or creative art projects. Whatever form it takes, followup activity should assess the success of the trip. Students and teachers should address content as well as possible ways to improve future trips.

PRINTED MATERIALS

Printed materials include textbooks, fiction and nonfiction books, booklets, pamphlets, study guides, manuals, and worksheets, as well as word processed documents prepared by students and teachers. Textbooks have long been the foundation of classroom instruction. The other forms of media discussed in this book are frequently used in conjunction with and as supplements to printed materials.

Advantages

- *Availability.* Printed materials are readily available on a variety of topics and in many different formats.
- *Flexibility.* They are adaptable to many purposes and may be used in any lighted environment.
- *Portability.* They are easily carried from place to place and do not require any equipment or electricity.
- *User friendly.* Properly designed printed materials are easy to use, not requiring special effort to "navigate" through.
- *Economical.* Printed materials are relatively inexpensive to produce or purchase and can be reused. In fact, some may be obtained free, as described in the next section.

Limitations

- *Reading level.* The major limitation of printed materials is that they are written at a certain reading level. Some students are nonreaders or poor readers lacking adequate literacy skills; some printed materials are above their reading level.
- *Prior knowledge.* Even though textbooks are generally written to be more considerate of the reader, with clear language and simple sentence structures, readers who lack some prerequisite knowledge may struggle to comprehend the text.
- *Memorization.* Some teachers require students to memorize many facts and definitions. This practice diminishes printed materials to mere memorization aids.
- *Vocabulary.* Some texts introduce a large number of vocabulary terms and concepts in a short amount of space. This practice places a heavy cognitive burden on students, which may be overwhelming for some.
- *One-way presentation.* Since most printed materials are not interactive, they tend to be used in a passive way, often without comprehension.
- *Curriculum determination.* Sometimes textbooks dictate the curriculum rather than being used to support the curriculum. Textbooks are often written to accommodate the curriculum guidelines of particular states or provinces. Consequently, the preferences of these authorities disproportionately influence textbook content or its treatment.
- *Cursory appraisal.* Selection committees might not examine textbooks carefully. Sometimes textbooks are chosen by the "five-minute thumb test"—whatever catches the reviewer's eye while thumbing through the textbook.

Integration

The most common application of printed materials is presenting content information. Students are given reading assignments and are held accountable for the material during class discussions and on tests. Teacher-made handouts can also complement a teacher's presentation, or students may use them as they study independently. (See "How to . . . Design Text.")

Students may also use printed materials to augment either the information you present or other forms of media. Students frequently refer to supplementary printed materials (such as books and journals from the media center) to locate information on a specific topic not covered in their textbook.

Printed materials are used in all subject areas and with students of all ages once they learn to read. The media center is a source of a variety of printed materials on countless topics and in almost every conceivable format (Figure 4.9).

Utilization

When using printed materials for instruction, one of the main roles of the teacher is to get learners actively involved with the material. One technique is to have students use the "SQ3R" method: Survey, Question, Read, Recite, and Review. *Survey* requires students to skim through the printed material and to read the overview and/or summary. In the *Question* step they write a list of questions to answer while reading. In the *Read* stage students are encouraged to look for the organization of the material, put brackets around the main ideas, underline supporting details, and answer the questions written in the previous step. *Recite* requires them to test themselves while reading and to put the content into their own words. *Review* suggests that the students look over the material immediately after reading it, the next day, a week later, and so on (Robinson, 1946).

HOW TO . . . Design Text

Assemble the Elements

- Word-processing and laser printing have placed a confusing profusion of typefaces at our disposal for most documents we produce. Remember the advice that professional graphic designers follow: Pick a serif and sans-serif typeface that you like and use them; ignore the rest except for very special situations.

Facilitating a Small Group Meeting

Title text is a simple style (gothic or roman sans serif) to distinguish from other text.

Title is short and informative.

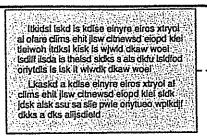
Getting the meeting started

Subheadings use the same typeface as the title, but usually a smaller size.

Subheadings should use an initial capital only.

As facilitator you should *never* laugh.

Use either italic or bold text for emphasis, not both.



Paragraphs are aligned at the left margin, not at the right margin or at both margins; left-margin alignment provides best readability.

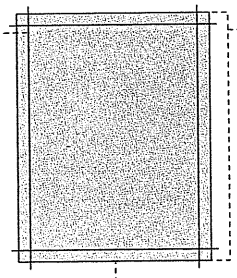
Paragraphs use a serif typeface in 10 or 12 point size for most readers; 14–18 points for young readers and visually impaired.

Choose Background and Underlying Pattern

- Don't scrimp on page margins; pages that look too full, too dense, or too disorganized are discouraging to readers at any level of proficiency.
- If your pages will be printed front and back, make a trial sheet to ensure that the text on each side is clearly readable.

When you have a choice of paper color, select a subdued shade that allows the smallest text on your page to stand out clearly in contrast.

If your text will be photocopied, avoid paper in any shade of red since it will darken in the copy process.



On the vertical dimension decide the spacing between lines of text, between the title and other text, and between text and subheadings.

On the horizontal dimension decide what column divisions, if any, you will use.

Arrange the Elements

- Use space—move elements closer together or further apart—before using styles like bold, italic, or underlined text. Spatial arrangement is more quickly perceived and processed by your readers than is a change of text style.
- Use text styles to reinforce the underlying pattern of the document; for example, make all subheadings bold and nothing else bold.



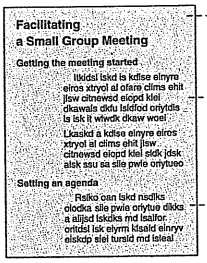
Titles may be aligned with the left margin or centered on the page; if you center the title take care that it looks centered and not simply misaligned.

Subheadings should be aligned with each other; if they are centered each one appears to be aligned differently and the viewer may have trouble identifying them.

All the regular text should be aligned at the same margin except lists and block quotations; making sense of multiple margins is distracting for the reader.

Check and Revise

- In a multiple-page document check for single words or lines that get stranded on a page separated from the rest of a paragraph; reset the page breaks or rearrange text so that paragraphs are complete or divided nearer the middle.
- If you use a computer spelling-checker, re-check for words you have spelled correctly but used in the wrong place.



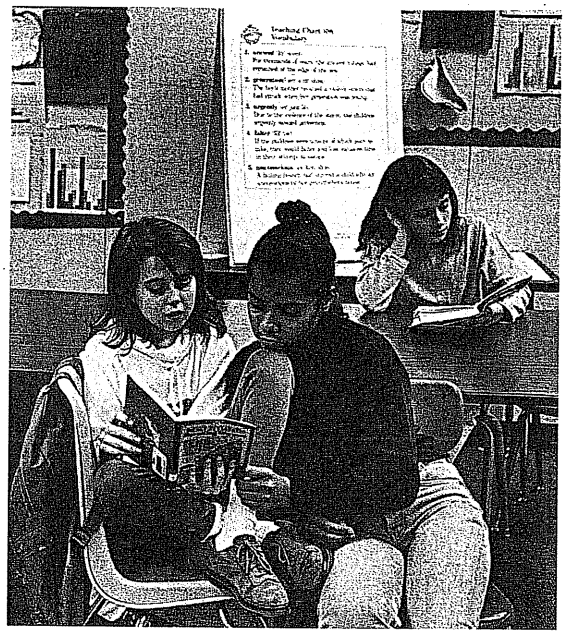
Check titles and subheadings; if they take up more than one line, make sure the phrases on each line make sense.

Move blocks of text close to their subheadings and away from other text on the page; this use of space helps the viewer make sense of the page easily and quickly.

Most text produced with a word processor instead of a typewriter is too dense and difficult to read in lines that extend from margin to margin; a margin of about 1/3 the page gives easier-to-read text and makes subheadings stand out.

© Elizabeth Boling 1995

FIGURE 4.9
Children's books and other printed materials can be used anytime and anywhere.



Other utilization techniques for printed materials include directing student reading with objectives or questions and providing a worksheet if one is not included in the materials. You should emphasize the use of visuals in printed materials and teach students to read visuals. You need to instruct students on the appropriate use of printed materials.

FREE AND INEXPENSIVE MATERIALS

With the ever-increasing costs of instructional materials, teachers and trainers should be aware of the variety of materials they may obtain for classroom use at little or no cost (Figure 4.10). These free and inexpensive materials can supplement instruction in many subjects; they can be the main source of instruction on certain topics. For example, many videotapes are available for loan without a rental fee; the only expense is the return postage. By definition, any material that you can borrow or acquire permanently for instructional purposes without a significant cost, usually less than a couple of dollars, can be referred to as free or inexpensive.

© COPYRIGHT CONCERNS: PRINT MEDIA

For educational use, a teacher may make a single copy of a chapter from a book; an article from a periodical or newspaper; a short story, short essay, or short poem, whether or not from a collective work; an illustration from a book, periodical, or newspaper. The context in which the term *teacher* is used seems to be broad enough to include support personnel working with teachers and trainers.

The guidelines further stipulate the amount of material that may fairly be copied and the special circumstances that permit multiple copies. *Fair use* is defined as one illustration per book or periodical, 250 words from a poem, and 10 percent of a prose work up to 1,000 words. Multiple copies cannot exceed the number of students in a class, nor can there be more than two excerpts or one short poem, article, story, or essay copied from the same author. These limitations (i.e., nine instances of multiple copying; two excerpts or one short item) do not apply to current news periodicals, newspapers, and current news sections of other periodicals.

However, multiple copies must meet the "spontaneity" test. The copying must be initiated by the individual teacher, not directed or suggested by any other authority. The decision to use the work and the "inspiration" for its use must be close enough to the moment of use to preclude waiting for permission from the copyright holder. This means of course, that the same "inspiration" cannot occur the same time next term.

The last guideline, concerning market value, means that copying must not substitute for purchasing the original or creating or replacing an anthology or compilation of works protected by copyright. It also prohibits copying works intended to be consumable (e.g., workbooks and standardized tests).

If a work is out of print (e.g., no longer available from the copyright holder), you are not affecting the market value of the work by copying it. The market value guideline can act in favor of the user, as we will see from the examples presented in the Copyright Concerns features throughout this text.

The term, or period of time, of the copyright has been changed by the Sonny Bono Copyright Term Extension Act of 1998. For an individual author, the copyright term continues for his or her life and for 70 years after his or her death. If a work is made for hire (i.e., by an employee or by someone commissioned to do the work), the term is 100 years from the year of creation or 75 years from the year of first publication or distribution, whichever comes first. Works copyrighted prior to January 1, 1978, are protected for 28 years and then may have their copyright renewed. The renewal will protect them for a term of 75 years after their original copyright date.

For general information on copyright, see the Copyright Concerns on page 87. Suggested readings on copyright appear at the end of this chapter.

APPRAISAL CHECKLIST

PRINT MATERIALS

KEY WORDS: _____ , _____ , _____

Title _____

Series Title (if applicable) _____

Source _____

Date _____ **Cost** _____ **Length** _____

Subject Area _____

Intended Audience _____

Format
- ❑ **Textbook**
- ❑ **Fiction**
- ❑ **Nonfiction**
- ❑ **Pamphlet**
- ❑ **Manual**

Brief Description

Objectives

Entry Capabilities Required (e.g., prior knowledge, reading ability, vocabulary level, math ability).

Rating	**High**	**Medium**	**Low**	**Comments**
Match with curriculum	❑	❑	❑	
Accurate and current	❑	❑	❑	
Clear and concise language	❑	❑	❑	
Arouse motivation/maintain interest	❑	❑	❑	
Learner participation	❑	❑	❑	
Technical quality	❑	❑	❑	
Evidence of effectiveness (e.g., field-test results)	❑	❑	❑	
Free from objectionable bias or advertising	❑	❑	❑	
User guide/documentation	❑	❑	❑	
Reading level appropriate	❑	❑	❑	
Clarity of organization	❑	❑	❑	
Table of contents/index	❑	❑	❑	

Strong Points

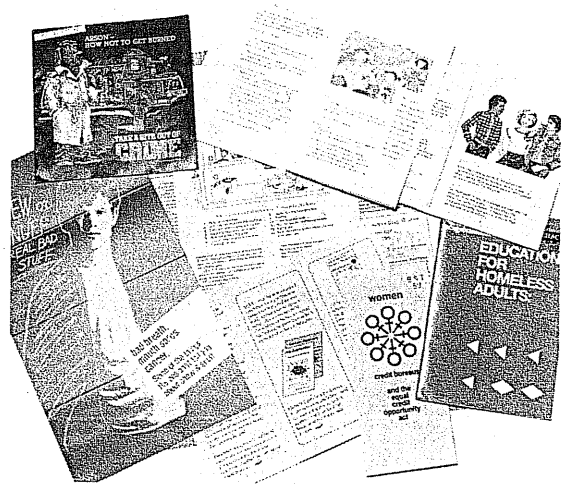
Weak Points

Recommended Action _____ **Name** _____ **Date** _____

Prentice Hall grants the reader permission to reproduce this checklist for personal use only. Heinich, Molenda, Russell, and Smaldino, *Instructional Media and Technologies for Learning* (2002).

A computer version of this Checklist is available on the "Classroom Link Portfolio" CD-ROM.

FIGURE 4.10
Free and inexpensive materials are available from a variety of sources.



The types of free and inexpensive materials are almost endless. The more commonly available items include posters, games, pamphlets, brochures, reports, charts, maps, books, audiotapes, videotapes, multimedia kits, and real objects. The more costly items, such as videotapes, are usually sent only on a free-loan basis and must be returned to the supplier after use. In some instances, single copies of audiocassettes, computer software, and videocassettes will be donated to your organization or school media center to be shared among many users.

Another resource that has become very important for obtaining free and inexpensive materials is the Internet (see Chapter 11). By connecting to websites around the world, teachers and students can acquire materials, photographs, and other educational resources. In addition, many teachers are placing their ideas for teaching an array of subjects, along with media and materials, on the Web.

Free and inexpensive materials include all the types of media discussed in this book—visuals, real objects, models, overhead transparencies, slides, filmstrips, audiotapes, CDs, videotapes, photographs, and even computer programs (called *shareware* or *freeware*). The applications of this variety of materials are described in detail in the chapters of this book related to specific types of media (see the Contents).

Advantages

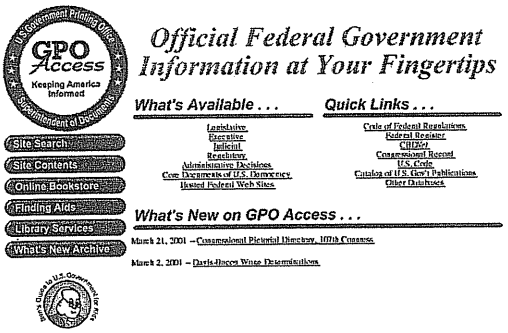
- *Up to date.* Free and inexpensive materials can provide up-to-date information that is not contained in textbooks or other commercially available media.
- *In-depth treatment.* Such materials often provide in-depth treatment of a topic. If classroom quantities are available, students can read and discuss printed materials as they would textbook material. If quantities are limited, you can place them in a learning center for independent or small-group study.
- *Variety of uses.* These materials lend themselves to your own classroom presentations. Individual students who want to explore a subject of interest can use the audiovisual materials for self-study or for presentation to the class. Posters, charts, and maps can be combined to create topical displays. These can be motivational (as in the case of a safety poster) or used for direct instruction (as in studying the solar system). Materials that you do not have to return can be modified and adapted for various instructional or display purposes.
- *Student manipulation.* Materials that are expendable have the extra advantage of allowing learners to get actively involved with them. For example, students can cut out pictures for notebooks and displays. They can assemble printed information and visuals in scrapbooks as reports of individual and group projects.

Limitations

- *Bias or advertising.* Many free and inexpensive materials are described as *sponsored* materials because their production and distribution are sponsored by particular organizations. These organizations—whether private corporations, nonprofit associations, or government agencies—often have a message to convey. You might consider covering or removing the advertisement, but that, too, raises ethical questions in view of the effort and expense that the sponsor has incurred in providing the materials to you.
- *Special interests.* What may be even more troublesome is sponsored material that does not contain outright advertising but promotes some special interest in a less obvious way. Propagandistic or more subtly biased materials can thus enter the curriculum through the back door. Preview carefully and exercise caution when you consider sponsored materials. If possible, solicit informational materials on the same subject from several points of view. Thereby, students are afforded a balance and diversity of opinions.
- *Limited quantities.* With the increasing expense of producing both printed and mediated materials, your supplier may have to impose limits on the quantities of items available at one time. You may not be able to obtain a copy of the material for every student in the class.

MEDIA FILE

Free and Inexpensive Materials



Source: U.S. Government Printing Office Access (http:///www.access.gpo.gov/su_does/index.html)

Government Printing Office Access (GPO Access) is a service of the U.S. Government Printing Office that provides free electronic access to a wealth of important information and products produced by the federal government. The information provided on the website is the official, published version and the information retrieved from GPO Access can be used without restriction, unless specifically noted. This free service is funded by the Federal Depository Library Program.

GPO Access provides free online use of over 1,500 databases of federal information in over 80 applications. A general search page provides the opportunity for searching one or multiple GPO Access databases from a single page, while specialized search pages allow you to perform more detailed searches. The "Helpful Hints" links available from each specialized search page provide you with quick and easy help to accomplish your search.

GPO Access provides a number of useful, free tools, called Finding Aids, to assist you in doing the following:

1. Find and order products available for sale through the Superintendent of Documents.
2. Explore links to free, official federal information available electronically.
3. Search more than 1,350 official U.S. federal agency and military Internet sites using keywords.

Sources

There are local, state, national, and international sources of free and inexpensive materials, and many of these are now available as websites. Many local government agencies, community groups, and private businesses provide informational materials on free loan. Public libraries often make videotapes, prints, and computer software available. Even libraries in small communities may have access to materials through a statewide network. These materials usually can be loaned to schools and other organizations. Other state and federal government agencies—such as cooperative extension services, public health departments, and parks departments—make materials available for use in schools, churches, hospitals, and companies.

Community organizations such as the Red Cross, the League of Women Voters, and medical societies welcome opportunities to spread information about their special interests. Videotapes, printed material, and guest speakers are frequently offered.

Among business organizations, utilities (telephone, electric, gas, and water companies) are most likely to employ education specialists who can inform you about the instructional services they offer. Chambers of commerce often can suggest private corporations that might supply materials of interest to you.

Nationally, one of the most prolific sources of free and inexpensive materials is the federal government. In the United States, two federal agencies offer special access to materials—the U.S. Government Printing Office and the National Audiovisual Center. Your key to the tremendous wealth of posters, charts, brochures, books, and other printed government documents available to the general public is *Selected U.S. Government Publications.* Their websites offer an array of free materials for classroom teachers. Visit these websites through the Web Links module in Chapter 4 of the Companion Website (http://www.prenhall.com/heinich).

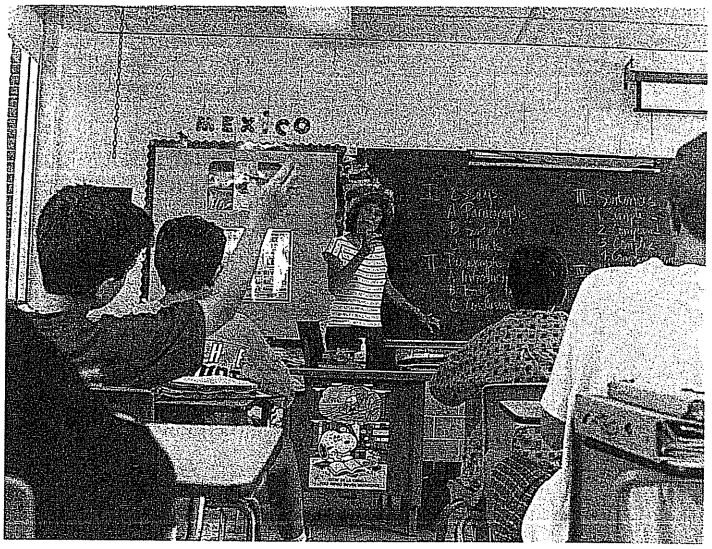
Trade and professional associations also aim to acquaint the general public with their fields of interest and the causes they promote. Private corporations that operate on a national or even international level often offer sponsored materials.

Most foreign governments disseminate information about their countries to promote trade, tourism, and international understanding. They typically offer free posters, maps, and informational booklets plus videotapes on a free-loan basis. To find out what is available for any particular country, write to or e-mail the embassy of that country. International organizations such as the Organization of American States (OAS), the United Nations (UN), and the North Atlantic Treaty Organization (NATO) also operate information offices. Airline and cruise ship companies are popular sources of posters of foreign countries. Consult a local travel agent for possible materials and addresses.

Obtaining Materials

When you have determined what you can use and where you can obtain it, write to the supplier; some agencies will not supply free and inexpensive materials unless you write on school or company letterhead. For classroom quantities (when they are available), send just one letter. Do not have each student write individually. If a single student is requesting one copy of something for a class project, the student can write the letter, but you should also sign it. We recommend that you request a preview

FIGURE 4.11
The chalkboard is universally recognized as a flexible and economical display surface.



copy of the material before requesting multiple copies. Don't send a request for "anything you have"! Be specific and specify at least the subject area and the grade level. Ask for only what you need. Don't stockpile materials or take unfair advantage of a free offer. Somebody is paying for those materials, so don't waste them. Follow up with a thank-you note to the supplier; mention how you used the materials and what the students' reactions were. Be courteous, but be honest! Many suppliers attempt to improve free and inexpensive materials on the basis of user comments.

Appraising Materials

As with any other types of material, appraise the educational value of free and inexpensive materials critically. Some are very slick (technically well presented) but not educationally sound. Use the appropriate "Appraisal Checklist" for the type of media (printed material, videotape, etc.) you are appraising. All the "Appraisal Checklist" forms in this book have the rating criterion "Free from objectionable bias or advertising." Use it judiciously when reviewing free and inexpensive materials.

For additional information on this topic, go to the Web Links module in Chapter 4 of the Companion Website (http://www.prenhall.com/heinich).

DISPLAY SURFACES

If you are going to use visuals such as photographs, drawings, charts, graphs, or posters, you need a way to display them. Visuals may be displayed in the classroom in a variety of ways, ranging from simply holding up a single visual in your hand to constructing elaborate exhibits for permanent display. Classroom surfaces commonly used for display of visuals include chalkboards, multipurpose boards, copy boards, pegboards, bulletin boards, cloth boards, and magnetic boards. Flip charts and exhibits, a display format incorporating a variety of materials such as real objects and models along with visuals, are also common. How you display your visuals will depend on a number of factors, including the nature of your audience, the nature of your visuals, the instructional setting, and, of course, the availability of the various display surfaces.

Chalkboards

The most common display surface in the classroom is, of course, the chalkboard (Figure 4.11). Once called *blackboards,* they now come in a variety of colors, as does chalk. Although the chalkboard is most commonly used to support verbal communication, you can use it as a surface on which to draw visuals (or pictures can be fastened to the molding above the chalkboard, taped to the board with masking tape, or placed in the chalk tray) to help illustrate instructional units. You may draw graphics, such as sketches and diagrams or charts and graphs, on the chalkboard for display to the class.

A chalkboard is such a common classroom item that instructors often neglect to give it the attention and respect it deserves as an instructional device. Using a chalkboard effectively requires conscious effort (See "AV Showmanship: Chalkboard and Multipurpose Board").

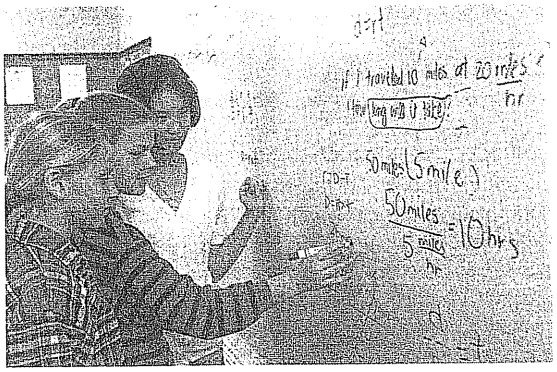
AV SHOWMANSHIP Chalkboard and Multipurpose Board

- Put extensive drawing or writing on the board before class. Taking too much time to write or draw creates restlessness and may lead to discipline problems.
- Organize in advance what you plan to write on the board and where you plan to write it.
- Cover material such as a test or extensive lesson materials with wrapping paper, newspaper, or a pull-down map until you are ready to use it.
- Eye contact with students is important! Face the class when you are talking. Do not talk to the board. Do not turn your back to the class unless it is absolutely necessary.
- Vary your presentation techniques. Do not overuse or rely entirely on the board. Use handouts, the overhead projector, flip charts, and other media during instruction when appropriate.
- Print neatly rather than using script. For a 32-foot-long classroom, the letters should be 1½–2 inches high and the line forming the letters should be 1/4 inch thick.
- Check the visibility of the board from several positions around the room to be sure there is no glare on the surface. In case of glare, move the board (if portable) or pull down the window shades.
- If your printing normally runs "uphill" or "downhill," use water-soluble felt-tip pen markings as temporary guidelines for straighter printing. The guidelines will not be wiped off by a chalk eraser but will wash off when no longer needed.
- Hold the chalk or marker at an angle so that it does not make scratching or squeaking noises.
- Use color for emphasis, but don't overuse it. Two or three different colors work best.
- Move around so you do not block what you have written on the board. Do not stand in front of what you have written.
- Use drawing aids such as rulers, stencils, and templates (patterns) to save time and improve the quality of your drawings.
- For frequently drawn shapes, use a template cut from wood or heavy cardboard. A dresser drawer knob or empty thread spool mounted on the template makes it easier to hold in position while tracing around it.
- Outline your drawings with barely visible lines before class and then fill them in with bold lines in front of the class. Your audience will think you are an artist!

Multipurpose Boards

Some classrooms are equipped with **multipurpose boards** (Figure 4.12) instead of chalkboards. These are also called *whiteboards* or *marker boards.* As the name implies, you can use them for more than one purpose. Their smooth, white plastic surface requires a special erasable marker rather than chalk. Do not use permanent felt-tip markers. These markers may permanently damage the surface.

FIGURE 4.12
Multipurpose boards are replacing chalkboards in business and industrial training classrooms and in some educational institutions.



The white surface is also suitable for projection of video, slides, and overhead transparencies. Materials cut from thin plastic, such as figures and letters, will adhere to the surface when rubbed in place. Some of these boards have a steel backing and can be used as a magnetic board (see page 104).

In addition to their variety of uses, these multipurpose boards have the advantage of being able to display bright, colorful lines. At least eight different colors of markers are currently available. They are dustless, so there is no chalk to get on your clothes. These boards are preferred for use around computers because chalk dust can harm computers and disks.

A multipurpose board will provide many years of use if cared for properly. Completely erase it after each use; it can be erased like a chalkboard using a felt eraser. Do not let the marks remain on the board overnight. The longer the marks remain on the board, the more difficult they are to erase. You can erase old marks by tracing over them with a black erasable marker and erasing immediately.

For general cleaning, simply wipe the board clean with a soft, damp cloth. If further cleaning is necessary, use a commercial mild spray cleaner. You can also apply a soapy detergent solution and rub briskly with a soft, clean cloth. Always rinse thoroughly with clean water and dry with a soft towel after cleaning.

The special erasable markers require some special care. They have a solvent base that dries quickly, which is the

key to their erasability. Keep the markers tightly capped and store them in a horizontal position with the cap tight when not in use to prevent them from drying out. If a marker dries out, cap it, turn it upside down, and shake it vigorously for 20 seconds. Leaving the marker stored overnight with the tip end down may also help.

Copy Boards

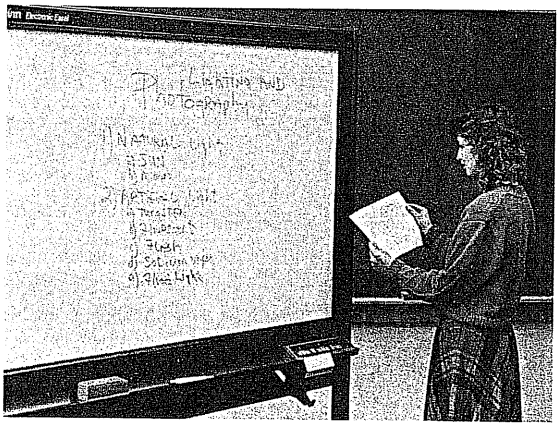
A high-tech variation of the multipurpose board is the **copy board,** or electronic whiteboard (Figure 4.13). This device makes reduced-size paper copies of what is written on the board. It looks like a smaller multipurpose board but may contain multiple screens or frames that can be scrolled forward and backward. You can prepare content beforehand on any or all of the screens. During your presentation you can reveal the frames one at a time, and add new information as desired. You can move the writing surface forward or backward to the desired frame quickly and easily.

You can write on the copy board using any erasable marker. If you make a mistake, erase your error as you would on any multipurpose board.

The special feature of the copy board is that the frames can be copied in about 10 seconds. You can make as many copies of each frame as you like by pushing the appropriate button. All material is copied in black and white using thermal-sensitive paper. It is possible to copy the material on a single 8½-by-11-inch sheet of paper.

By copying the information almost instantaneously, you are free to erase the board and continue to teach without losing valuable time or ideas. You can make copies for yourself or for everyone at the session to avoid extensive note taking. Everyone gets the same copy of what you presented, so there are no omissions or errors (except in what was or was not put on the board).

FIGURE 4.13
Diagrams and words written on a copy board can be reproduced on paper with the push of a button.



The copy board is especially valuable for brainstorming sessions and for summarizing group discussions. Students can lead discussions and have copies of the ideas to share with other groups. Copies could be particularly helpful for students who miss class. You can include complex drawings without having students hand copy them. They can take the notes into the field, laboratory, or assembly plant for immediate use. Some of these boards can directly transmit a video signal to a monitor in the same room or to a distant location.

Because of the high cost of current models, the copy board is not commonly found in school settings.

Pegboards

Another popular display surface is the pegboard. It is particularly useful for displaying heavy objects, three-dimensional materials, and visuals.

Pegboards are made of tempered Masonite with ¼-inch holes drilled 1 inch apart. Pegboard material is usually ¼-inch thick and comes in 4-by-8-foot sheets, which can be cut to any size. You can insert special metal hooks and holders into the pegboard to hold books, papers, and other objects. Various types of special hooks are available in most hardware stores. You may also insert golf tees into the holes for holding lightweight materials such as posters and visuals mounted on cardboard. For a background effect, cover the entire pegboard surface with cloth or colored paper, and then insert the golf tees or special hooks through the cloth or paper.

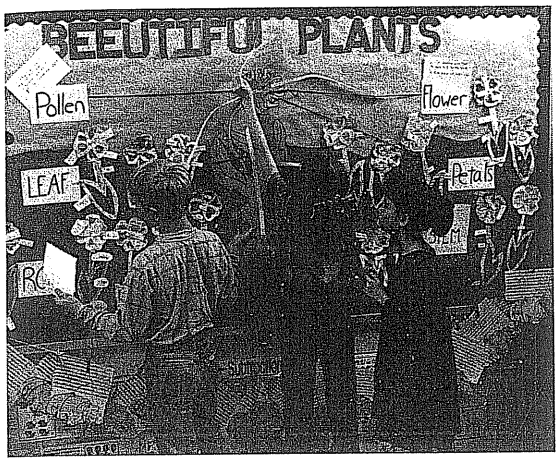
Bulletin Boards

The term *bulletin board* implies a surface on which bulletins—brief news announcements of urgent interest—are posted for public notice. This was the original purpose of bulletin boards, but it does not describe the variety of uses of these display spaces today. A bulletin board is a surface of variable size and shape made of a material that holds pins, thumbtacks, and other sharp fasteners without damage to the board (Figure 4.14). In practice, bulletin board displays tend to serve three broad purposes: decorative, motivational, or instructional.

The decorative bulletin board is probably the most common, certainly in schools. Its function is to lend visual stimulation to the environment. You might have a bulletin board that displays the colors and designs associated with a special holiday or a season. Or, you might have one about some books that students might be interested in reading for pleasure.

Displaying student work exemplifies the motivational use of bulletin boards. The public recognition offered by such displays can play an important role in the life of the classroom. It fosters pride in achievement, reinforcing students' efforts to do a good job. It is also relatively easy for you to create a display of student work.

FIGURE 4.14
Bulletin boards, long a standard in elementary classrooms, can be primarily decorative, motivational, or instructional.



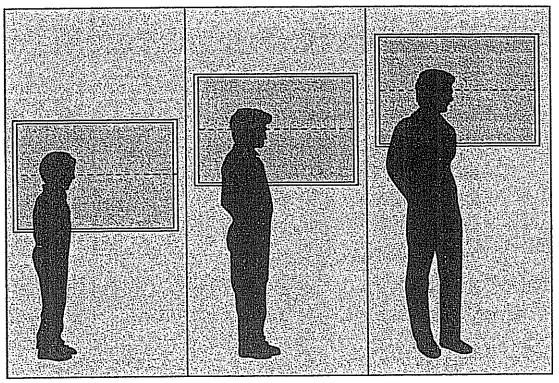
The third broad purpose of bulletin boards is instructional, complementing the educational or training objectives of the formal curriculum. Rather than merely presenting static informational messages, you may design displays that actively invite participation. Such displays ask questions and give viewers some means of manipulating parts of the display to verify their answers, such as flaps, pockets, dials, or movable parts.

Another form of learner participation is in taking part in the actual construction of the display. For example, to introduce a unit on animals, an elementary teacher might ask each student to bring in a picture of a favorite animal. The students would then make a bulletin board incorporating all the pictures. Or a geometry teacher might divide his class into five groups and assign each group a different geometric shape. As the class studies each shape, the appropriate group would construct a bulletin board on that shape. A discussion leader in a book club might prepare a portable bulletin board to stimulate discussion of the book everyone has read for the monthly meeting.

Preparing an effective bulletin board display, whether done by teacher or students, requires some thought and planning. As with any instructional activity, the objective is primary. A display should focus on one main topic or objective. One way to attract attention to your display and to prompt the viewer's thinking about your topic is to lead off with a catchy headline, one that communicates the main theme, perhaps with a question, a challenge, or a humorous phrase.

Once you have decided on an approach and have assembled some materials, you can refer to "How to . . . Design Bulletin Boards" for tips on arranging the elements into a display that will send its message clearly and attractively (Figure 4.15).

FIGURE 4.15
The placement of a display should vary according to the average height of the intended viewers. A useful rule of thumb is to align the middle of the display with the viewer's eye level.



Criteria for Evaluating your Bulletin Boards.

Emphatic. Conveys message quickly and clearly
Attractive. Color and arrangement catch and hold interest
Balanced. Formal or informal
Unified. Repeated shapes or colors or use of borders hold display together visually
Interactive. Involves the viewer
Legible. Lettering and visuals can be read across the room
Lettered properly. Spelled correctly, plain typeface, use of lowercase except where capitals needed
Relative. Correlated with lesson objectives
Durable. Well constructed physically, items securely attached
Neat. A clean, neat appearance makes the display more attractive, shows that the designer has regard for the audience, and provides a proper role model for student work

Materials for production of bulletin boards may be available through the school media center. Most schools have work rooms with large tables where you may construct items for your bulletin board and consider various layouts. A popular letter cutting device is the Ellison Lettering System (Figure 4.16). This allows for neat, large letters to be cut quickly from construction paper.

The media center may also store the components for bulletin board displays so that teachers can share materials and have easy access to them from one year to the next.

Bulletin boards need not always be attached permanently to the wall. You may choose to set portable boards on an easel for temporary display. Beware of having too many bulletin boards, though. Too many competing visual displays in one place can lessen their individual impact.

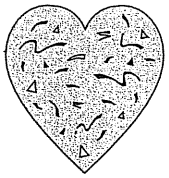
HOW TO . . . Design Bulletin Boards

Assemble the Elements

- Elements that look large in your hands suddenly seem to shrink when you place them on a large wall or bulletin board. When you are making or choosing elements for a bulletin board prop them up and walk across the room to judge how well they will show up.

AIDS AWARENESS

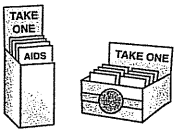
Large cut-out letters are at least 1.5" high to be visible from across a room.



Illustrations are large enough to be seen within the bulletin board format; they are chosen with regard for the viewers' interests and stylistic preference; they reinforce the theme of the display.

LOVE	LIFE	DEATH
Itkidsl lskd is kdlse n einyre eiros xtryol al citnewsd eiopd lkjdk dkaw woei Lkaskd a kdlse einyre eiros xtryol al clims alijsdield eiros xtryol	Itkidsl lskd is kdlse n einyre eiros xtryol al citnewsd eiopd lkjdk dkaw woei Lkaskd a kdlse einyre eiros xtryol al clims alijsdield eiros xtryol	Itkidsl lskd is kdlse n einyre eiros xtryol al citnewsd eiopd lkjdk dkaw woei Lkaskd a kdlse einyre eiros xtryol al clims alijsdield eiros xtryol

Text elements have large, compelling captions that encourage viewers to look closer and get engaged with the content being presented.

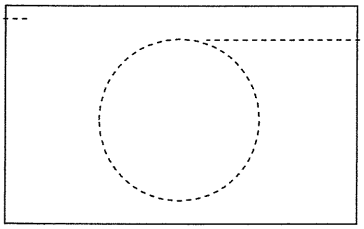


Actual products add 3-D texture to the display and promote engagement through manipulation of display elements.

Choose Background and Underlying Pattern

- Use subdued color for large areas to avoid distraction.
- Small samples of paper tend to look lighter than large sheets of the same paper; if you're working from samples, pick one lighter than you think you need.

Background color is pale pink, a subdued color that will allow other elements to stand out and will harmonize with the bright red and purple of the large heart.



Underlying pattern chosen is a circle to lead the eye from one content element to another without pointing to any single element as the most or least important.

Arrange the Elements

- Look for a large floorspace to test the layout of your bulletin board. Once you have fastened the whole display to the board you will be reluctant to pull it apart and revise it.

Title is centered at the top of the display.

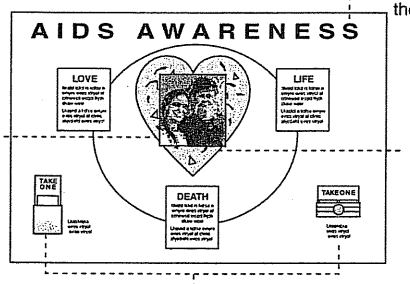


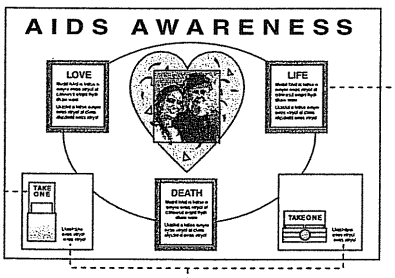
Photo of teenaged couple is superimposed over the heart, a strong use of proximity. The underlying circle is made visible as a dark pink element grouping the main elements together.

The heart and the photo are placed at the center of the display, leaving the more "dynamic" positions on the circle to the text elements.

Additional content elements are aligned with the ends of the title text; they are out of the way of the main content and their placement allows 2 students to interact with the display simultaneously without crowding.

Check and Revise

- Stand back from the display and unfocus your eyes slightly; if the underlying pattern remains discernible in this fuzzy view your design probably has unity.
- Observe student reactions to help gauge the instructional effectiveness of your display.



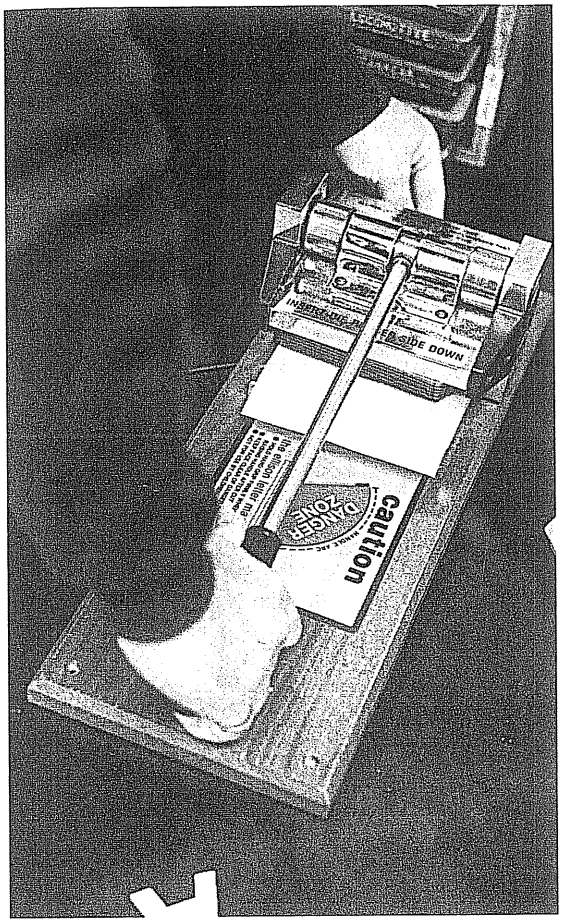
The additional content elements are placed on light purple rectangles to improve their alignment with other elements and to tie them into the circle pattern.

Text elements are more clearly linked by the addition of colored borders; the borders are a cool aqua blue, which offsets the overwhelming red effect of the initial design.

Captions on these elements have been made consistent.

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FIGURE 4.16
The Ellison lettering machine quickly cuts out large letters for bulletin boards.



Cloth Boards

Cloth boards are constructed of cloth stretched over a sturdy backing material such as plywood, Masonite, or heavy cardboard (Figure 4.17). The cloth used for the board may be of various types, including flannel, felt, or hook-and-loop material.

Pieces of flannel stick together when gentle pressure is applied. You can draw with felt-tip markers on visuals cut from flannel and put them on a flannel board. You can back still pictures and graphics with pieces of flannel. Coarse sandpaper also works to attach visuals to a cloth board. Pipe cleaners, available in a variety of colors, and fuzzy yarns stick to the flannel and you can use them for drawing lines and letters. If adhesion is less than desired, slant the board slightly back at the top to prevent materials from slipping.

The most expensive cloth board is made from hook-and-loop material (such as Velcro®). The hook-and-loop board has a fine but fuzzy surface composed of tiny, strong nylon loops. The material used for backing visuals and other items to be attached to the board has a coarse, hooklike texture. When pressed together, the two surfaces stick firmly. You can purchase the hooklike material in rolls or strips. One great advantage of the hook-and-loop board is that it can support large and heavy visuals, even books and other three-dimensional objects. One square inch of the cloth can support up to 10 pounds of properly backed visual material.

Teachers of reading and other creative activities often use the cloth board to illustrate stories, poems, and other reading materials. For example, they may place on the board visuals depicting characters and scenes in a story and move them around as the story unfolds. If you use this approach, you may encourage your students' creativity by allowing them to manipulate cloth-board

FIGURE 4.17
Cloth boards are often used to involve students in storytelling.



FIGURE 4.18
Magnetic boards allow quick manipulation of letters and other materials.



materials. Shy children may particularly profit from this kind of activity. It encourages them to speak through the visual representations of story characters as they move the illustrations on the board.

Be sure you have proper storage space for your cloth board and cloth-board visuals when not in use. Proper storage will help keep them clean and prevent them from being bent or torn. If possible, store your materials on a flat surface rather than stacking them up against a wall. If you use sandpaper backing on your visuals, put paper between them during storage, as sandpaper can scratch the surface of visuals.

Magnetic Boards

Magnetic boards serve much the same purpose as cloth boards. Visuals are backed with magnets and then placed on the metal surface of the board (Figure 4.18). Magnetic boards, magnets, and flexible strips of magnetic materials for use in backing are available commercially. Plastic lettering with magnetic backing is available from teacher supply stores and can be used for captioning visuals.

Any metal surface in the classroom to which you can attach a magnet can serve as a magnetic board. For example, some chalkboards are backed with steel and thus attract magnet-backed visuals. Use the chalk for captioning or to depict lines of association between visuals. You can also use steel cabinets and metal walls and doors as magnetic boards.

You can make your own magnetic board from a thin sheet of galvanized iron, a cookie sheet, a lap tray, or any similar thin sheet of metal. Paint the sheets in the color of your choice with paint designed for use on metal surfaces or cover with adhesive-backed paper. Unpainted surfaces may be unattractive and cause glare. Another alternative is to fasten steel screening to a nonmetal surface, such as plywood, and cover it with cloth.

The major advantage of magnetic boards is that maneuvering visuals is easier and quicker than with cloth boards. For example, physical education instructors often use them to demonstrate rapid changes in player positions. Magnetic boards also have greater adhesive quality. Visuals displayed on a magnetic board are not likely to slip or fall. They move only when you move them.

Flip Charts

A **flip chart** is a pad of large paper fastened together at the top and mounted to an easel. The individual sheets each hold a limited verbal/visual message and usually are arranged for sequential presentation to a small group. You may write messages extemporaneously while talking or you can prepare them in advance to be revealed one at a time. You can use poster makers, such as the PosterPrinter, to produce flip chart pages (Figure 4.19). Commercially produced materials are also available in this format; they are especially prevalent in reading and science instruction and military training. Prepared visual sequences are especially useful for instruction involving sequential steps in a process. The diagrams or words can serve as cues, reminding you of the next point in your presentation.

The most common use of flip charts, though, is for the extemporaneous drawing of key illustrations and key words to supplement a standup presentation. The flip chart is an extremely versatile, convenient, and inexpensive media format. It requires no electrical power, has no moving parts to wear out, can be used in a range of lighting conditions, is portable, and requires only a marking pen as peripheral equipment. Next to the

AV SHOWMANSHIP Flip Charts

- Position the flip chart at an angle so everyone can see it. Place it in the left front corner (as you face the audience) if you are right handed and in the right front corner if you are left handed.
- Be sure the easel is properly assembled and the pages are securely fastened so the flip chart will not fall apart during your presentation.
- Prepare lettering and visuals in advance or outline their shape using a light-blue pencil; then trace them during your presentation.
- For group-generated responses, draw lettering guidelines with a blue pencil.
- Keep lettering and visuals simple but large enough for everyone to see.
- Use more than one color, but not more than four.
- Use broad-tip marking pens that provide contrast but will not bleed through to the next sheet.
- Print rather than use cursive writing.
- Keep words short or use well-understood abbreviations.
- Include simple drawings, symbols, and charts.
- Talk to the audience, not to the flip chart.
- Avoid blocking the audience's view of the flip chart.
- Be sure your materials are in proper sequence.
- Have a blank sheet exposed when not referring to the flip chart.
- Reveal pages only when you are ready to discuss them, not before.
- Put summary points on the last sheet rather than paging back as you make your summary.

chalkboard, it is the most user-friendly media tool. But don't let the flip chart's simplicity fool you. Using it professionally takes some practice.

Audience members seem to regard the flip chart in friendly terms. It seems casual and comfortable, a pleasing change of pace in an increasingly high-technology world. It is an exceptionally valuable aid to any group discussion process. You may record ideas contributed by group members in a way visible to all participants, make any desired comments or corrections, and preserve the results. If you wish, tear the finished sheets off the pad and tape them to walls or windows for later reference. Flip charts are available in a variety of sizes for large-group use; others, often referred to as *travel easels,* are designed for portability (Figure 4.20).

Flip-chart-size Post-It™ easel pads are available from 3M. These 25-by-30-inch self-sticking easel sheets come in white or with a blue grid on white. The easel pads have a built-in handle, a sturdy backing, and a cover flap to protect the sheets from damage or flapping while in transit. The universal slots on the backing attach to most easel stands. Each sheet peels off for quick posting or can be flipped over the top of the pad.

FIGURE 4.19
The PosterPrinter converts a notebook-size original into a poster that is eight times larger.

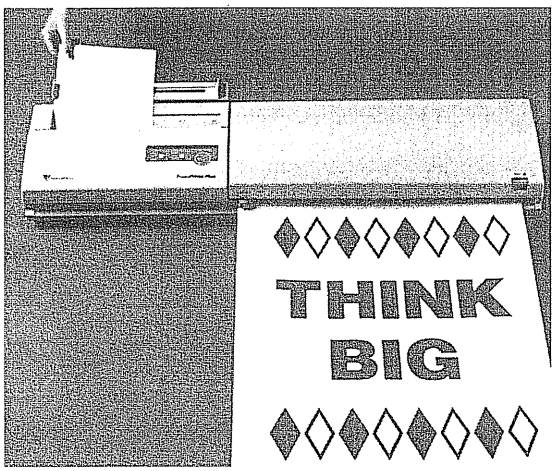


FIGURE 4.20
Flip charts, a standard in business and industrial training, are also used in schools.

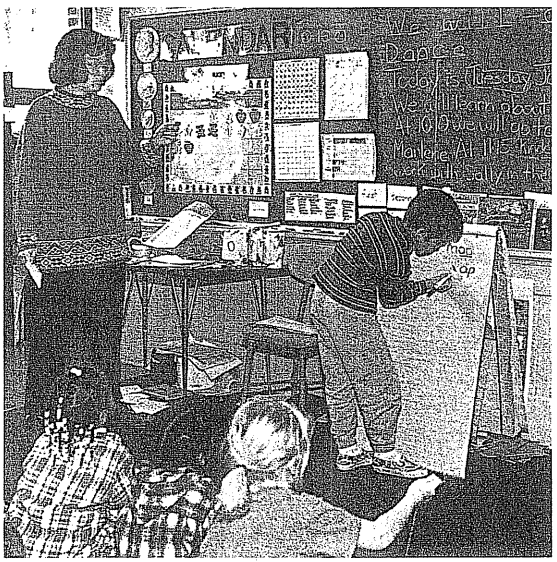


FIGURE 4.21
A complex exhibit such as this one brings together real objects, still pictures, and other visuals with verbal information.

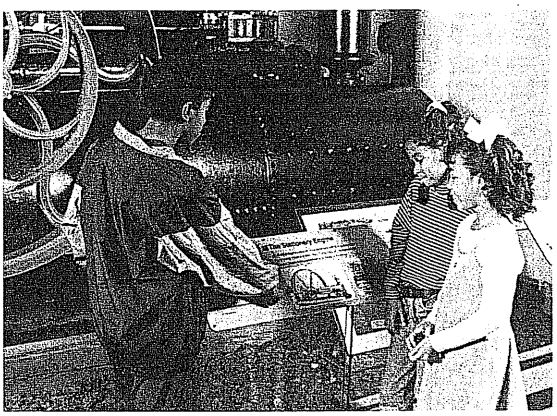
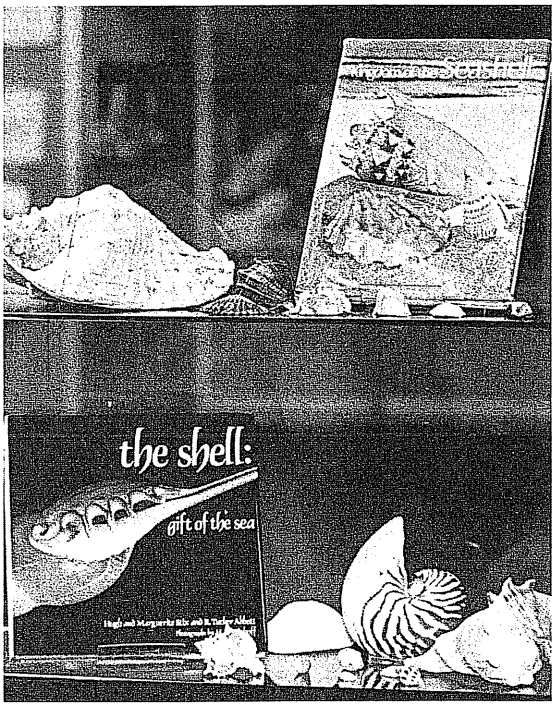


FIGURE 4.22
This simple teacher-made display consists of related artifacts arranged for easy observation by students.



Exhibits

Exhibits are collections of various objects and visuals designed to form an integrated whole for instructional purposes (Figure 4.21). Any of the visuals discussed in this chapter, as well as models and real objects, can be included in an exhibit, and any of the display surfaces discussed can contribute to an exhibit. Exhibits can generally be used for the same instructional purposes and in the same ways as their individual components are used.

Exhibit locations are readily available in most classrooms. You can set up simple exhibits on a table, shelf, or desk. More complex exhibits may require considerable floor space and special structures (a booth or bookshelf, for example).

The school media center is a convenient location for exhibits, displays, and dioramas. Often area museums or historical societies will loan these items. The media center may also provide space for display of student-produced exhibits.

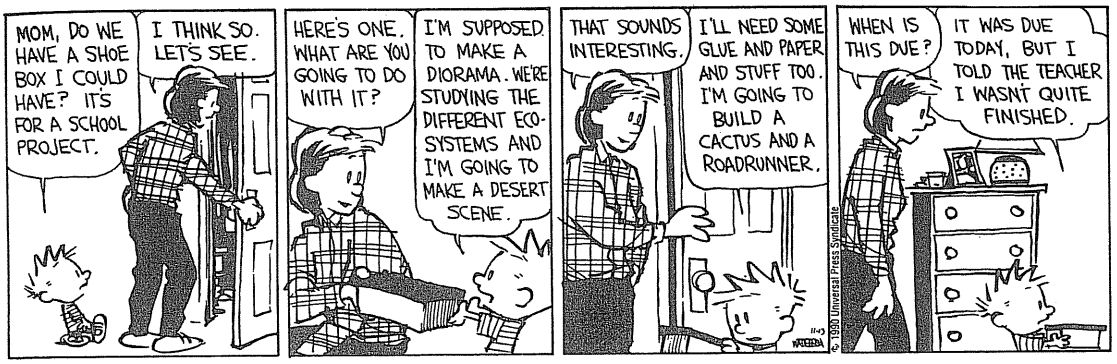
There are two types of exhibits—displays and dioramas. A display is a collection of materials, whereas a diorama shows a three-dimensional scene.

Displays. A *display* is an array of objects, visuals, and printed materials (e.g., labels and descriptions). Most displays include descriptive information about the objects or visuals shown. Instructional displays are used in the classroom (Figure 4.22), in museums, and in many other settings.

Student assembly of a display can be a motivating learning experience. It can foster retention of subject matter and sharpen visual skills. For a lesson in transportation, one sixth-grade teacher had each student bring in a replica of a vehicle. Some students made their own vehicles from construction paper. Others brought in toys from home or contributed vehicles assembled from hobby kits (e.g., boats, cars, trucks, trains, space ships). The teacher placed tables and other classroom furniture along a wall to provide the children with a shelf on which to arrange their three-dimensional objects. On the wall above the display surface, the teacher placed a long sheet of paper containing a timeline. The timeline illustrated forms of transportation from the past (humans and beasts), through the present (trains, cars, planes), and into the future (space vehicles). The display was a great success.

Dioramas. **Dioramas** are static displays consisting of a three-dimensional foreground and a flat background to create a realistic scene. The foreground is usually a landscape of some sort with models of people, animals, vehicles, equipment, or buildings. The naturalistic background may be a photograph, drawing, or painting. The diorama is usually contained within a box, with the sides of the box providing a backdrop. The rear corners or the entire back may be rounded to provide an illusion of depth, and lights can be added for a special effect.

FIGURE 4.23

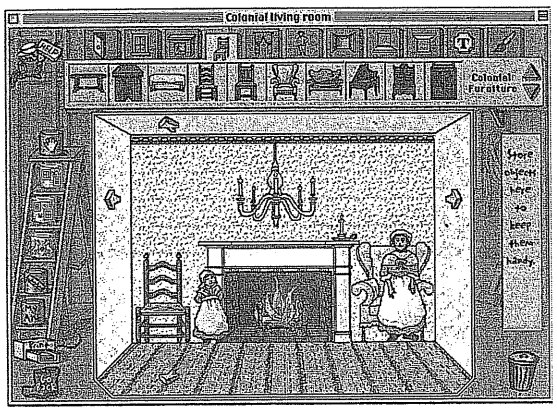


Calvin and Hobbes copyright© 1990 Watterson. Distributed by Universal Press Syndicate. Reprinted with permission.

MEDIA FILE

Diorama Designer©

Diorama Graphics Program



Source: Tom Snyder Productions

Age level: Grades 2 through 6

It is easy for students to create dioramas on the computer using the *Diorama Designer*© program. They can design original dioramas, print them in color, and assemble them to demonstrate understanding of historical periods for interdisciplinary units in social studies, language arts, or other classes. Students can select from a variety of backgrounds and decorative elements. People and furniture can be printed separately as 3-D elements to place inside the diorama. Dioramas can be printed in different sizes, from small enough to fit in a shoebox to a puppet-sized stage. Options include making posters, puppets, and masks.

A variation of this is *Rainforest Designer*©, which lets students design, build, and print 3-D rainforest habitats.

For additional product information, visit the Tom Snyder Productions Web Site at www.tomsnyder.com.

Dioramas are usually designed to reproduce past or present scenes and events or to depict future ones. Examples in museums are often lifesize, whereas those used in classrooms are usually on a smaller scale (Figure 4.23). In industry, dioramas often are constructed to show company products in use.

You may construct dioramas to illustrate your lessons or to introduce new topics. You may ask students to design their own dioramas as a followup activity to instruction (see "Media File: *Diorama Designer*"). Scenes from history, particularly battles, are often portrayed with model figures. Animals can be shown in their natural habitats for a biology class. Scenes including towns and landscapes from various parts of the world make stimulating dioramas for geography instruction. Prehistoric landscapes and geologic formations are also popular topics for dioramas.

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 4 of the Companion Website (http://www.prenhall.com/heinich).

1. *Planning Lessons Using Media Resources:* Locate a lesson or unit of study and identify all the various media resources that are included in the design of the lesson. Cite sources. What activities are identified in the lesson? How do the media you identified enhance the learning activities presented? What might you add to make it better? (ISTE NETS-T II-C; VI-A)
2. *Written Reflection.* Examine and reflect on the copyright guidelines given in this chapter. How might a teacher use media to enhance student learning and expand their access to resources within the guidelines? (ISTE NETS-T VI-A & D)

ASSURE BLUEPRINT

Vocational Technical College Welding Class

Analyze Learners

General Characteristics

The students at the Summit VoTech College range in age from 18 to 68 and include both men and women. All are high school graduates or have earned their GED, but most have low reading abilities (the average is ninth grade, with a range from sixth to fourteenth).

Most students are highly motivated to learn how to weld. With this skill they can get a high-paying job at a local manufacturing company. These jobs are some of the highest-paying ones in the area for high school graduates.

Entry Competencies

The chief requirements are the ability to follow instructions (which may be committed to memory after several weeks on the job) and to demonstrate good manual dexterity.

Students who are "coming back to school" while working are highly motivated to be successful. This is especially true of the "older" workers (25 years or older). The younger students sometimes just want to get by with as little effort as possible.

Learning Style

The students display a range of learning styles. Most of them have limited language skills, low math ability, good visual and spatial skills, and excellent kinesthetic ability.

State Objectives

On completion of the welding unit, the students will be able to do the following:

- Weld two pieces of metal according to specifications in the Product Rating Checklist (see Chapter 3, Figure 3.12) within seven minutes when given the necessary components and appropriate tools.

Subobjectives include the following:

- Adjust welding machine to proper settings for type of materials to be welded without reference to the manual and within 10 percent of the suggested settings.
- Demonstrate a proper weld using the materials and equipment provided. The bead must meet the criteria in the Product Rating Checklist and must be completed within seven minutes.

There are several other subobjectives as well as this affective objective:

- Wear safety helmet and work gloves during the entire welding process. (The students know they should do this, but they don't always do so.)

Select Methods, Media, and Materials

After checking through catalogs of industrial training materials and talking with curriculum directors from other vocational technical schools, Jan Smith, the chief welding instructor, decided to develop a set of drawings and photographs to be incorporated into a small (9-by-12-inch) flip chart for students to use. Jan wanted her students to learn to weld with the actual materials in front of them. Therefore, she rejected the idea of using one of the many videotapes on welding. The videotapes required viewing in a classroom and then going to the lab to practice the skills. Because of the need for hands-on practice and training, Jan developed a self-instructional unit incorporating actual welding materials, the flip chart, and an audiotape. She used humor to enhance motivation for those students who are not motivated.

Utilize the Materials

The students will be allowed to use the set of drawings and photographs incorporated into the small flip chart and practice actual welding as many times as necessary in the laboratory. An instructor will be available to answer questions and to evaluate the completed welds.

Require Learner Participation

The students will practice the skill and an instructor will provide constructive feedback. When the instructor is satisfied that a student has mastered the task, that student will do three test welds with different metals. The instructor will evaluate these test welds using the Product Rating Checklist. If all criteria are met the student receives a mastery score.

Evaluate and Revise

Jan will evaluate the students and the instruction based on a number of factors. The number of defective welds identified by the instructors during competency testing is one criterion. The instructors also will constantly observe the students for safety procedures (gloves and helmet) and welding sequence.

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 4 of the Companion Website (http://www.prenhall.com/heinich).

1. Obtain an example of manipulative(s) that you could use for instruction. Submit the manipulative(s) and a description of how you would use them, including an objective.
2. Use the "Appraisal Checklist: Print Materials" to evaluate a textbook, fiction book, nonfiction book, pamphlet, or manual.
3. Use the World Wide Web to locate free or inexpensive materials. Identify the website and describe the types of resources that are available to you.
4. Plan a lesson that would include a field trip. Locate at least one site on the World Wide Web that could be a place to visit as a virtual field trip in your lesson.
5. Demonstrate techniques (showmanship tips) for improving your utilization of chalkboards and multipurpose boards.
6. Demonstrate techniques (showmanship tips) to enhance learning from flip charts.
7. Prepare a bulletin board, cloth board, magnetic board, flip chart, or exhibit. Submit the material (or a photograph of the display), a description of the intended audience, the objectives, how you will use it and how you will evaluate it.

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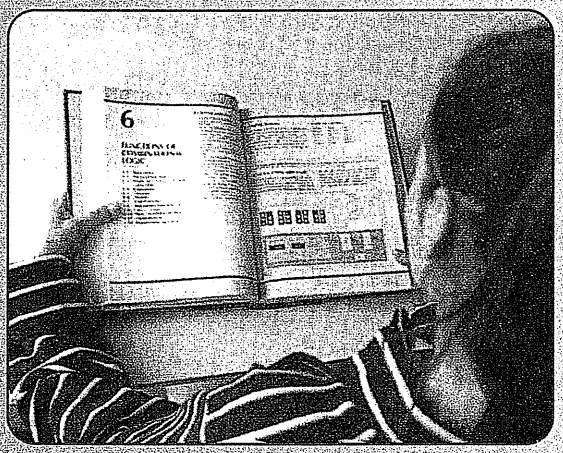
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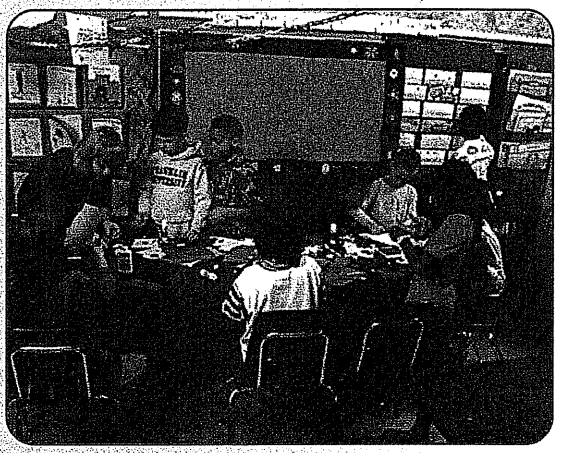
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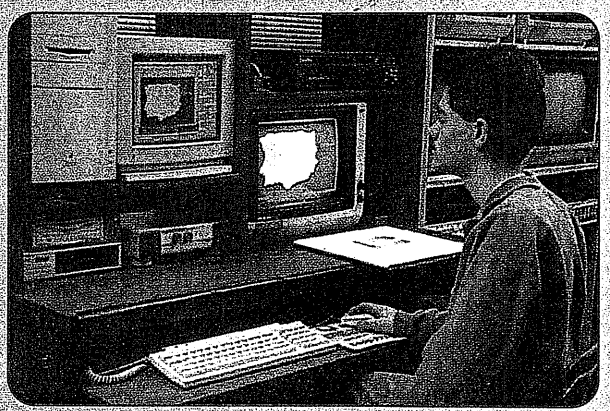
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Since the earliest days of schooling, education scholars have lamented teachers' overreliance on words as communication vehicles. Pictures can clarify complex ideas, make them easier to remember, and provoke emotional responses. In many schools, student media portfolios often include such items as illustrated books, videos, or audiovisual presentations.









Students vary in their abilities to interpret visuals and to create their own visual messages; the goal of visual literacy education is to enhance these abilities. You can improve your own ability to create instructionally effective visuals by following some basic visual design principles and processes and applying them to everyday design tasks, such as creating bulletin boards and designing computer screens.

CHAPTER 5

Visual Principles

OUTLINE

- The Roles of Visuals in Instruction
- Visual Literacy
- Goals of Visual Design
- Processes of Visual Design
- Visual Planning Tools
- Digital Images

KNOWLEDGE OBJECTIVES

1. Describe the roles that visuals play in instruction.
2. Define *visual literacy* in your own words.
3. Identify two general methods that you may use to teach visual literacy.
4. Describe the factors that influence students' decoding of visuals.
5. Describe the factors that influence students' encoding of visuals.
6. State in your own words the goals that good visual design aims to achieve.
7. Regarding the visual design process, characterize the qualities that a designer would look for in the individual visual and verbal elements of the design, including elements that add appeal.
8. Describe the factors that a designer would manipulate in establishing an underlying pattern to the design.
9. Describe the factors that a designer would manipulate in arranging the visual and verbal elements to achieve clear communication, reduce effort in interpreting, increase active engagement, and focus viewer attention.
10. List various roles that color can play in enhancing the impact of visual displays.

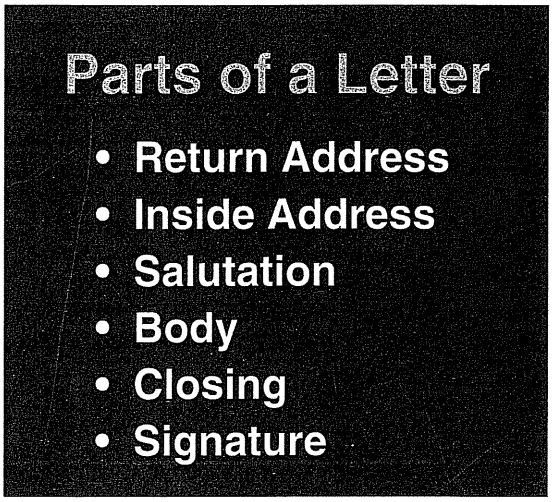
LEXICON

referent
iconic
visual literacy
sans serif
optical spacing
alignment
rule of thirds
complementary colors
analogous colors
proximity
directional
figure–ground contrast
storyboarding
digital camera
scanner
charge-coupled device (CCD)
photo CD

Because so much learning involves visual imagery, the design and use of visuals in instruction is worthy of separate consideration. Most of the media discussed in this text—transparencies, slides, video programs, computer courseware, multimedia—have a visual component. The rapidly increasing visual capabilities of computers and digital telecommunications can only heighten the importance of visuals in education. Unfortunately, in the past teachers and materials designers have too often used this valuable visual capability primarily to show pictures of . . . WORDS! (Figure 5.1.) The overemphasis on words has contributed to the failure of formal education to reach its ideal of universal success. We know that some students learn more readily through visual imagery, and even those who are verbal learners need visual supports to grasp certain types of concepts.

This chapter examines the functions and characteristics of visuals and visual literacy; it presents guidelines for designing and using visuals effectively. We suggest specific applications for teacher-made materials such as bulletin board displays and computer screens.

FIGURE 5.1
Too often, visual media are used to show only verbal messages.

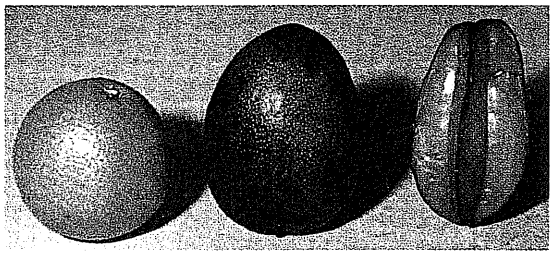


THE ROLES OF VISUALS IN INSTRUCTION

Attempts to make broad generalizations about the role of visuals in learning invariably fail to yield simple answers. For example, a major synthesis of research studies comparing visual-based lessons (those using photographs, overhead transparencies, video, and the like) with conventional instruction indicated a small overall superiority in achievement for students who experienced the visual treatment (Cohen, Ebeling, & Kulik, 1981). However, on closer examination it was found that the degree of superiority depended on many factors, including the subject matter and the utilization practices of the teacher. As discussed in Chapter 3, individual students vary in terms of their visual "intelligence" and in the way they process and use visual information.

One role that visuals definitely play is to provide a concrete **referent** for ideas. Words don't look or sound (usually) like the thing they stand for, but visuals are **iconic**—that is, they have some resemblance to the thing they represent (see Dale's Cone of Experience in Chapter 1). As such, they serve as a more easily remembered link to the original idea (Figure 5.2). Visuals can also motivate learners by attracting their attention, holding their attention, and generating emotional responses.

FIGURE 5.2
A color photograph can be a highly iconic visual, capturing much of the reality of the original referent.



Visuals can simplify information that is difficult to understand (Figure 5.3). Diagrams can make it easy to store and retrieve such information. They can also serve an organizing function by illustrating the relationships among elements, as in a flowchart or timeline.

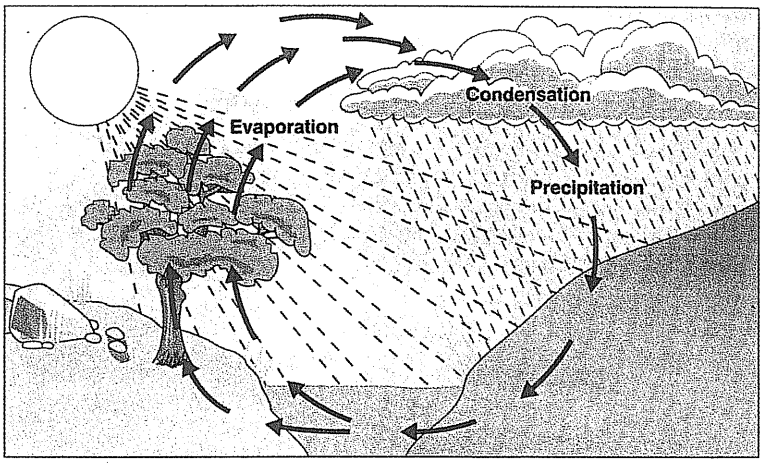
Finally, visuals provide a redundant channel; that is, when accompanying spoken or written verbal information they present that information in a different modality, giving some learners a chance to comprehend visually what they might miss verbally.

VISUAL LITERACY

Consider the sorts of visuals that are used every day for important communication purposes, such as the emergency information cards in airplanes (Figure 5.4) or highway signs that warn of dangerous curves or ob-

Significant contributions to this chapter were made by Elizabeth Boling, MFA, and Dennis Pett, EdD, both of Indiana University.

FIGURE 5.3
A complex process can be simplified and therefore made easier to understand and remember.



structions. They work only to the extent that you are "literate" in the conventions of that medium. Whereas the term *literacy* once was used only to refer to reading and writing of verbal information, today we use the term **visual literacy** to refer to the learned ability to interpret visual messages accurately and to create such messages. Research on visual literacy examines the influence of the visual processing system on the acquisition of knowledge, skills, and attitudes. Interest in visual literacy has grown to the point that it has become a professional interest area. The International Visual Literacy Association (IVLA), which conducts formal meetings and publishes its own periodical, is an organization established for professionals involved in visual literacy.

The critical role of visuals in education was recognized forcefully a century ago by John Dewey (1897), probably the most influential American philosopher of education:

> I believe much of the time and attention now given to the preparation and presentation of lessons might be more wisely and profitably expended in training the student's power of imagery and in seeing to it that he is continually forming definite, vivid, and growing images of the various subjects with which he comes in contact in his experience. (p. 80)

Visual literacy can be developed through two major approaches:

- *Input strategies.* Helping learners to *decode,* or "read," visuals proficiently by practicing visual analysis skills (e.g., through picture analysis and discussion of multimedia and video programs).

FIGURE 5.4
Well-designed visuals communicate clearly across boundaries of language and culture.



Source: Copyright SafeAir. Reproduced by permission.

FIGURE 5.5
Reading is the "decoding" activity of print literacy.

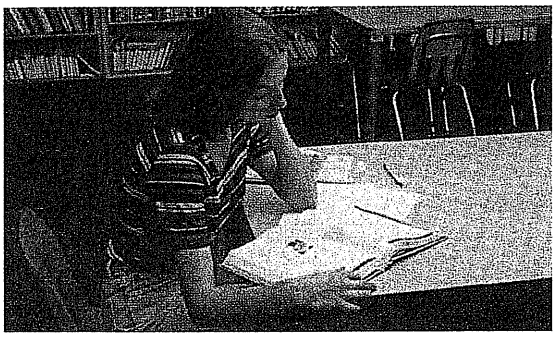
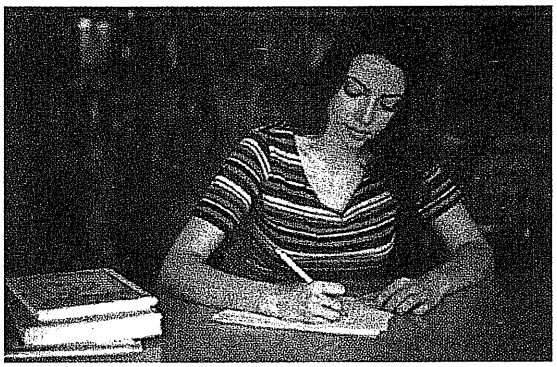


FIGURE 5.6
Writing is the "encoding" activity of print literacy.



- *Output strategies.* Helping learners to *encode,* or "write," visuals—to express themselves and communicate with others (e.g., through planning and producing photo and video presentations).

These input and output strategies are shown in Figures 5.5 through 5.8.

Decoding: Interpreting Visuals

Seeing a visual does not automatically ensure that one will learn from it. Learners must be guided toward correct decoding of visuals (see Figure 5.4). One aspect of visual literacy, then, is the skill of interpreting and creating meaning from surrounding stimuli.

Developmental Effects. Many variables affect how a learner decodes a visual. Prior to the age of 12, children tend to interpret visuals section by section rather than as a whole. In reporting what they see in a picture, they are likely to single out specific elements within the scene. Students who are older, however, tend to summarize the whole scene and report a conclusion about the meaning of the picture (Figure 5.9).

FIGURE 5.7
Interpreting a video program is the "decoding" activity of visual literacy.

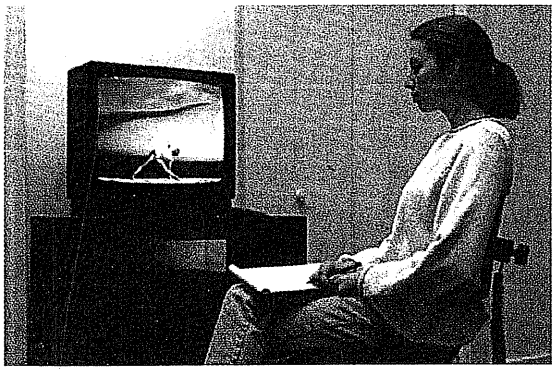
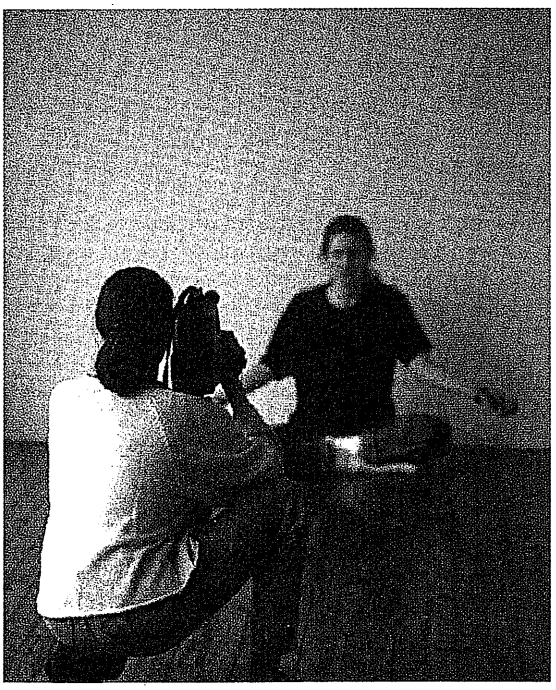


FIGURE 5.8
Creating a video program is the "encoding" activity of visual literacy.



Hence, abstract symbols or a series of still pictures whose relationship is not clearly spelled out may fail to communicate as intended with younger viewers (Figure 5.10). On the other hand, highly realistic visuals may distract younger children. However, as Dwyer (1978, p. 33) notes, "As a child gets older, he becomes more capable of attending selectively to those features of an instructional presentation that have the greatest potential for enhancing his learning of desired information."

FIGURE 5.9
What story do you think this picture is telling? Do you think a 5-year-old would see the same story?

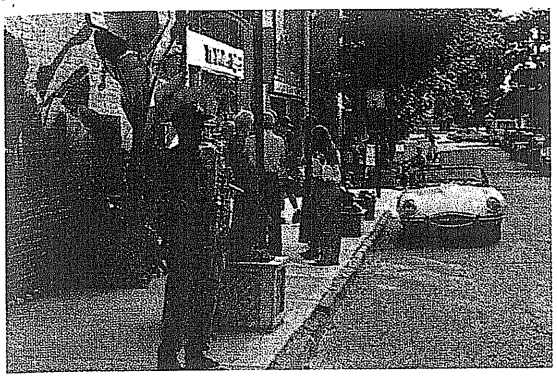
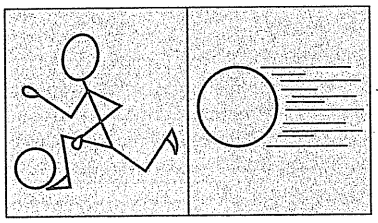


FIGURE 5.10
An active posture, as in the drawing on the left, communicates movement more reliably than arbitrary graphic conventions such as speed lines, as in the drawing on the right.



Cultural Effects. In teaching, we must keep in mind that the act of decoding visuals may be affected by the viewer's cultural background. Different cultural groups may perceive visual materials in different ways. For example, let's say your instruction includes visuals depicting scenes typical of the home life and street life of inner-city children. It is almost certain that students who live in such an area will decode these visuals differently than will students whose cultural (and socioeconomic) backgrounds do not include firsthand knowledge of inner-city living. Similarly, scenes depicting life in the Old West might be interpreted quite differently by a Native American child than they would be by an African American, Caucasian, or Mexican American child (Figure 5.11).

Visual Preferences. In selecting visuals, teachers have to make appropriate choices between the sorts of visuals that are preferred and those that are most effective. People do not necessarily learn best from the kinds of pictures they prefer to look at. For instance, research on picture preferences indicates that children in upper elementary grades tend to prefer color to black and white and to choose photographs over drawings; younger children tend to prefer simple illustrations, whereas older children tend to prefer moderately complex illustrations (Myatt & Carter, 1979).

Most learners prefer colored visuals over black-and-white visuals. However, there is no significant difference in the amount of learning except when color is related to the content to be learned (e.g., when workers must learn to assemble electrical components with different-colored wires, the presence of color is essential). Most

FIGURE 5.11
The cultural biases of a communicator, although unspoken, may be perceived vividly by viewers having a different cultural background.

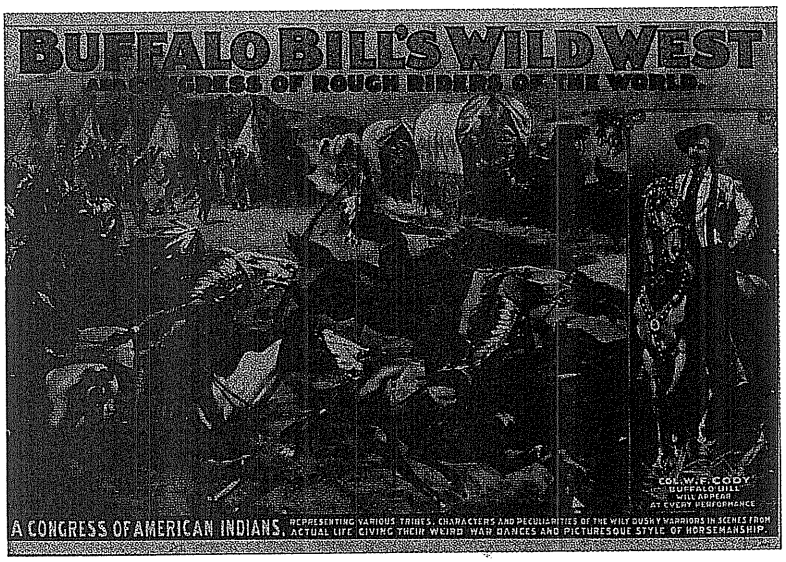
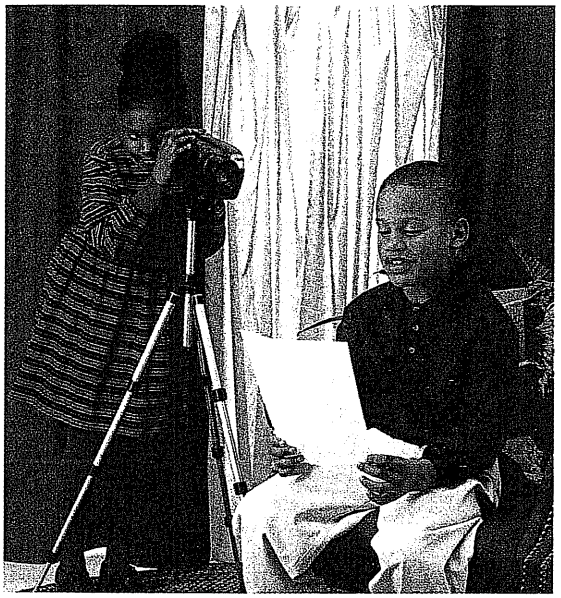


FIGURE 5.12
The camcorder is a handy tool for creating visual reports.



learners also prefer photographs over line drawings, even though in many situations line drawings may communicate better (e.g., drawings can eliminate distracting pictorial elements and highlight the important details). Even though many learners prefer very realistic visuals over abstract representations, teachers must strike a balance between the two to achieve their instructional purposes. Even though young learners prefer simple visuals and older students prefer more complex ones, simpler visuals are usually more effective, whatever the age group.

Regardless of their different starting points and differences in bias, students develop their visual abilities by *using* them. They can practice by viewing and critiquing visual displays, such as magazine ads, and by thinking critically about and discussing television programs. This chapter begins to explore some of these possibilities.

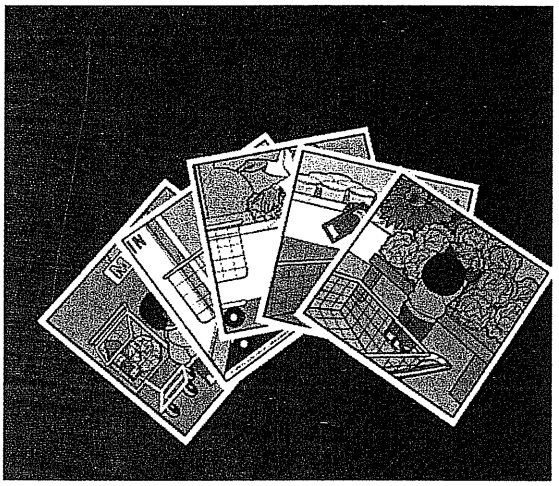
Encoding: Creating Visuals

Another route to visual literacy is through student creation of visual presentations. Just as writing can spur reading, producing media can be a highly effective way of understanding media.

Most older students have access to a camera. For example, you could encourage students to present reports to the class by carefully selecting sets of 35mm slides, which can help them to develop their aesthetic talents. The video camcorder is another convenient tool for students to practice creating and presenting ideas and events pictorially (Figure 5.12). Or, students can scan photos or drawings into a computer-generated presentation using software such as *PowerPoint*.

MEDIA FILE

Sequencing Picture Cards



Source: Judy/Instructo.

Beginning or remedial readers can improve their ability to visualize a narrative as a chronological sequence of events by arranging story cards in proper sequence. Each set of cards tells a story through a series of cards having pictures but no text. Eight different sets are included in this package, including "A Trip to the Grocery Store" (shown here), "Mailing a Letter," "Rescuing the Cat," and five others. Each set contains three to five cards.

One skill nearly always included in visual education curricula is that of sequencing. Reading specialists have long known that the ability to *sequence*—that is, to arrange ideas in logical order—is an extremely important factor in verbal literacy, especially in the ability to communicate in writing (see "Media File: Sequencing Picture Cards").

Children who have grown up constantly exposed to movies and television may expect the visuals they encounter in school to be similarly packaged and sequenced. They may need practice in arranging visuals into logical sequence, which is a learned skill, like the verbal sequencing in reading and writing. For this reason, many visual education programs, especially for primary school children, emphasize creative activities that call for arranging and making visuals.

This chapter emphasizes the principles that define effective visuals. The main purpose is to help you increase your own critical ability with visuals. But we also want to provide you with additional tools for teaching others these skills. This chapter focuses on understanding visual design and doing visual displays—creative activities

CLOSE-UP

VISUAL LITERACY EDUCATION

Visual literacy education programs have been developed throughout the United States and in many other countries to introduce students to the concepts and skills related to interpreting visuals and communicating visually. These programs are designed for children from preschool through high school and encompass both encoding and decoding visual information in all media. Visual literacy has now become well accepted as an important aspect of the curriculum at all levels of education.

One such program in the Minneapolis public schools involves students in many viewing skills activities and media production projects with the aim of developing critical viewing and thinking skills. Students examine all media with a focus on how elements such as color, camera angle, and pacing can affect the impact of visual messages. "Visual Education," the district's curriculum guide, encourages teachers to consider visual learning styles and emphasizes the importance of visuals in developing creativity and critical thinking skills. In many media centers around the district, students create poster campaigns, design new products and advertising, examine their television viewing habits, and analyze commercial messages. They produce videos using camcorders, and they design projects in video, photography, and other media.

In programs such as this all over the country, teachers are encouraged to think visually and to focus students' attention on the visual aspects of textbooks and storybooks while reading. Visuals inundate today's students, so their ability to read, understand, create, and analyze the persuasiveness of visuals has become more important than ever. Media production, computer design,



and critical thinking skills can enhance students' abilities to work and succeed in an increasingly visual world.

Elementary teachers have discovered the appeal of visual tools such as tangrams, visual searchers, and three-dimensional shapes. The concepts of sequencing, patterning, visual analogies, visual perception, visual attributes, and categorization are enhanced by other visual teaching tools, such as Venn diagrams, hidden pictures, drawings, memory games, and video clips. Students work alone or together on visual learning activities and develop communication, organization, and reporting skills in the process.

Source: Rhonda S. Robinson, Northern Illinois University.

that are certainly appropriate for students. Teachers use the storyboarding techniques discussed later in this chapter not only for their own planning but as a learning tool for their students; it helps them practice inferencing, sequencing information, and so on. Chapter 6 discusses slides and multi-image presentations, and Chapter 8 explores the possibilities of local video production. These skills are not just for you—you should pass them on to your students as well.

GOALS OF VISUAL DESIGN

What does a professional visual designer think about when facing a visual design problem? The considerations are too numerous and complex to be spelled out fully here. However, there are a few fundamental principles of visual design that even novices may pursue. For purposes of information and instruction, good visual design tries to achieve at least four basic goals in terms of improving communication:

- Ensure legibility.
- Reduce the effort required to interpret the message.
- Increase the viewer's active engagement with the message.
- Focus attention on the most important parts of the message.

Ensure Legibility

A visual cannot even begin to do its job unless all viewers can see the words and images. It's surprising how often this simple rule is broken. Think of how many times you have heard a presenter say, "you may not be able to see what's on this transparency [or slide], so let me read it to you." The goal of good visual design is to remove as many obstacles as possible that might impede transmission of your message (specific guidelines on, for example, the size of letters appear later in this chapter).

Reduce Effort

As a designer you want to convey your message in such a way that viewers expend little effort making sense out of what they are seeing and are free to use most of their mental effort for understanding the message itself. You

may use several simple processes to help reduce the effort required to interpret your visuals. Later in this chapter you will see how establishing an underlying pattern (alignment, shape, balance), putting like things together (proximity), and following a regular pattern in your treatment (consistency) contribute to this goal. Using harmonious color combinations and figures that contrast with their backgrounds also play roles.

Increase Active Engagement

Your message doesn't stand a chance unless people pay attention to it. So a major goal is to make your design as appealing as possible—to get viewers' attention and to entice them into thinking about your message. Ideas elaborated later in this chapter include using novelty to grab attention and using textures and interactive features to get viewers actively engaged with your message. Choosing a style appropriate for your audience and using appealing color schemes also will help you gain and hold your audience.

Focus Attention

Having enticed viewers into your display, you then face the challenge of directing their attention to the most important parts of your message. The overall design pattern plus specific directional guides (woven into the design and color cues) are your means for achieving the goal of focusing attention.

PROCESSES OF VISUAL DESIGN

This section outlines a set of procedures for carrying out visual design so as to enhance these goals. Throughout this chapter and in Chapters 4 and 6 are specific examples of these procedures and explanations of how these decisions contribute to reaching the four basic goals of visual design. In this chapter, see "How to . . . Use Color in Instructional Materials" and "How to . . . Design Computer Screens;" in Chapter 4 see "How to . . . Design Text" and "How to . . . Design Bulletin Boards"; and in Chapter 6 see "How to . . . Design Overhead Transparencies."

Teachers, designers, and others who create visual and verbal/visual displays face a series of design decisions about how to arrange the elements to achieve their goals. We will group these decisions into three sets:

1. *Elements:* Selecting and assembling the verbal/visual elements to incorporate into the display
2. *Pattern:* Choosing an underlying pattern for the elements of the display
3. *Arrangement:* Arranging the individual elements within the underlying pattern

As a final step, check your decisions against the goals and revise as needed.

Elements

Designing a visual display begins by gathering or producing the individual pictorial and text elements that you expect to use in the display. This assumes, of course, that you have already determined students' needs and interests regarding the topic and decided what objective you might achieve through the visual you are planning—be it a bulletin board, an overhead transparency, printed handouts, or computer screen display.

In selecting or producing the pictorial and text elements, you will want to make your choices based on achieving the visual design goals—ensuring legibility, helping viewers to quickly see your message, getting viewers actively engaged with your message, and focusing attention on key points. We have grouped the following design suggestions according to the various elements or components of the display: the visual elements (choosing the type of visual), the verbal elements (lettering style and location), and the elements that add appeal (surprise, texture, interaction).

Visual Elements. The type of visual selected for a particular situation depends on the learning task. Visual symbols, one classification of learning resources in Dale's Cone of Experience (discussed in Chapter 1), can be subdivided into three categories: realistic, analogic, and organizational (Houghton & Willows, 1987).

Realistic visuals show the actual object under study. For example, the color photograph of a covered wagon in Figure 5.13 is a realistic visual. Using realistic colors can heighten the degree of realism; this is one of the major instructional purposes that color serves. No representation, of course, is totally realistic. The real object or event will always have aspects that cannot be captured pictorially, even in a three-dimensional color motion picture. The various visual forms themselves range in representation from highly realistic to highly abstract.

One might be inclined to conclude that effective communication is always best served by the most realistic visual available. After all, the more realistic a visual is, the closer it is to the original. This, however, is not necessarily so. There is ample research to show that under certain circumstances, realism can actually interfere with communication and learning. For example, the ability to sort out the relevant from the irrelevant in a pictorial representation grows with age and experience. So, for younger children and for older learners who are encountering an idea for the first time, the wealth of detail found in a realistic visual may increase the likelihood that the learner will be distracted by irrelevant elements of the visual.

As Dwyer (1978, p. 33) notes in his review of visual research, "The arbitrary addition of stimuli in visuals makes it difficult for learners to identify the essential learning cues from among the more realistic background stimuli." Dwyer concludes that rather than be-

FIGURE 5.13
Photographs, illustrations, graphics, and words represent a continuum of realism for different kinds of symbols.

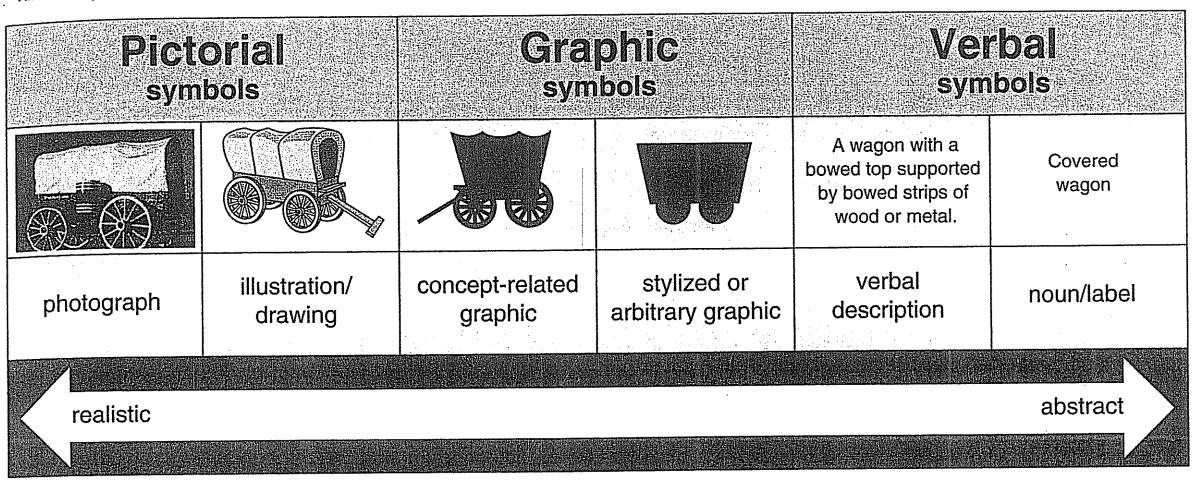
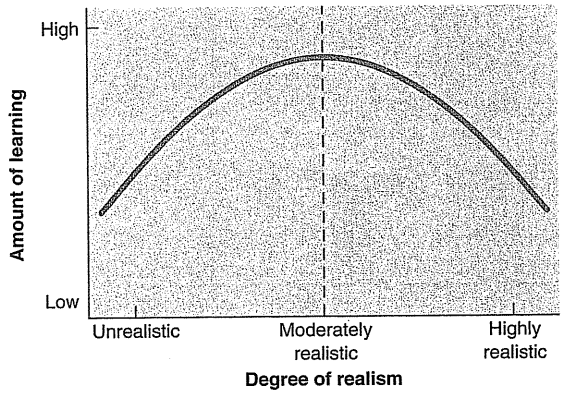


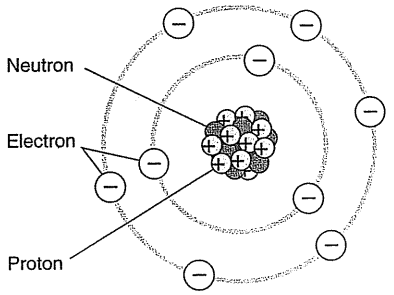
FIGURE 5.14
Visuals tend to become less useful in instruction as they approach the extremes of very abstract or very realistic.



ing a simple yes-or-no issue, the amount of realism desired has a curvilinear relationship to learning. That is, either too much or too little realism may affect achievement adversely (Figure 5.14).

Analogic visuals convey a concept or topic by showing something else and implying a similarity. Teaching about electricity flow by showing water flowing in series and parallel pipes is an example of using analogic visuals. An analogy for white blood cells fighting off infection might be an army attacking a stronghold. Later in this chapter, we use the color wheel as an analogy to help you visualize the relationships among the colors of the visible spectrum. Such visuals help learners interpret new information in light of prior knowledge and thereby facilitate learning (Figure 5.15).

FIGURE 5.15
The solar system is often used as a visual analogy to explain the composition of an atom.



Organizational visuals include flowcharts, graphs, maps, schematics, and classification charts. (See Chapter 6 for details on types of charts and graphs.) These graphic organizers can show relationships among the main points or concepts in textual material. This type of visual (such as the one in Figure 5.16) helps communicate the organization of the content.

Verbal Elements. Most displays incorporate some type of verbal information in addition to visuals. In evaluating a display for its instructional potential or in preparing your own display, you need to consider the lettering as carefully as you consider the pictorial elements, for it can communicate powerfully, too. At a minimum, you have to be sure that the lettering is legible in terms of size and spacing and of a style that is consistent with your intended message.

FIGURE 5.16
An organizational chart, such as this one representing a section of this chapter, can help show relationships among concepts.

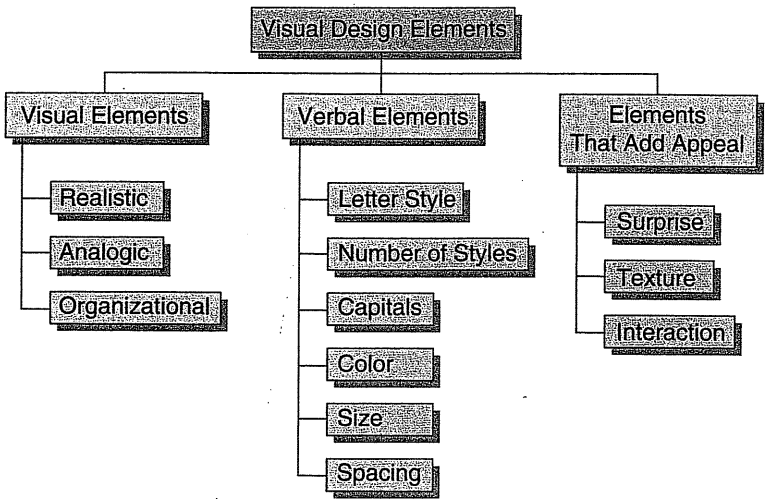
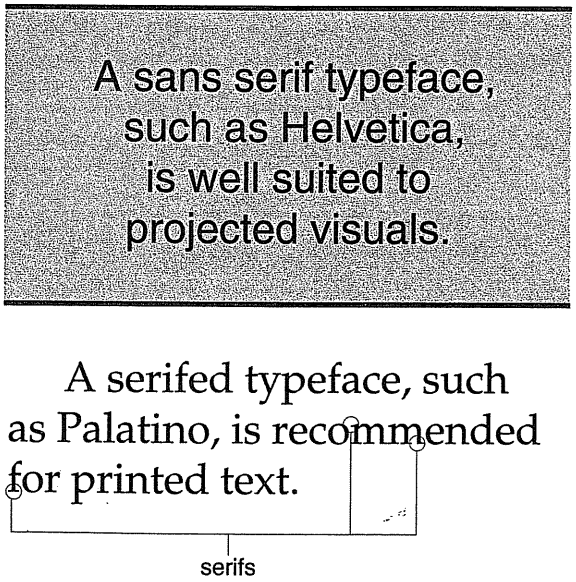


FIGURE 5.17
Styles of type should be selected to suit their purpose.



Letter Style. The style of the lettering should be consistent and should harmonize with the other elements of the visual. For straightforward informational or instructional purposes, a plain (i.e., not decorative) lettering style is recommended. You may choose a **sans serif** style, such as Helvetica, or a simple serif style, such as Palatino, for either projected visuals or bulletin boards. As illustrated in Figure 5.17, it is recommended that you use sans serif typefaces for projected visuals and displays and serif typefaces for printed materials such as handouts (Faiola, 2000).

Number of Lettering Styles. A display—or a series of related visuals, such as a slide series—should use no more than two different type styles, and these should harmonize with each other. When preparing text on a computer it is tempting to use many variations of a typeface, but for good communication it is best to limit the number of variations (e.g., bold, italic, underline, size changes) to a maximum of four. That is, you could use two different type sizes plus some italics and some underlining, or three different type sizes plus bold for emphasis.

Capitals. For best legibility, use lowercase letters, adding capitals only where normally required. Short headlines may appear in all capitals, but phrases of more than three words and full sentences should follow the rule of lowercase lettering.

Color of Lettering. As discussed later in the section "Figure–Ground Contrast," the color of the lettering should contrast with the background color both for the sake of simple legibility and for the sake of emphasis in cases where you want to call particular attention to the verbal message. You must also remember that some of your learners may be color blind. Legibility depends mainly on contrast between the lettering color and the background color.

Size of Lettering. Displays such as bulletin boards and posters are often meant to be viewed by people situated at a distance of 30 or 40 feet or more. In these cases the size of the lettering is crucial for legibility. A common rule of thumb is to make lowercase letters ½ inch high for each 10 feet of viewer distance. This means, for example, that to be legible to a student seated in the last seat of a 30-foot-long classroom the lettering would have to be at least 1½ inches in height.

FIGURE 5.18
These are the minimum heights of boldface lowercase letters for visibility at increasing distances.

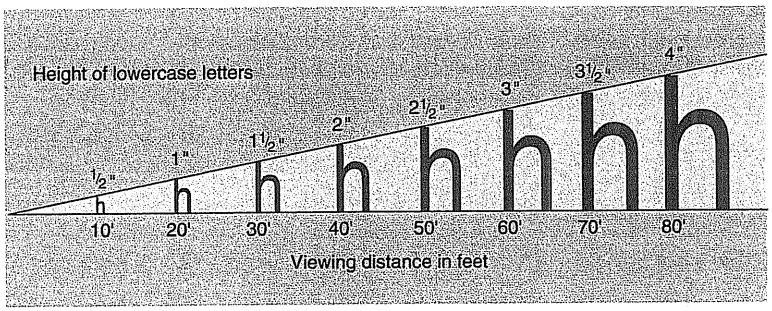


FIGURE 5.19
Optical spacing means estimating approximately equal amounts of white space between letters.

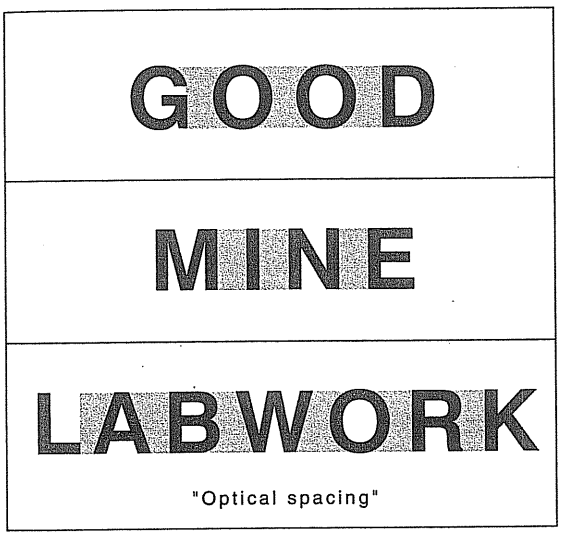


FIGURE 5.20
Lines of text should not be too cramped or too widely separated.

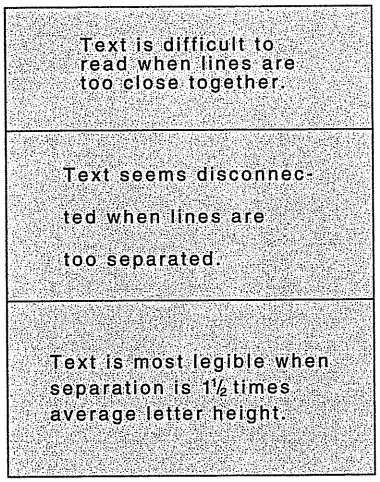


Figure 5.18 illustrates these minimum specifications for lettering height.

Spacing Between Letters. The distance between the letters of the individual words must be judged by experience rather than on a mechanical basis. This is because some letters (e.g., capital *A, I, K,* and *W*) are quite irregular in shape compared with rectangular letters (e.g., capital *H, M, N,* and *S*) and circular letters (e.g., capital *C, G, O,* and *Q*). When rectangular letters or circular letters are combined with each other at equal spacing, rather regular patterns of white space occur between letters. But when irregular letters are combined with others in this way, the patterns of white space can be very uneven. The only way to overcome this potentially distracting unevenness is to space all your letters by **optical spacing**—that is, by what *appears* even to the eye (Figure 5.19).

Spacing Between Lines. The vertical spacing between lines of printed material is also important for legibility. If the lines are too close together, they will tend to blur at a distance; if they are too far apart, they will seem disjointed (i.e., not part of the same unit). For a happy medium, the vertical space between the lines should be slightly less than the average height of the lowercase letters. To achieve this, use a ruler to draw lines lightly on your blank layout. Separate baselines by about one and a half times the height of the lowercase letters. Lettering on these lines will then result in text with the correct spacing (Figure 5.20).

Elements That Add Appeal. Your visual has no chance of having an effect unless it captures and holds the viewer's attention. Let's look at three devices for making displays more appealing: surprise, texture, and interaction.

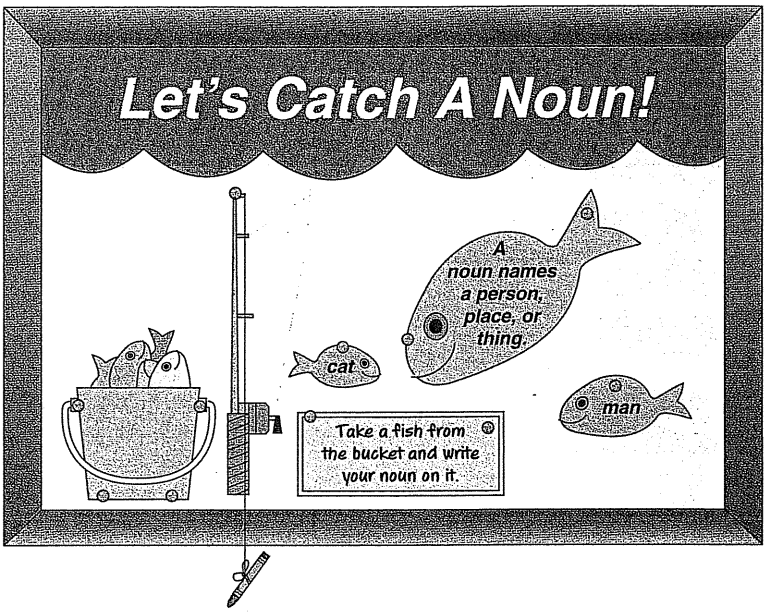


FIGURE 5.21
Encouraging interaction adds greatly to the appeal of a display.

Surprise. What grabs attention? The unexpected, primarily. Think of an unusual metaphor, an incongruous combination of word and picture, an abrupt infusion of color, a dramatic change of size. People pay attention as long as they are getting novel stimuli or new information. They tune out when the message becomes monotonous.

Texture. Most visuals are two dimensional. However, you can add a third dimension by using texture or actual materials. Texture is a characteristic of three-dimensional objects and materials. It can convey a clearer idea of the subject to the viewer by involving the sense of touch—for example, touching samples of different cereal grains. Or texture can simply invite involvement—for example, using cotton balls to represent clouds or showing book jackets to entice students to read a new book. Company products can be incorporated into a display. Components of equipment can be shown with drawings and captions.

Interaction. The R of the ASSURE model ("*R*equire learner participation") applies to all forms of media. Viewers can be asked to respond to visual displays by manipulating materials on a display, perhaps to answer questions raised in the display. Students can move answer cards to math facts into the correct position. Answers to geography questions can be hidden under movable flaps. The teacher or learners can move dials on a weather display to indicate the forecast for the day or the actual weather outside the classroom. One example of an interactive format is shown in Figure 5.21.

Pattern

Having made tentative decisions about what elements to include in your visual display, you are ready to consider its overall "look." The idea is to establish an underlying pattern—to decide how the viewer's eye will flow across your display. The major factors that affect the overall look are alignment of elements, shape, balance, style, color scheme, and color appeal.

Alignment. When you position the primary elements within a display so that they have a clear visual relationship to each other, viewers expend little effort making sense out of what they are seeing and are free to concentrate on understanding the message being conveyed. The most effective way to establish such visual relationships is to use **alignment.** Viewers will perceive elements to be aligned when the edges of those elements are aligned on the same imaginary horizontal or vertical line, as shown in Figure 5.22. These imaginary lines should be parallel to the edges of the display. For an irregularly shaped element, surround it mentally with a rectangle and align that rectangle, as shown in Figure 5.23.

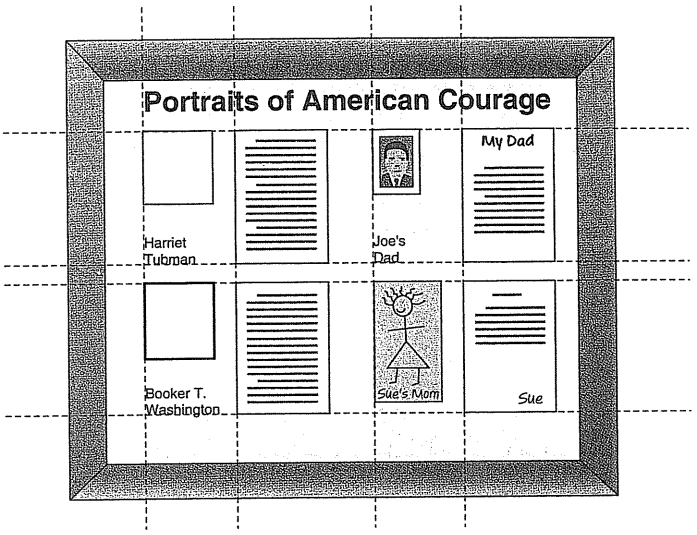


FIGURE 5.22
Pictorial elements should be aligned with reference to the edges of the display.

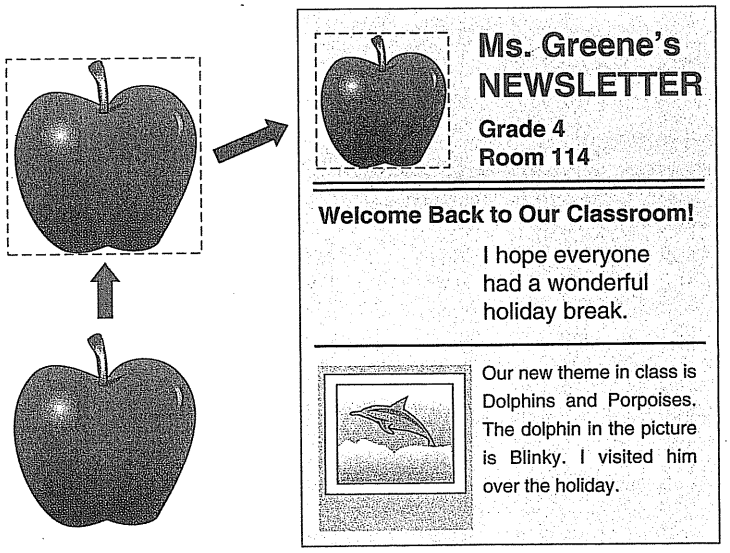


FIGURE 5.23
An irregularly shaped element can be aligned by mentally surrounding it with a rectangle.

Shape. Another way to arrange the visual and verbal elements is to put them into a shape that is already familiar to the viewer. Your aim should be to use a pattern that attracts and focuses attention as effortlessly as possible. A simple geometric figure, such as a circle, triangle, or rectangle, provides a convenient framework because its shape is predictable to most viewers (Figure 5.24). Shapes that approximate certain letters of the alphabet have the same virtue. The letters *Z, L, T,* and *U* are frequently used as underlying patterns in display layouts (Figure 5.25). Of course, the words used in the layout, as well as the pictures, form part of the shape.

Another principle that can guide the placement of visual elements is the **rule of thirds.** That is, elements arranged along any of the one-third dividing lines take on importance and liveliness. The most dominant and dynamic position is at any of the intersections of the horizontal and vertical one-third dividing lines,

FIGURE 5.24
Arrangement of elements in a familiar geometric pattern, such as a circle, makes a display easier to decode.

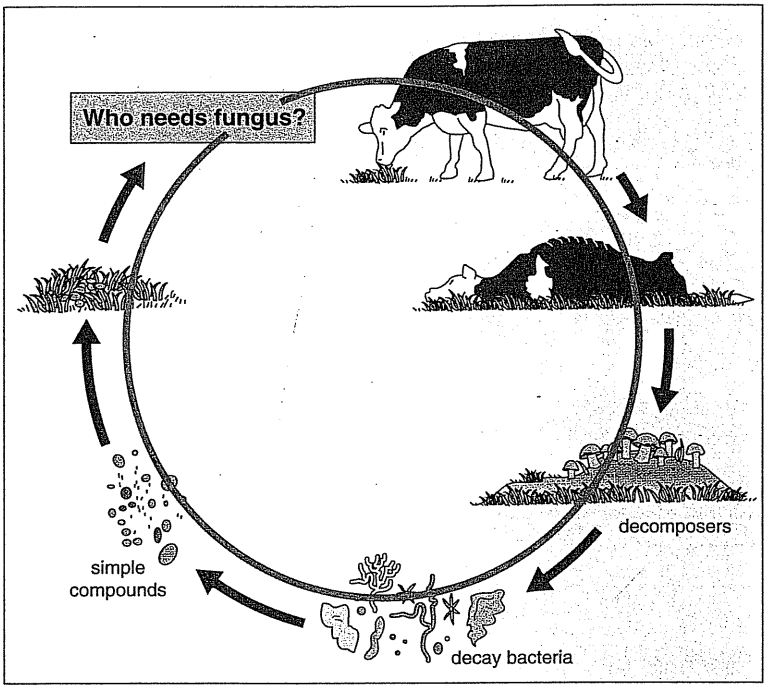
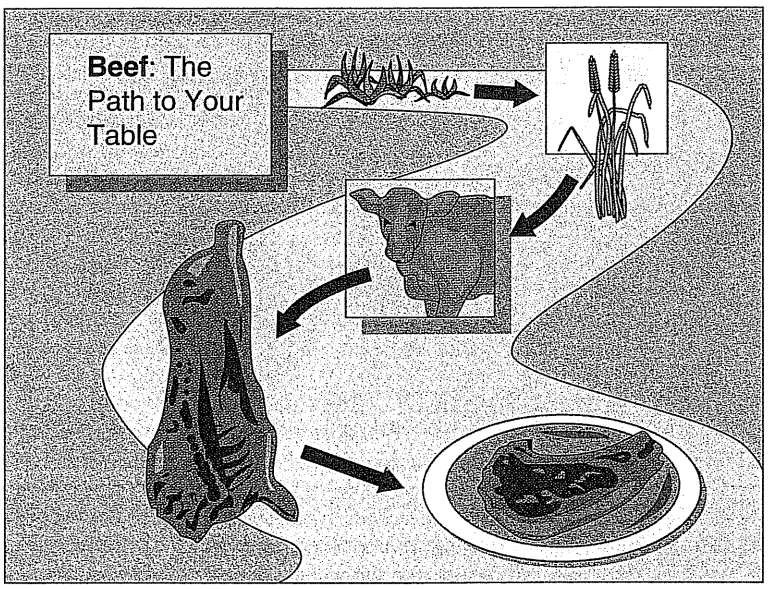


FIGURE 5.25
Arrangement in the shape of the letter Z leads the viewer's eye from upper left to lower right.



especially the upper left intersection (Figure 5.26). The most stable and least interesting point on the grid is dead center. Items placed in the corners or at the edges tend to be ignored or to make the arrangement unbalanced.

Balance. A psychological sense of equilibrium, or *balance,* is achieved when the "weight" of the elements in a display is equally distributed on each side of an axis, either horizontally or vertically or both. When the design is repeated on both sides, the balance is symmetrical, or formal.

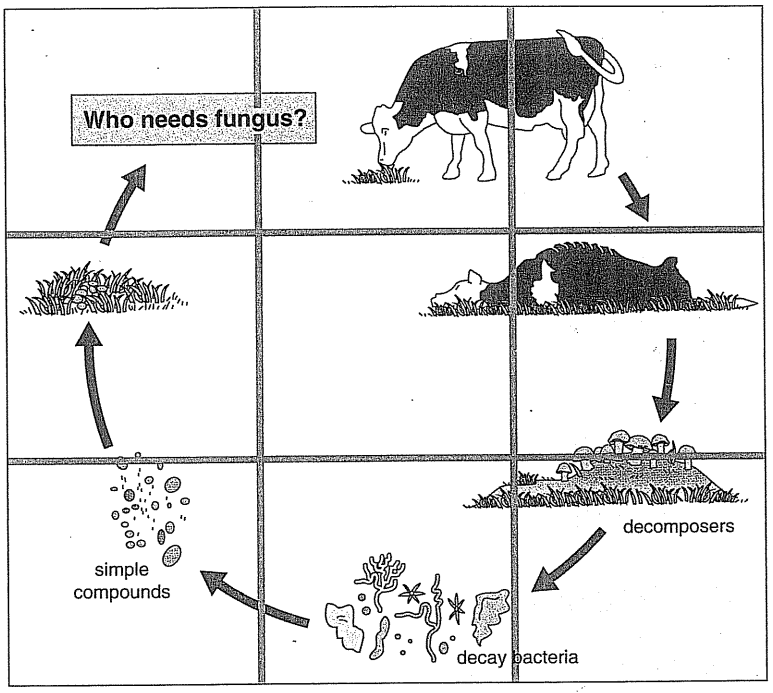


FIGURE 5.26
According to the "rule of thirds," the most important elements should appear near the intersections of the lines dividing the visual into thirds.

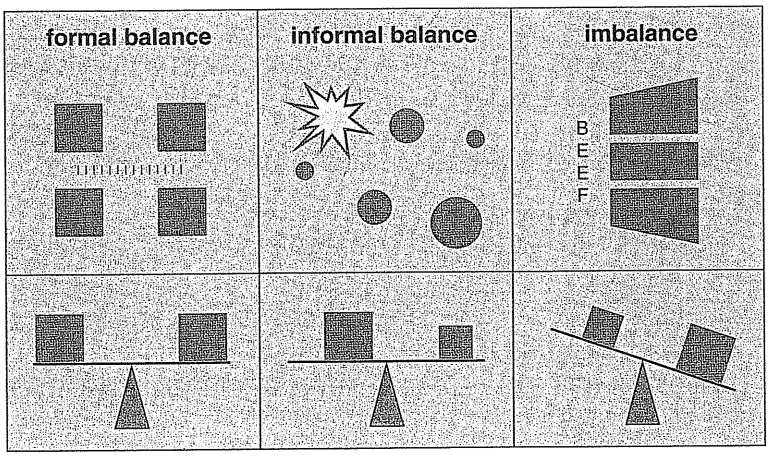


FIGURE 5.27
The analogy of a balance scale, shown in the bottom row, represents the three different types of balance.

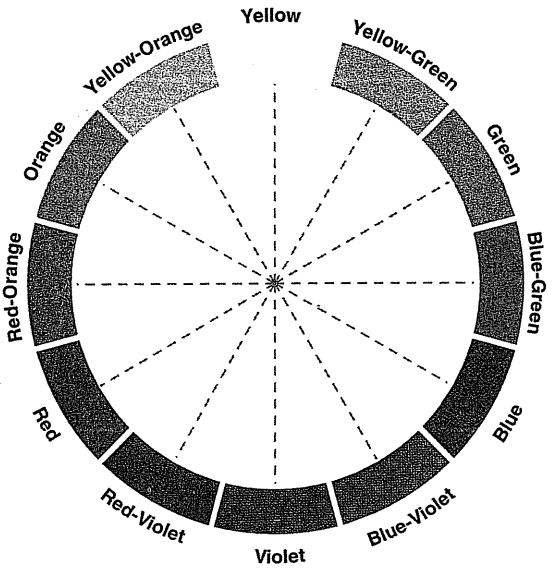
In most cases, though, for visuals that will catch the eye and serve an informational purpose you should aim to achieve an asymmetrical, or informal, balance. With asymmetrical balance there is rough equivalence of weight, but with different elements on each side (e.g., one large open square on one side, three small dark circles on the other). Informal balance is preferred because it is more dynamic and more interesting than formal balance (Figure 5.27). In general, try to avoid *imbalance*—using a distinctly disproportionate weight distribution—because it tends to be jarring.

Style. Different audiences and different settings call for different design styles. Think about the simple, uncluttered, primary-color "look" of the *Barney and Friends* television show compared with the complex imagery, busy scenes, and realistic color of an adult action drama. Likewise, you would not use the same stylistic

FIGURE 5.28
A slide set intended for an adult, professional audience should have a different style than one intended for elementary school–age children.



FIGURE 5.29
The traditional color wheel helps one visualize complementary colors.



treatment for a first-grade bulletin board (see, for example, Figure 5.21) as you would for a slide set made to show at a teachers' professional development conference (Figure 5.28). Your choice of lettering and type of pictures should be consistent with each other and with the preferences of the audience.

Color Scheme. When choosing a color scheme for a display, consider the harmoniousness of the colors. Viewers are more likely to linger over and to remember a display having pleasant color harmony than they would a display done with clashing colors. The color wheel is a visual analogy to help us understand the relationships among the colors of the visible spectrum (Figure 5.29).

Any two colors that lie directly opposite each other on the color wheel are called **complementary colors**—for example, red and green or yellow and violet. (The latter combination is one of the most popular ones for colored overhead transparencies—yellow-orange lettering on a blue-violet background.) Complementary colors often harmonize well in terms of an overall color scheme (Figure 5.30). However, try not to directly juxtapose two complementary colors (e.g., placing green letters on a red background). There are two reasons for this. First, if the colors are of equal value, or darkness, the letters will not have good figure–ground contrast. Second, when saturated (intense) complementary colors are placed directly next to each other the eye cannot focus on both at the same time, so you get an unpleasant vibrating effect.

Colors that lie next to each other on the color wheel are called **analogous colors**—for example, blue-green, blue, and blue-violet. Analogous colors may also form pleasing combinations when used together in a display.

When thinking about a color scheme for a display or a computer screen, it may be helpful to think in terms of a background color, a color for the images or text appearing against that background, and a color for highlights. Colors that work well together are shown in Table 5.1.

Please view these suggestions about color schemes as general guidelines, not as absolute rules, because in any situation there are many factors that will have an impact on whether particular colors will work well together. Keep in mind that these generalizations also assume normal color vision on the part of viewers. We know that 8 percent of all men and less than 1 percent of all women are color blind. Most color-blind people confuse reds with greens and see mainly in shades of blue and yellow. That is, for color-blind viewers, red lettering on a green background might be difficult to distinguish. You can alleviate this problem by making sure that the colors vary in darkness, for example, by using dark red letters on a light green background.

Colors on a computer screen may not be the same from one computer to another. Projected colors may also be different. Colors that look good on your computer may look different when projected. It is a good idea to practice your presentation to determine if the projected colors are acceptable to you. Some colors may fade in brightness.

HOW TO . . . Use Color in Instructional Materials

Pett and Wilson (1996) provide the following guidelines for the use of color in instructional materials:

- Use color to add reality.
- Use color to discriminate between elements of a visual.
- Use color to focus attention on relevant cues.
- Use colors to code and link logically related elements.
- Be consistent in general color choices throughout materials.
- Use colors such as highly saturated red and violet to attract attention and to create emotional response.
- Use highly saturated colors for materials intended for young children.
- Consider accepted color meanings such as red and yellow are warm, green and blue are cool, red means stop, green means go, etc.
- When producing materials for persons from varied cultures consider the meanings they attribute to colors.

Adapted from Dennis Pett and Trudy Wilson, "Color Research and Its Application to the Design of Instructional Materials," *Educational Technology Research and Development, 44,* no. 3 (1996), p. 31.

FIGURE 5.30
Complementary colors, such as violet and yellow, can make pleasing combinations.

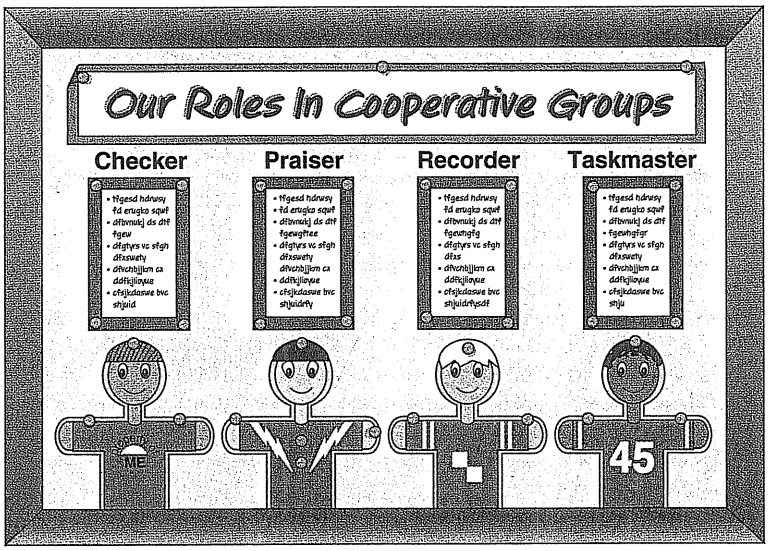


TABLE 5.1
Effective combinations of colors for background and images for displays and computer screens

BACKGROUND	FOREGROUND IMAGES AND TEXT	HIGHLIGHTS
white	dark blue	red, orange
light gray	blue, green, black	red
blue	light yellow, white	yellow, red
light blue	dark blue, dark green	red-orange
light yellow	violet, brown	red

Based on recommendations in "Color in Instructional Communication," by Judy Loosmore, *Performance and Instruction* 33 (November–December 1994): 36–38.

FIGURE 5.31
In this bulletin board display, warm colors fit with the friendly motif.

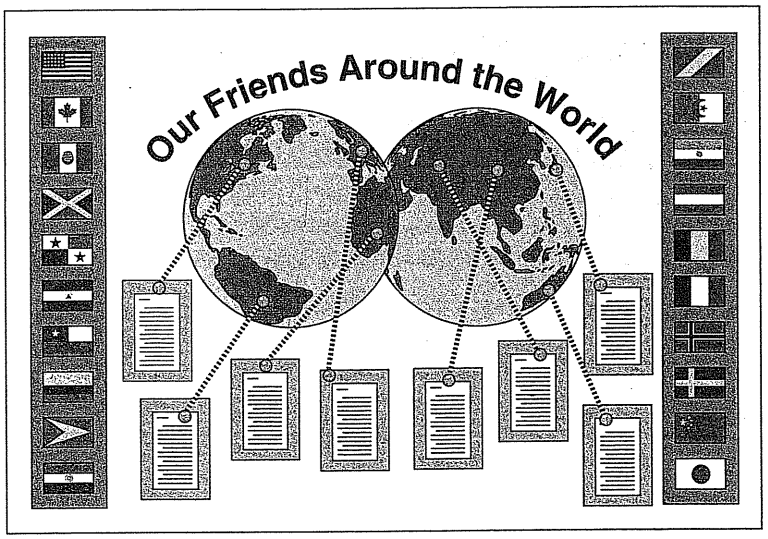
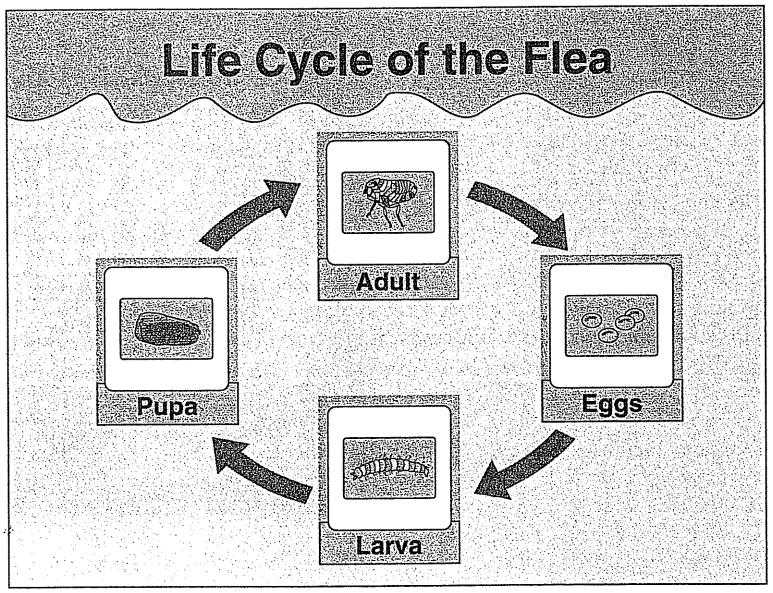


FIGURE 5.32
Here cool colors predominate, consistent with a more scientific atmosphere.



Color Appeal. Artists have long appreciated that blue, green, and violet are considered "cool" colors, whereas red and orange are considered "warm" colors. Research has shown that this is a learned phenomenon. When choosing colors for instructional materials, consider the emotional response you are seeking—an active, dynamic, warm feeling or a more contemplative, thoughtful, cool feeling. Also, saturated reds and orange appear to approach the viewer, whereas cool colors tend to recede. Take advantage of this effect by highlighting important cues in red or orange, helping them leap out at the viewer the way a red STOP sign stands out even in a cluttered urban landscape. By the same reasoning, use cool colors for backgrounds (Figures 5.31 and 5.32).

Response to warm and cool colors seems to be related to age. In general, children seem to prefer warm colors (particularly red, pink, yellow, and orange). Children also prefer brighter colors and combinations of intense colors more than do adults. With maturity tends

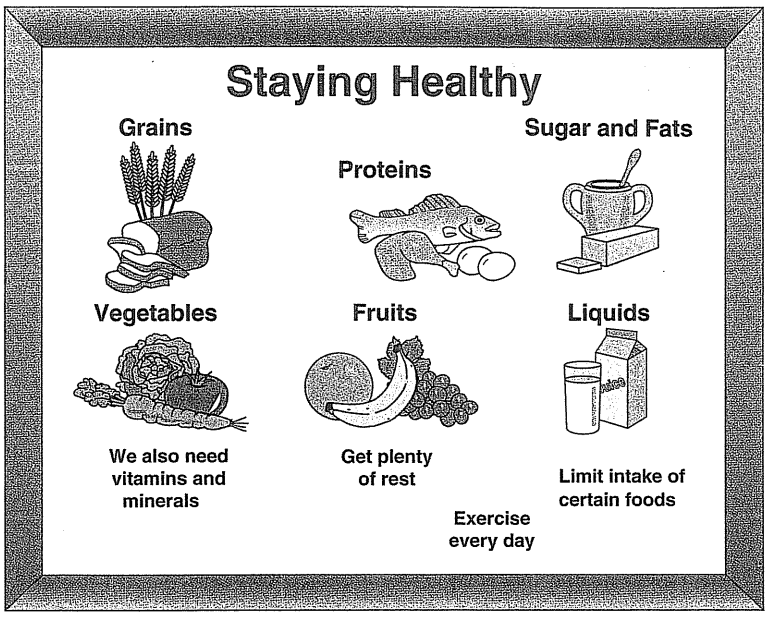


FIGURE 5.33
Here it is difficult to be sure which labels go with which images.

to come a changing preference toward cooler colors and subtler combinations.

There is also a cultural basis to color response. These responses are often deep seated and unconscious. For example, in North America certain colors are associated with certain holidays: red for Christmas and Valentine's Day, green for St. Patrick's Day, yellow and purple for Easter, orange and black for Halloween. Such symbolism can vary dramatically across cultures. For example, in Western countries black is the color of mourning, whereas in China and Japan white is the color of mourning.

Arrangement

Proximity. Once you have established the overall shape of your display, you will want to arrange the items within that pattern. Viewers assume that elements close to each other are related and those that are far apart are unrelated. You can use this principle of **proximity** by putting related elements close together and moving unrelated elements apart. Figure 5.33 shows how confusing it can be when this rule is broken. If a display includes verbal labels for the picture elements, connect the related words and pictures clearly (Figure 5.34).

Directionals. Viewers scan a display, with their attention moving from one part to another. The underlying pattern of the elements of the display will be the main determinant of the eye movement pattern. But if you want viewers to "read" the display in a particular sequence or focus on some particular element, you can use various other devices, called **directionals,** to direct attention. An arrow (as in Figure 5.32) is an obvious device for directing the viewer's attention. For verbal material, you may emphasize key words by bold type, and use "bullets" to indicate items in a list (as shown in Figure 5.1).

Colored elements—whether words or images—in a monochrome display will also draw the eye. Notice how the "hot" arrows in Figure 5.32 stand out from the cool background. Throughout this book we use colored text on "monochrome" pages as a way to call attention to topical headings and special features. Further, a color repeated in different parts of a display tends to show a relationship between those parts. For example, if only two symbols in a display are shown in cherry red, they will appear to be related to each other, and the viewer's gaze will go back and forth between them. The more extreme the color is (e.g., red or blue, at the opposite ends of the color spectrum), the more likely it will attract attention.

Figure–Ground Contrast. Important elements, especially wording, should stand out in good contrast to the background. The simple rule of **figure–ground** contrast is that dark figures show up best on light grounds and light figures show up best on dark grounds (Figure 5.35).

Different color combinations provide different figure–ground contrasts. When lettering or graphic symbols are

FIGURE 5.34
This display communicates clearly because the principle of proximity is observed.

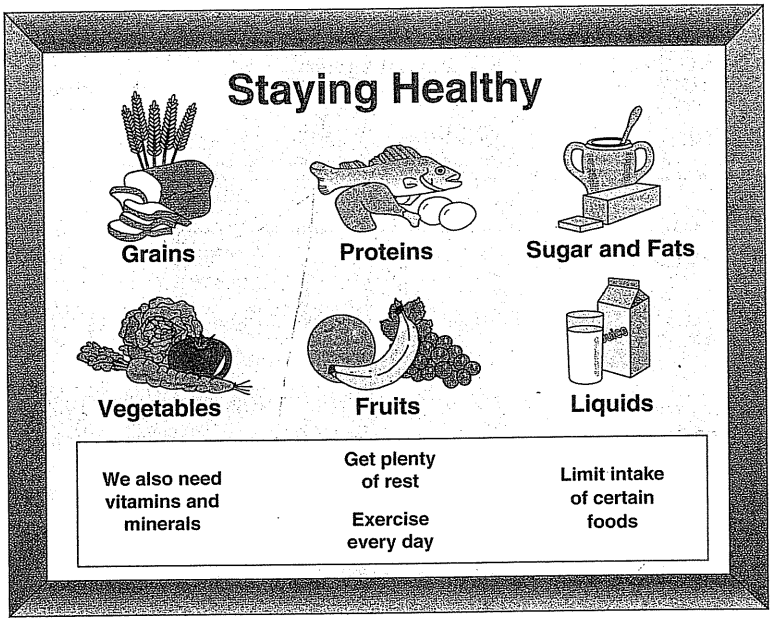
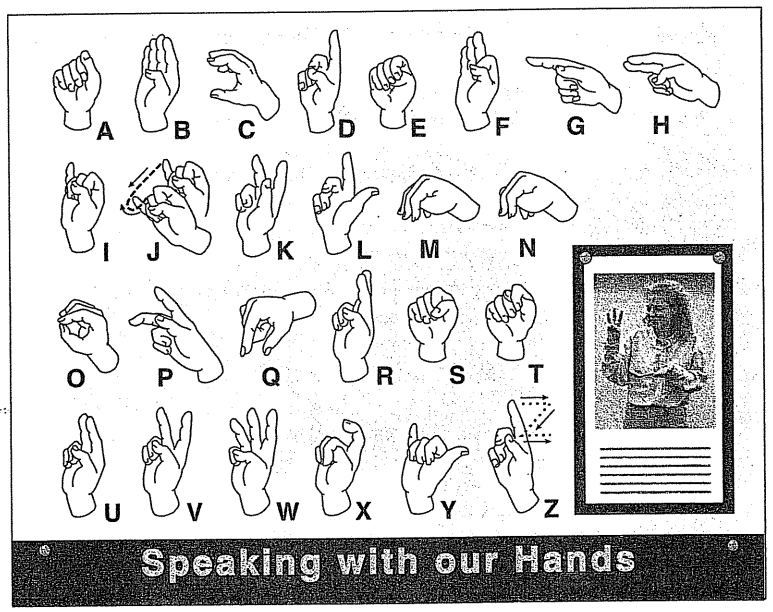


FIGURE 5.35
Sharp figure–ground contrast helps the important elements stand out.



the "figures," they will show up more clearly on certain backgrounds. As indicated in Figure 5.36, black on yellow is the most legible combination (Birren, 1963). Obviously, a combination of dark figures on a dark background will be even less legible than the combinations shown.

Consistency. If you are planning a series of displays, such as a set of overhead transparencies, a multipage handout, or a series of computer screens, you should be consistent in your arrangement of the elements. As viewers go through the series of images they

FIGURE 5.36
Black lettering on a yellow background (a) is most legible; the other combinations are shown in descending order of legibility.

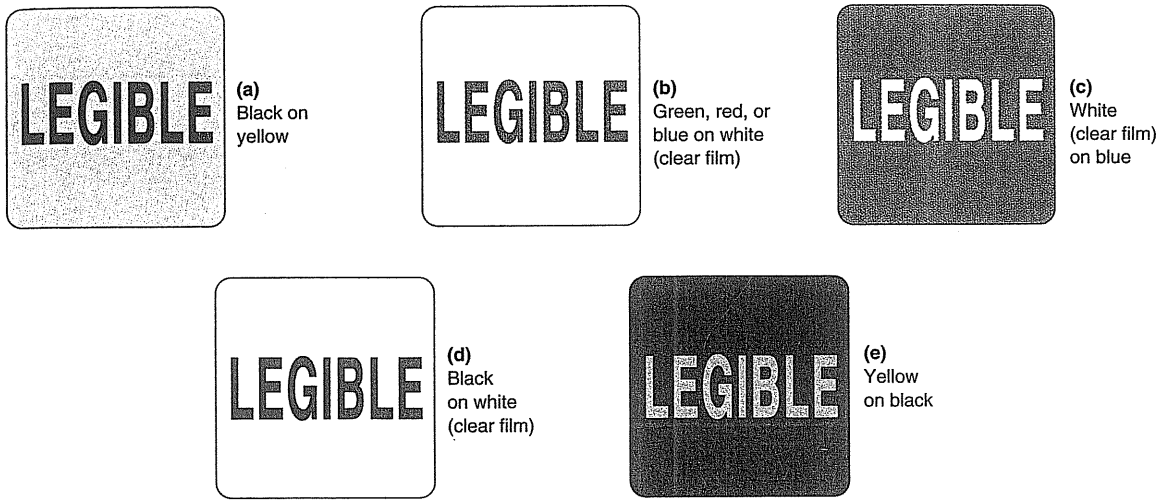
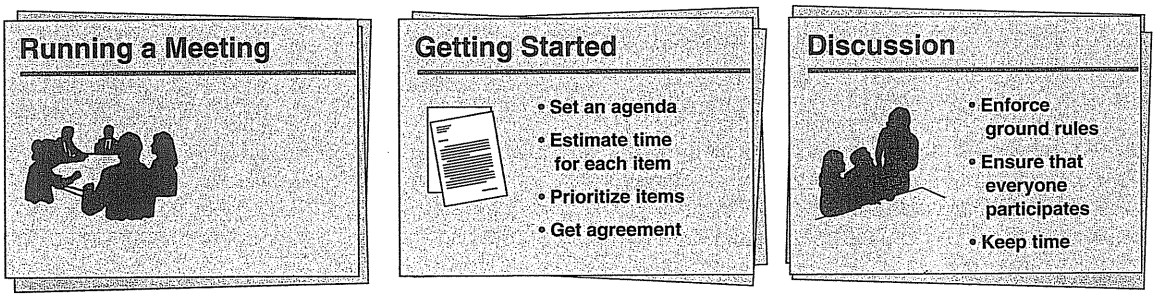


FIGURE 5.37
Consistency in the placement of elements, color, and text treatment adds greatly to the readability of a series of visuals.



begin unconsciously to form a set of rules about where information will appear in your display. The more often the arrangement conforms to these rules (or exhibits *consistency*) the more viewers trust the rules. Every time the arrangement breaks the rules, viewers have to expend mental energy deciding whether this is a deliberate exception or whether they need to revise the rules. You enhance consistency when you place similar elements in similar locations, use the same text treatment for headlines, and use the same color scheme throughout the series of displays (Figure 5.37).

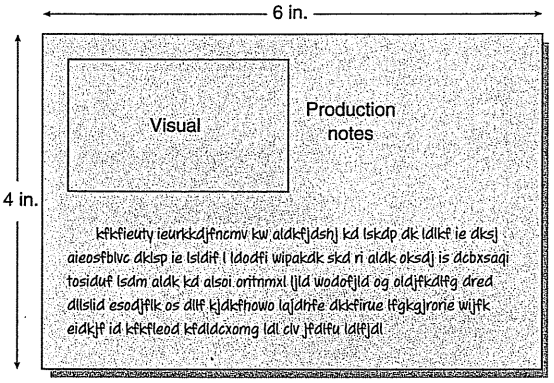
VISUAL PLANNING TOOLS

This chapter emphasizes the design decisions that you must make, not the technical steps involved in the production processes. For those encountering visual design for the first time, don't expect the process to be quick or easy, especially at the beginning. These skills grow with practice, and with practice you will find yourself thinking visually more often as you grapple with instructional problems.

Storyboard

If you are designing a *series* of visuals—such as for several related overhead transparencies, a slide set, a video sequence, or a series of computer screens—**storyboarding** is a handy method of planning. This technique, borrowed from film and video production, allows you to creatively arrange and rearrange a whole sequence of thumbnail sketches. In storyboarding, you place on a card or piece of paper a sketch or some other simple representation of the visual you plan to use along with the narration and production notes that link the visuals to the

FIGURE 5.38
The storyboard card contains places for the visual, production notes, and the narration.



narration. After developing a series of such cards, place them in rough sequence on a flat surface or on a storyboard holder (see Figure A.4 in Appendix A).

Index cards are commonly used for storyboarding because they are durable, inexpensive, and available in a variety of colors and sizes. You also may use small pieces of paper. Self-sticking removable notes have become popular because they will stick to almost anything—cardboard, desks, walls, chalkboards, bulletin boards, and so on.

Divide the individual storyboard cards into areas to accommodate the visual, the narration, and the production notes (Figure 5.38). The exact format of the storyboard card should fit your needs and purposes. Design a card that facilitates your work if the existing or recommended format is not suitable. You can make a simple sketch or write a short description of the desired visual on the card, or use Polaroid pictures or visuals cut from magazines.

You may streamline your storyboarding by using computer software designed for this purpose, such as *StoryBoard Artist* (see the "Media File"). Such software allows you to draw pictures with the mouse, import graphics from files, and manipulate images (enlarging, reducing, and so on). You may couple these images with text and store them as cards, arranging them in different sequences on the screen according to your needs. (Storyboarding is discussed at greater length in Appendix A.)

Types of Letters

A variety of lettering techniques for visuals exists. The simplest is freehand lettering with markers and felt-tip pens, which come in an array of colors and sizes.

You also may cut letters from construction paper or other materials. Precut letters are available in stationery and office supply stores. The letters are easy to use because most come with an adhesive backing; however, they are rather expensive.

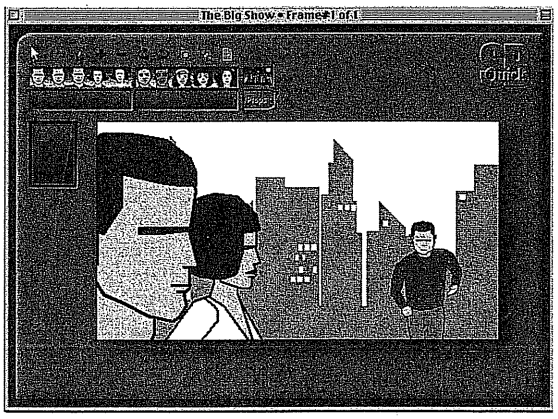
Some media centers and graphic production units in business and industry use mechanical lettering devices (however, desktop publishing has almost entirely taken their place). With such devices, the style and size of the letters are determined by interchangeable large plastic wheels. The letters are "printed" on strips of clear plastic or colored film. Once the backing has been removed, the letters will adhere to most surfaces. You also may use an available desktop publishing system to prepare lettering in various styles and sizes. The lettering ranges from a fraction of an inch in height for overhead transparencies to over a foot high for banners.

Drawing, Sketching, and Cartooning

As we will describe in Chapter 6, drawings, sketches, and cartoons are visuals that can enhance learning. There are many sources of these in magazines, textbooks, and ad-

MEDIA FILE

StoryBoard Artist
Utility Software



Source: PowerProduction Software.

Creating storyboards for visual presentations has long been tedious because the designer has to sketch each visual and outline the audio that goes with it. The age of the computer has made this task simpler by providing a quick and easy way to create and print the information. The software provides predrawn graphic images, backgrounds, and other types of visual materials that can be used to produce detailed descriptions of the visuals. Further, with this type of software, the designer can add dialogue, camera movements, and script notes. Designers can import actual digital images, including photos, to create more realistic storyboards. *StoryBoard Artist* also will "play" the storyboards as a slide show, including transitions and sounds.

FIGURE 5.39
Digital cameras make it easy to take photos to use in computer-based programs or on a website.



vertisements. One often overlooked source is *you*. You don't have to be an artist to draw. There are some basic guidelines and many how-to books that can help you communicate effectively using these graphic media.

With a little practice, you may be surprised by how well you can draw. Simple drawings can enhance chalkboard presentations, class handouts, bulletin boards, and overhead transparencies. For ideas on getting started, see "How to . . . Sketch" (Appendix A) and the Suggested Readings at the end of this chapter.

DIGITAL IMAGES

As computer technologies advance, creating visual images has moved into the digital world. Students may use digital cameras to create originals or may transfer images into digital formats using scanners.

Digital imaging allows users to capture, edit, display, share, and network still and video images. The technology makes the process very easy for both teachers and students. Users may send images to other digital devices, store them in computers, or share them through the Internet. Digital images are another example of *nonlinear media*. The picture and video quality provides clearer details and richer colors than their analog counterparts.

These technologies provide students with the tools to create visual images, including drawings and photographs, and to integrate them into computer-based materials such as desktop published documents, hypermedia projects, World Wide Web pages, and e-mail messages. Students may import digital images into their documents as they are or enhance or change them by using special software, and can quickly make their documents more exciting by using pictures as part of their message.

Digital Cameras

Digital cameras are small and lightweight with fewer moving parts than traditional cameras. Instead of squinting through a tiny optical viewfinder, most digital cameras permit you to see a large image displayed on the back of the camera before you take the "picture." They capture the images directly onto a 3.5-inch floppy disk or special memory card instead of film. Consequently there is no waiting for film processing. The "photo" can be viewed immediately using a screen on the back of the camera. You can delete images you don't want and reshoot on the spot until you get exactly what you want.

Printing the digital images is quick and easy with a color printer or "photo printer." You can insert the floppy disk or memory card into your computer to place the image in a document or report. You can use your computer to print the images. It is possible to make copies of the "photo" without using a computer. "Photo printers" allow you to take the disk from the camera and put into the printer to make copies. Copies of digital photos can be made without degradation in quality and the colors won't fade over time (Figure 5.39).

FIGURE 5.40
Scanning images is a simple task.



Scanners

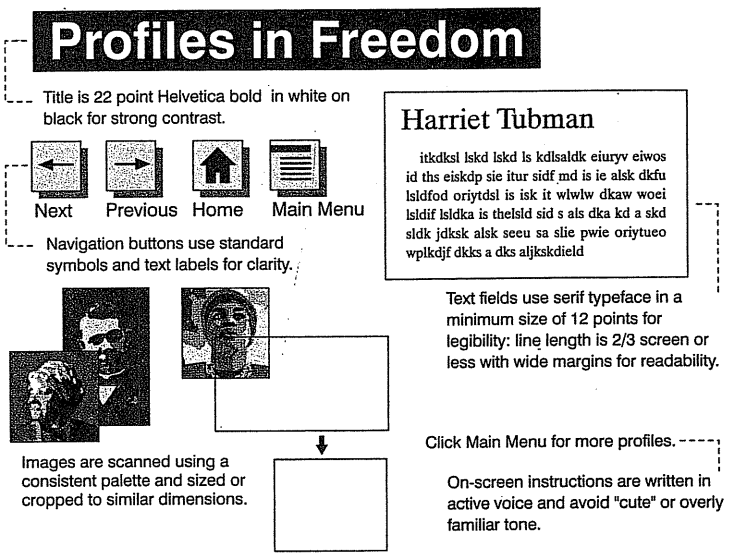
Scanners work with computers to transfer existing visual images, such as drawings or photographs, into digitized computer graphic files. As with digital photographs, students may quickly incorporate scanned images into a word processing file or enhance or change them using software.

The *flatbed* scanner looks like the top of a photocopy machine and is connected to the computer with special cables. The user lifts the lid of the scanner and places the image face down on the glass surface. Special software on the computer operates the scanner. Inside the scanner is a lens or mirror system to focus the light reflected from the original into a **charge-coupled device (CCD).** This device changes the optical image into electrical charges, which in turn are converted into a digital form acceptable by a computer (Figure 5.40).

HOW TO . . . *Design Computer Screens*

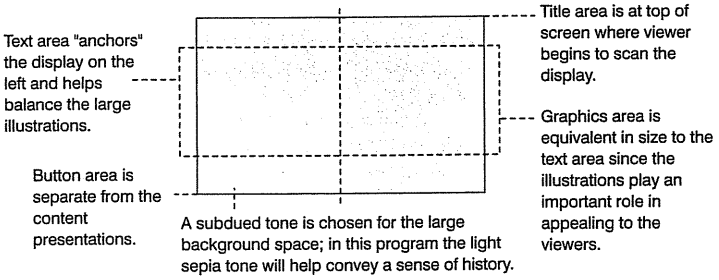
Assemble the Elements

- Consider the relatively low resolution of computer screens (compared to print) and keep individual elements clean and simple.
- Remember to include features that allow learners control over the pace of the programs.
- Rewrite text to fit the smaller space available on screen: avoid breaking sentences across screens.



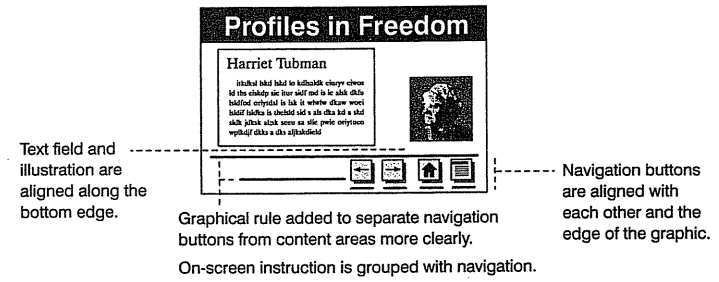
Choose Background and Underlying Pattern

- Use subdued color for large areas to avoid distraction.
- Establish areas of the screen where types of information appear consistently throughout the program.



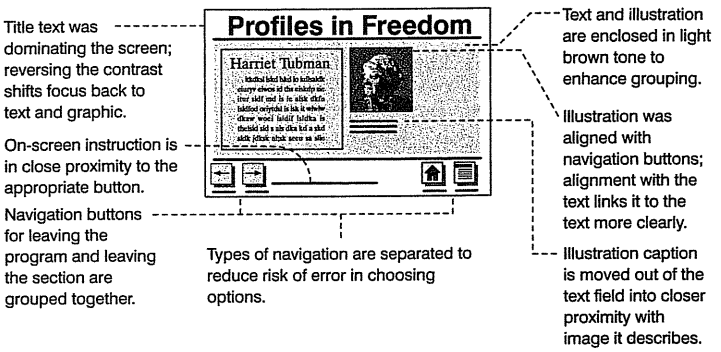
Arrange the Elements

- Place navigation elements so learners don't have to cross content areas too often in order to control the program.
- Remember to align elements and consider their proximity to related elements.



Check and Revise

- Make a technical review once the elements are assembled, since their interrelationships are an important part of your design.
- Observe viewers of program to assess the effectiveness of your design.



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VISUAL DESIGN CHECKLIST

KEY WORDS: _____ , _____ , _____

Material being evaluated _____

Evaluator _____ **Date** _____

	Exemplary	Acceptable	Poor	Comments
Overall Pattern				
Alignment	❑	❑	❑	
Shape	❑	❑	❑	
Balance	❑	❑	❑	
Style	❑	❑	❑	
Color scheme	❑	❑	❑	
Color appeal	❑	❑	❑	
Arrangement				
Proximity	❑	❑	❑	
Directionals	❑	❑	❑	
Figure-ground contrast	❑	❑	❑	
Consistency	❑	❑	❑	
Verbal Elements				
Lettering style	❑	❑	❑	
Letter size and spacing	❑	❑	❑	
Appeal				
Surprise	❑	❑	❑	
Texture	❑	❑	❑	
Interaction	❑	❑	❑	

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ASSURE BLUEPRINT

Visual Literacy and Writing

A teacher wants to improve student skills in using visuals to communicate along with oral and written communication skills. Students work in pairs to help and support each other.

Analyze Learners

General Characteristics

The sixth-grade class at St. Matthew School has 33 students who come from diverse cultural and language backgrounds; in this school in Brooklyn, New York, 85 percent of the students are Hispanic, 10 percent are African American, and 5 percent are Asian American. According to standardized tests, almost all the students in this class are achieving well below grade level in reading.

Entry Competencies

Because the teacher is focusing on reading and writing skills, she administers a standardized rating scale to evaluate compositional ability. Her students are writing at about 50 percent competency for content and mechanics compared with other sixth-grade populations in the United States.

The teacher has discovered that her students have difficulty organizing their writing because they lack a sense of sentence and paragraph structure. She also realizes that they have difficulty retaining information when it is presented in a way that is disconnected from their experience.

Learning Styles

The students are already visually oriented because they have grown up in the MTV generation. However, even though they prefer visual communication, they lack skills in this area just as they do in oral communication. The school has learning style data on file for most of these students, who tend to be concrete random. The desire to please the teacher is a strong motivator for many of these sixth graders. The school routinely addresses many of the possible physiological factors that might interfere with learning. There is a "breakfast before school" program for those who qualify and a school nurse is available to assist those students who are not feeling well.

State Objectives

The main objective for this unit is as follows: Given themes developed by student pairs, sixth-grade students will be able to compose visual essays in sequential and descriptive styles that exhibit composition skills appropriate to their grade level.

A supporting objective includes the following: In pairs, students will exhibit active listening skills so that they will successfully reach consensus, be able to express themselves orally, and make oral presentations of their photo essay storyboards using coherent standard English.

Select Methods, Media, and Materials

This teacher prefers to follow the whole-language approach, integrating listening, speaking, reading, and writing activities together in one unit. She decides to use a visual literacy approach implemented through cooperative learning pairs and discovery methods to provide concrete experiences that might help fill gaps in students' mental schemata. She wants to improve both language ability and motivation by providing meaningful connections between the students' real-world experiences and their language activities in school. This means that the students, rather than the teacher, would be the main performers.

Photo CDs

An alternative for digital images that is less expensive and that uses equipment that might already be in schools is the **photo CD.** Students may use a regular camera and film to take photographs. Then, when having the film developed, instead of getting glossy prints, they can have their photographs stored on a CD-ROM. One CD can store 100 to 150 images. A unique feature of this technology is that additional pictures can be added to the CD at a later date.

A photo CD can be read by a CD-ROM player connected to the computer. Students may then incorporate into their documents the images displayed on the screen. It is an inexpensive way to capture a large number of images in a small space.

Caution When Editing Images

It is important to recognize the need for caution when digitally editing or changing images, as there arises the possibility of misrepresentation. With the advanced capabilities of computer tools, a computer user could alter an image in a way that might distort reality and present a false message to the reader or that might violate a copyright holder's rights in regard to the original image (see the "Copyright Concerns" on page 87).

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 5 of the Companion Website (http://www.prenhall.com/heinich).

1. *Planning Lessons to Improve Visual Literacy Skills.* Plan a set of learning activities to improve the visual literacy skills of a present or future learner you might work with, focusing on a standard or topic of interest. What activities can students do to improve their skills in (a) interpreting visuals, and (b) creating visuals? How does this activity fit with content standards? (ISTE NETS-T II-A; III-A)

First the teacher prepares materials for a schematic mapping activity the whole class will do. She visually models the process of building a map of ideas by using the overhead projector in the front of the room.

Next, she organizes student pairs to create photo essays. There is a logistical hurdle: getting enough cameras to allow all students to have hands-on experiences taking pictures. Fortunately, the library media specialist is able to help her obtain 20 cameras from the district media center.

Finally, she decides the students need to learn to use the computer program, *Inspiration,* to help them develop storyboards to organize their photo essays. Students will each write an essay based on their pair's photo story.

Utilize Media and Materials

The two-week unit begins with the teacher conducting a large-group brainstorming session, using the overhead projector, to develop schematic maps. They start with the general theme of "Brooklyn's Amazing History" and break that down into subtopics, such as "The Role of the Subway." These subtopics constitute the content for the photo shooting that follows.

Students, working in pairs, use the computer program, *Inspiration,* brainstorming their ideas to develop storyboards of their photo stories.

Require Learner Participation

Following these planning sessions, the pairs of students go out into their neighborhoods to shoot the photographs they had visualized in their schematic maps.

When the finished photos are available, the pairs use storyboarding techniques to organize their pictures and prepare captions. Each pair presents their storyboard to the rest of the class. The unit culminates with each student writing an essay on the photo story created by the pair.

This procedure is repeated once, for a total of four weeks of planning, photographing, storyboarding, and writing.

Evaluate and Revise

The teacher analyzes the essays, again using a standardized rating scale. The typical score for each of the essays is in the 70 percent range. The structure of the essays is improved compared with those written earlier, although there are still obvious deficiencies in spelling and grammar.

She also uses simple rating forms for class members to give feedback on each oral presentation; she notes that students make fewer negative and more positive comments about the second attempts.

The teacher also keeps an informal journal of instances of nonstandard English use in students' everyday classroom speaking. She notices that a number of students are improving their ability to speak standard English.

In class discussion after completing the two projects, students agree that they prefer this approach to conventional writing approaches.

This "Blueprint" is adapted from an actual case report by Richard Sinatra, Jeffrey S. Beaudry, Josephine Stahl-Bemake, and E. Francine Guastello, "Combining Visual Literacy, Text Understanding, and Writing for Culturally Diverse Students," Journal of Reading (May 1990), pp. 612–617.
All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

2. *Written Reflection.* Reflect on a recent learning experience in which you were the learner. How valuable were each of the following for you? For a visually impaired learner? For a hearing-impaired student? (ISTE NETS-T IV-B; VI-B)
   - When you had to read something
   - When you had to write something
   - When you had to interpret visuals
   - When you had to create visuals

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 5 of the Companion Website (http://www.prenhall.com/ heinich).

1. Critique a bulletin board or other display using the "Visual Design Checklist" in this chapter. Attach a description of audience, objectives, and the features of the display that help achieve the goals of visual design.
2. Locate a visual (not a photograph) on a website and evaluate it using the guidelines/principles in this chapter.
3. Design a series of computer screens related to an instructional purpose exemplifying the principles given in "How to . . . Design Computer Screens." Attach a description of audience, objectives, and features that help achieve the goals of visual design.
4. Design a visual using computer graphics and describe which guidelines and principles you used.
5. Critique either a display or a computer lesson using the criteria described in the "Visual Design Checklist" and in "How To . . . Design Computer Screens."
6. Develop a storyboard for a visual presentation, such as a *PowerPoint* presentation. Incorporate at least six visuals. You may develop it either on a computer using software such as *Inspiration,* or using paper and pencil.

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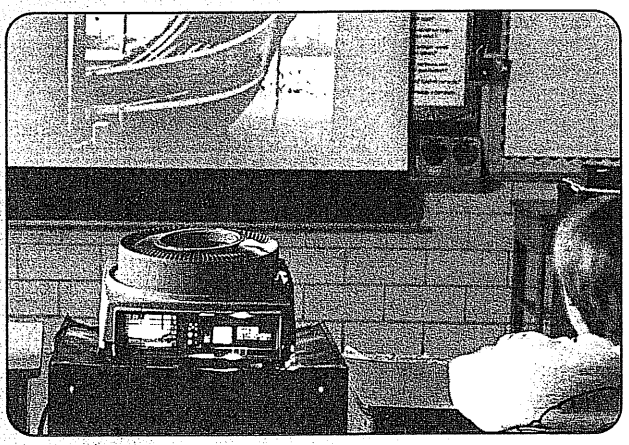
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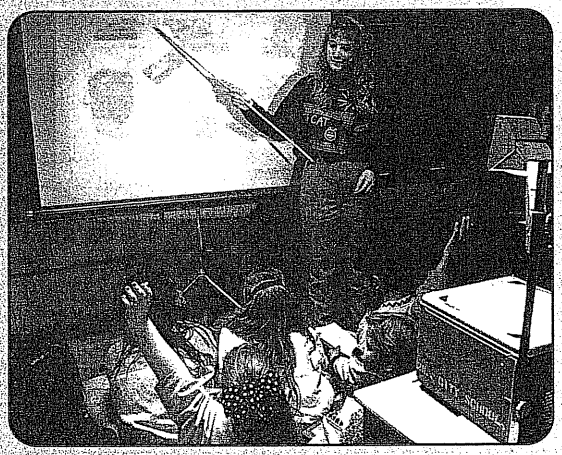
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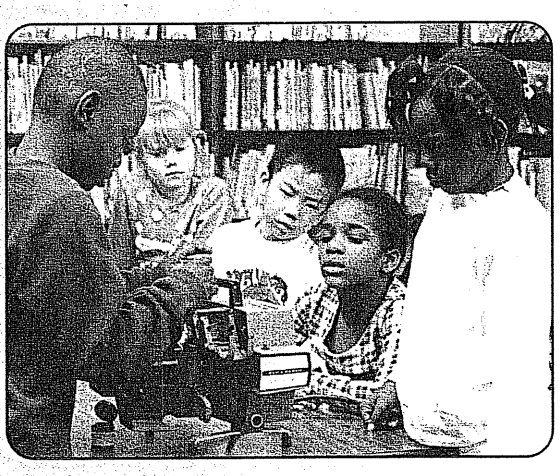
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Visuals, overhead projection, and slides are the traditional media associated with the classroom. Although they have been around for more than half a century, they are still among the most popular teaching tools. The large, bright image captures the audience's attention as no other technology can. The challenge is to make the most of that attention, to present messages that are clear, legible, attractive, and illustrative of your point.









It's easy to prepare your own materials in the form of overheads and slides. With computer support you can easily show text and visual displays. And with presentation graphic software you can make graphics that are as slick and artistic as professionally designed ones.

Instructional media and the technologies for learning provide you with the tools to engage students powerfully in learning. The array of media formats and of quality materials available to the teacher is increasing dramatically. As a teacher, you must be prepared to choose the best tools for your students, who are in diverse situations and pursuing different types of learning goals.

CHAPTER 6

Visuals

OUTLINE

Nonprojected Visuals
Projected Visuals
Document Cameras
Overhead Projection
Slides
Digital Images
Digital Image Projection

KNOWLEDGE OBJECTIVES

1. Identify six types of visuals and compare their advantages and limitations.
2. Describe specific situations in which the document camera would be especially useful.
3. Describe the characteristics and operation of overhead transparency and slide projection.
4. Describe specific applications of overheads and slides to your teaching field.
5. Outline the procedures for creating transparencies by each of these methods: direct drawing, electrostatic film process, and computer generation.
6. Identify examples of digital images that exhibit the guidelines for the design of effective visuals.
7. Describe the advantages, limitations, and applications of digital image formats.
8. Discuss the advantages and limitations of using the LCD panel for image projection.

LEXICON

nonprojected visuals
visuals
study prints
projected visuals
document camera
overhead projection
fresnel lens
transparency
acetate
overlays
keystone effect
electrostatic film (xerography)
presentation graphics software
slide
thumb spot
liquid crystal display (LCD)

Not all media plug into an electrical outlet. There is a variety of nonprojected media that can make your instruction more realistic and engaging. Pictures, charts, graphs, posters, and cartoons—including those that students themselves produce—can provide powerful visual support to abstract ideas. These nonprojected media can be displayed in a variety of ways.

Projected media, such as overhead transparencies and *PowerPoint* slides, can enhance a presentation made by students or teachers.

NONPROJECTED VISUALS

Nonprojected visuals can translate abstract ideas into a more realistic format (Figure 6.1). They allow instruction to move down from the level of verbal symbols in Dale's Cone of Experience (see Chapter 1) to a more concrete level.

Nonprojected visuals are easy to use because they do not require any equipment. They are relatively inexpensive. Many can be obtained at little or no cost. They can be used in many ways at all levels of instruction and in all disciplines. You may also use them to stimulate creative expression, such as telling or writing stories or composing poetry.

You may use all types of nonprojected visuals in testing and evaluation. They are particularly helpful with objectives requiring identification of people, places, or things.

Some nonprojected visuals are simply too small for use before a group. It is possible to enlarge any visual photographically, but that can be an expensive process. A document camera (see page 148) can show an enlarged image before a group.

Some nonprojected visuals demand special caution. Because the images are visually symbolic rather than fully representational, they leave more room for viewers to misinterpret the intended meaning. (We discussed this phenomenon in Chapter 5.) For example, research on newspaper readers' interpretations of editorial cartoons indicates that a large proportion of viewers may draw conclusions that are opposite of what the artist intended. Psychologists find that people tend to project their own hopes, fears, and preconceptions onto images or verbal messages that are ambiguous.

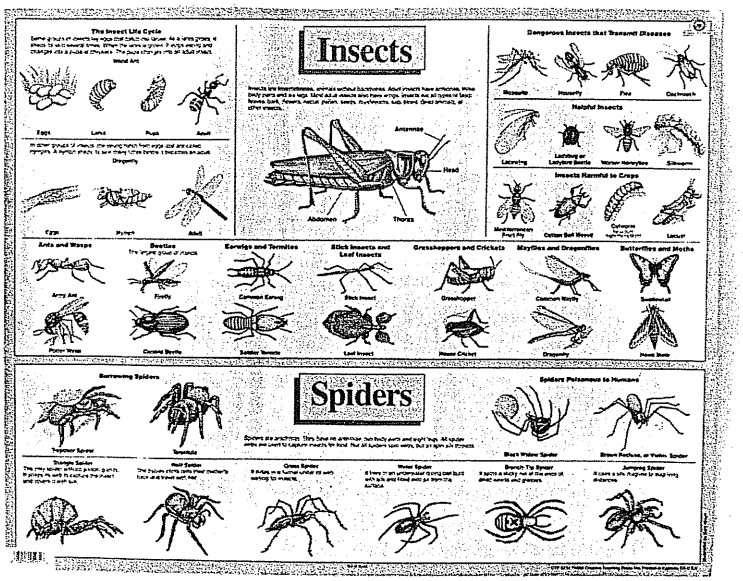
We will explore six types of **visuals** commonly found in the classroom situation: still pictures, drawings (including sketches and diagrams), charts, graphs, posters, and cartoons.

See Appendix A for information and techniques to preserve nonprojected visuals. The appendix includes the following procedures for working with visuals: mounting (rubber cement and dry mounting), laminating, filing, and storing.

Still Pictures

Still pictures are photographic (or photograph-like) representations of people, places, and things. The still pictures most commonly used in instruction are photographs; postcards; illustrations from books, periodicals, and catalogs; and study prints (oversized illustrations commercially prepared to accompany specific instructional units).

FIGURE 6.1
Visuals carry the main message in a well-designed chart.

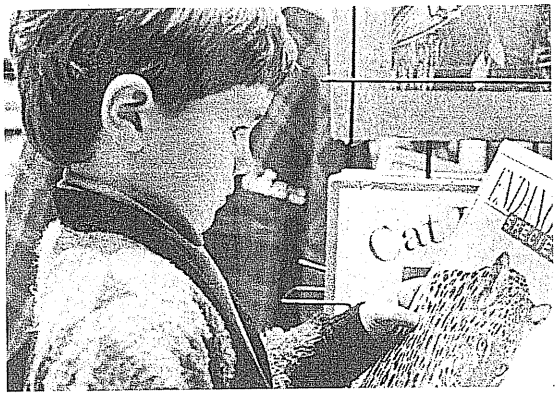


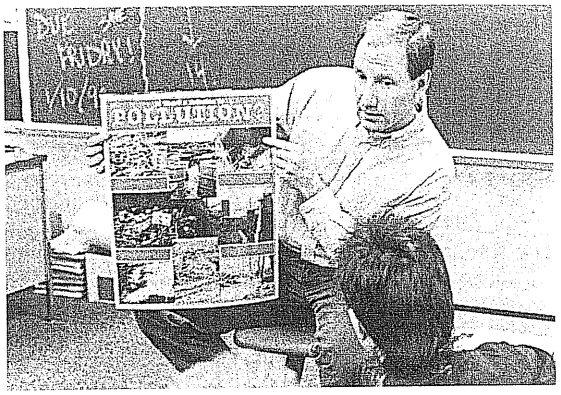
CLOSE-UP

USING NONPROJECTED VISUALS

Students of all ages can use nonprojected visuals. This student examines examples of endangered species as part of a class project. The teacher assigns small groups of students to each study an endangered animal. Each small group cooperates and prepares a brief oral report to share with the class. During the presentation, visuals of the assigned species are shown to the class. Following each group's presentation, the teacher facilitates a discussion and summarizes key points. The still pictures are then displayed on a bulletin board along with other visuals of endangered species.

Here, a fifth-grade teacher uses study prints to show examples of pollution. The teacher works with the students in small groups. While some of the students are working on other activities in the classroom and in the media center, the teacher gathers 10 to 12 students to discuss the study prints. His objective is for the students to be able to describe the common causes of pollution. He shows students the study prints and then asks them to describe what procedures they would recommend for improving the environment.





Still pictures are readily available in books (including textbooks), magazines, newspapers, catalogs, and calendars. In addition, you can purchase large photographs from educational supply companies to use with groups of students, or you can obtain them from your media center or library.

Still pictures are two dimensional. You can compensate for the lack of three-dimensionality by providing a group of pictures showing the same object or scene from several different angles or positions. Also, a series of sequential still pictures can suggest motion.

You may use photographs in a variety of ways. Teacher-made or student-made photographs may illustrate and help teach specific lesson topics. Photographs of local architecture, for example, can illustrate a unit on architectural styles. (In this case, you could reinforce the students' skill in "reading" a visual by pointing out that merely looking at the buildings in our environment is not the same as really "seeing" them.) Photographs taken on field trips can be valuable for classroom followup activities.

You may include skill in decoding textbook pictures in instructional objectives to motivate learners to use them for study purposes. The quality and quantity of illustrations are, of course, important factors in textbook choice. You may use pictures from newspapers and periodicals in similar ways.

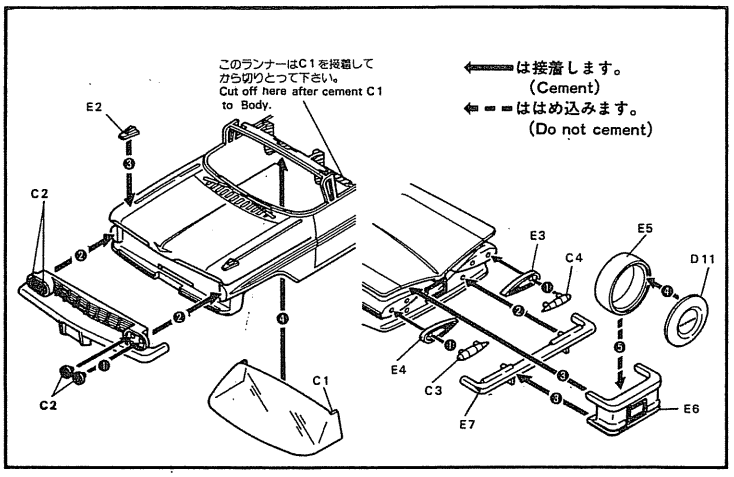
Students should understand that textbook pictures are not decorations but are intended to be study aids and should be used as such. Encourage students to give attention to them.

Photographic **study prints**—enlargements printed in a durable form for individuals to use or for display—also have many applications in the instructional setting. They are especially helpful in the study of processes—the production of iron or paper, for example, or the operation of the internal combustion engine. They are also very useful in teaching the social sciences. In geography they may help illustrate relationships between people and their environment that, because of space limitations, could not be depicted easily in textbook pictures.

Drawings

Drawings, sketches, and diagrams employ the graphic arrangement of lines to represent persons, places, things, and concepts. Drawings are, in general, more finished and representational than sketches (e.g., stick-figure compositions), which are likely to lack detail. Diagrams are usually intended to show relationships or to help explain processes, such as how something works or is constructed (Figure 6.2).

FIGURE 6.2
The use of visual symbols greatly reduces the need for words in this multilingual diagram for assembling a plastic scale model of an automobile.



Drawings are readily found in textbooks and other classroom materials. You can use them in all phases of instruction, from introduction of the topic through evaluation. Because they are likely to be less detailed and more to the instructional point than photographic materials, students of all ages understand them easily.

Teacher-made drawings can be effective aids to learning. You can sketch on the chalkboard (or some other appropriate surface) to coincide with specific aspects of your instructional unit. For example, you may quickly and easily draw stick figures to show motion in an otherwise static representation.

Charts

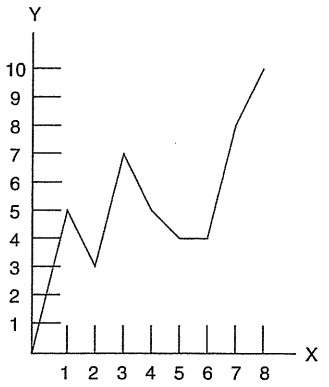
Charts are visual representations of abstract relationships such as chronologies, quantities, and hierarchies: They appear frequently in textbooks and training manuals as tables and flowcharts. They are also published as wall charts for group viewing in the form of organization charts, classification charts (e.g., the periodic table), and timelines (see "Types of Charts," p. 145).

A chart should have a clear, well-defined instructional purpose. In general (especially for younger students), it should express only one major concept or configuration of concepts. If you are developing your own charts, be sure they contain the minimum of visual and verbal information needed for understanding. A cluttered chart is a confusing chart. If you have a lot of information to convey, develop a series of simple charts rather than a single complex one. Use the KISS principle—Keep It Simple for Students.

A well-designed chart should communicate its message primarily through the visual channel. The verbal material should supplement the visual, not the reverse.

FIGURE 6.3
A line graph can make a table of data much easier to interpret.

X	Y
0	0
1	5
2	3
3	7
4	5
5	4
6	4
7	8
8	10



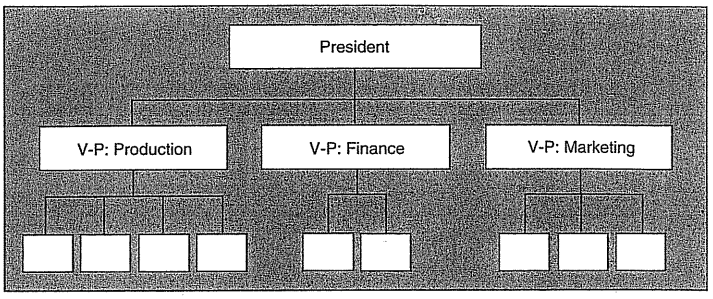
Graphs

Graphs provide a visual representation of numerical data. They also illustrate relationships among units of the data and trends in the data. Many tabular charts can be converted into graphs, as shown in Figure 6.3.

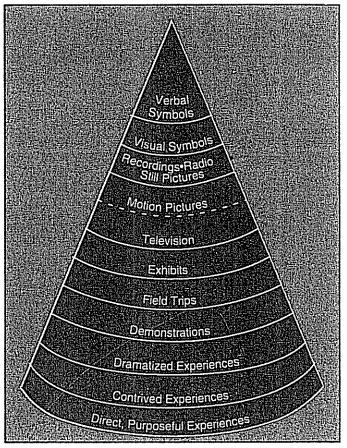
Data can be interpreted more quickly in graph form than in tabular form. Graphs are also more visually interesting than tables. There are four major types of graphs: bar, pictorial, circle, and line (see "Types of Graphs," p. 146). The type you choose will depend largely on the complexity of the information you wish to present and the graph-interpretation skills of your audience. Numerous computer software programs now make it easy to produce professional-looking charts, graphs, and other visuals. Type your data into the computer, and the computer will create the type of chart or

Types of Charts

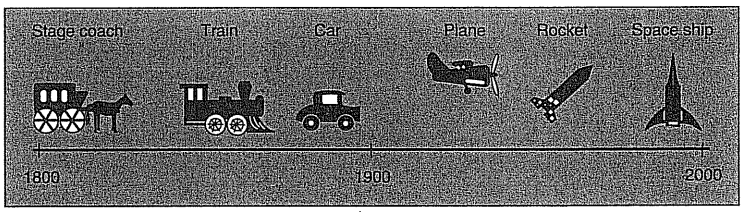
Organization charts show the structure or chain of command in an organization such as a company, corporation, civic group, or government department. Usually they deal with the interrelationship of personnel or departments.



Classification charts are similar to organization charts but are used chiefly to classify or categorize objects, events, or species. A common type of classification chart is one showing the taxonomy of animals and plants according to natural characteristics. Dale's Cone of Experience classifies media from concrete to abstract.



Time lines illustrate chronological relationships between events. They are most often used to show historical events in sequence or the relationship of famous people and these events. Pictures or drawings can be added to the time line to illustrate important concepts. Time lines are very helpful for summarizing a series of events.

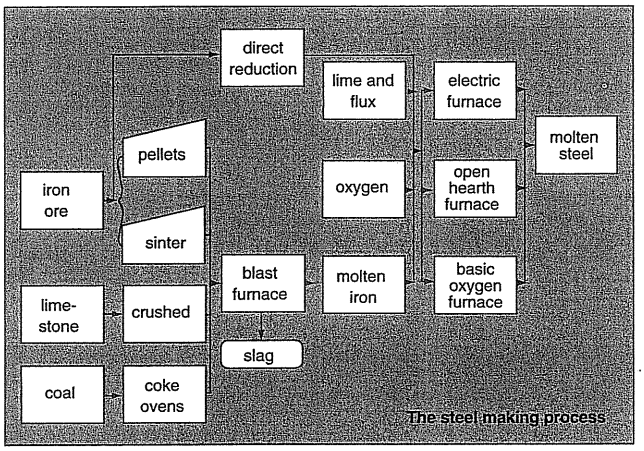


Tabular charts, or tables, contain numerical information, or data. They are also convenient for showing time information when the data are presented in columns, as in timetables for railroads and airlines.

Import Percentages

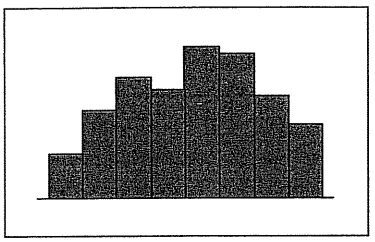
	Wheat	Cotton	Steel	Oil
USA	0	0	20	35
England	65	95	35	10
France	15	95	30	90
Japan	85	15	0	95
Brazil	0	0	20	70

Flowcharts, or process charts, show a sequence, a procedure, or, as the name implies, the flow of a process. Flowcharts show how different activities, ingredients, or procedures are interrelated.

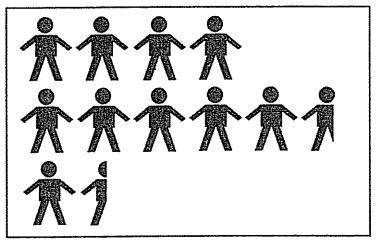


Types of Graphs

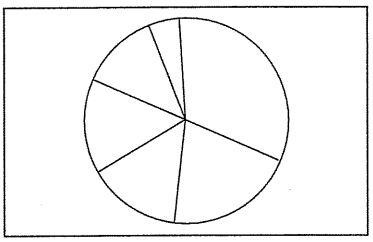
Bar graphs are easy to read and can be used with elementary age students. The height of the bar is the measure of the quantity being represented. The width of all bars should be the same to avoid confusion. A single bar can be divided to show parts of a whole. It is best to limit the quantities being compared to eight or less; otherwise the graph becomes cluttered and confusing. The bar graph, a one-scale graph, is particularly appropriate for comparing similar items at different times or different items at the same time; for example, the height of one plant over time or the heights of several students at any given time. The bar graph shows variation in only one dimension.



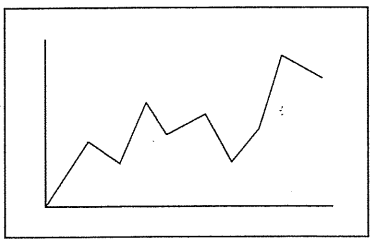
Pictorial graphs are an alternate form of the bar graph in which numerical units are represented by a simple drawing. Pictorial graphs are visually interesting and appeal to a wide audience, especially young students. However, they are slightly more difficult to read than bar graphs. Since pictorial symbols are used to represent a specific quantity, partial symbols are used to depict fractional quantities. To help avoid confusion in such cases, print values below or to the right of each line of figures.



Circle (or pie) graphs are relatively easy to interpret. In this type of graph, a circle or "pie" is divided into segments, each representing a part or percentage of the whole. One typical use of the circle graph is to depict tax-dollar allocations. The combined segments of a circle graph should, of course, equal 100 percent. Areas of special interest can be highlighted by illustrating a piece of pie separately from the whole.



Line graphs are the most precise and complex of all graphs. Line graphs are based on two scales at right angles. Each point has a value on the vertical scale and a value on the horizontal scale. Lines (or curves) are drawn to connect the points. Line graphs show variations in two dimensions, or how two or more factors change over time. For example, a graph can show the relation between pressure and temperature when the volume of a gas is held constant. Because line graphs are precise, they are very useful in plotting trends. They can also help simplify a mass of complex information.



graph you wish. When you see the preliminary result on the computer monitor, you can change parameters (axes, size, orientation, etc.). Some programs even provide output in a variety of colors.

Most spreadsheet programs, such as *Microsoft Works, AppleWorks,* and *Excel,* have a chart and graph option. Spreadsheet programs are easy-to-use tools for creating graphs from numerical data.

You and your students can use drawing programs for layout and design, as well as for drawing and illustrating. Most computer graphics programs come with hundreds or even thousands of typefaces and clip-art images and can manipulate visuals in every imaginable way. Examples of these programs are *Harvard Graphics, Lotus Freelance Graphics,* and *Microsoft Graph.*

Posters

Posters incorporate visual combinations of images, lines, color, and words. They are intended to catch and hold the viewer's attention at least long enough to communicate a brief message, usually a persuasive one. To be effective, posters must be colorful and dynamic. They must grab attention and communicate their message quickly. One drawback in using posters is that their message is quickly blunted by familiarity. Consequently, they should not be left on display for too long. Commercial billboards are an example of posters on a very large scale.

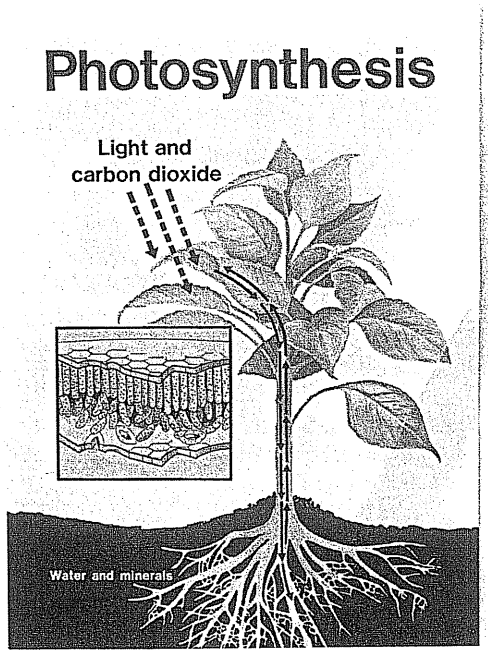
Posters can be effective in numerous learning situations. They can stimulate interest in a new topic, a special class, or a school event. They may be employed for motivation—

AV SHOWMANSHIP Nonprojected Visuals

- Use large visuals that everyone can see simultaneously. (If visuals are not large enough for all to see, use one of the projection techniques described in this chapter.)
- Use visuals that are not cluttered with illegible details.
- Cover irrelevant material with plain paper.
- Hold visuals steady when showing them to a group by resting them against a desk or table or putting them on an easel.
- Limit the number of visuals used in a given period of time. It is better to use a few visuals well than to overwhelm your audience with an abundance of underexplained visuals.
- Use just one visual at a time, except for purposes of comparison. Lay one visual flat before going on to the next.
- Keep your audience's attention and help them learn from a visual by asking direct questions about it.
- Teach your audience to interpret visuals (see Chapter 5).
- Display pertinent questions alongside each visual. Cover the answers with flaps of paper. Have students immediately check their own responses for accuracy.
- Provide written or verbal cues to highlight important information contained in the visuals.

luring students to a school meeting or to the media center, for example, or encouraging them to read more. In industrial education courses, science laboratories, and other situations where danger may be involved, posters can remind people of safety tips. Posters can also promote good health practices such as not using drugs. An effective learning technique is to have students design posters as part of a class project, during fire prevention week or dental health month, for example (Figure 6.4).

FIGURE 6.4
Posters catch the eye to convey a single, simple message.



You may obtain posters from a variety of sources, including commercial companies, airlines, travel agencies, and government departments. You can make your own posters with colored markers, computer printouts, and devices that print poster-sized pages. If you draw your own posters, follow the visual design guidelines in Chapter 5 and refer to "How to . . . Sketch" (Appendix A). You can make computer-generated posters and banners by taping together standard-size printer paper. Software, such as *Print Shop,* can facilitate poster design and production.

Devices, such as the PosterPrinter by Varitronics (see Figure 4.19), can convert 8½-by-11-inch originals into 23-by-33-inch posters. The originals can be hand-drawn visuals, computer output, overhead transparency masters, or the like. The machines use high-speed electronics and a thermal printing process, which means no ink, toner, or ribbons. The process takes about a minute. The paper comes in a variety of colors (white, pink, yellow, or blue) and several print colors are available (black, red, blue, or orange). In addition to making posters, these machines can generate prepared flip chart pages and signs.

Cartoons

Cartoons (line drawings that are rough caricatures of real people and events) are perhaps the most popular and familiar visual format. They appear in a variety of print media—newspapers, periodicals, textbooks—and range from comic strips intended primarily to entertain to drawings intended to make important social or political comments. Humor and satire are mainstays of the cartoonist's skill.

Cartoons are easily and quickly read and appeal to children and adults alike. The best of them contain wisdom as well as wit. You can often use them to make or reinforce a point of instruction. Appreciation and interpretation, however, may depend on the experience and

sophistication of the viewer. Be sure the cartoons you use for instructional purposes are within the experiential and intellectual range of your students.

PROJECTED VISUALS

Because an illuminated screen in a darkened room tends to rivet the attention of viewers, projected visuals have long been popular as a medium of instruction as well as entertainment. The lighted screen is a silent shout—a shout even the most reluctant learners are likely to heed.

Some of this attraction may be due to the aura of magic that seems to surround such presentations. The room lights are dimmed, the viewers grow quiet in expectation, you throw a switch, and (presto!) a large, bright image appears on the screen. You have the attention of your audience, who is ready to receive the message. Exploit this readiness by selecting materials that will maintain viewers' attention and by using them in a way that involves viewers actively in learning.

Projected visuals are defined here as media formats in which still images are enlarged and displayed on a screen. Such projection may be achieved by passing a strong light through transparent film (as in overhead transparencies and slides), magnifying the image through a series of lenses, and casting this image onto a reflective surface. Or, the image can be displayed on a monitor using a document camera. Newer techniques include storing the images electronically and projecting them in a digital or analog format such as *PowerPoint*. Digital storage mechanisms include CD-ROM, the photo CD, digital cameras, DVD, and the scanner. The most common analog storage medium for visuals is the videodisc, or laserdisc (the analog counterpart of CD-ROM and DVD).

Integration

Projected visuals are suitable for use at all grade levels and for instruction in all curriculum areas. Many high-quality commercial visuals are available. In general, the fine arts, geography, and the sciences are especially well represented with commercially distributed visuals.

Following are some typical subjects among the myriad possibilities for visual presentations:

- Provide a tour for new employees of a local business without walking through the plant.
- Make a visual history of your community, school, or organization.
- Illustrate lectures about art history or art technique.
- Document student activities, products of student work, and community problems (e.g., crime and pollution).
- Present a preoperative explanation of a surgical procedure tailored to a specific surgeon's patients.
- Show people at work in various jobs, for career awareness.
- Illustrate the uses of a company's products throughout the world.
- Teach a step-by-step process with close-ups of each operation.
- Simulate a field trip.
- Promote public understanding of your school or organization.

Projected visuals have appropriate applications in a variety of subjects and grade levels. Their broad appeal is evidenced by the volume of commercial materials produced. Tens of thousands of titles are available either in school media center collections or directly from the producers.

The focus of the rest of this chapter is on the characteristics and applications of document cameras, overhead transparencies, slides, and digital images, and digital and analog image projection systems—the most widely used means of projecting visuals in education and training settings.

DOCUMENT CAMERAS

The **document camera** is a video camera mounted on a copy stand, pointed downward at documents, flat pictures, or graphics and small objects (like coins). The image may be projected onto a large screen within the room or it may be transmitted to distant sites via television. You may place any sort of visual on the stage, and can manipulate the material or write on it, as you would on overhead transparencies (Figure 6.5). With backlighting you can show overheads or slides.

Some document cameras can be folded into portable units and moved into classrooms. Connecting the document camera to television monitors or digital projectors in the classroom for a demonstration can mean that all students will have an equal view of some small items being displayed, or can view the same action simultaneously without having to crowd around.

Advantages

- *No production required.* A document camera allows on-the-spot projection of readily available classroom materials, such as diagrams, newspapers, and illustrations from books and magazines. Three-dimensional objects (especially relatively flat ones such as coins, plant leaves, and insect specimens) can be magnified for close-up inspection.
- *All students have equal view.* This type of projection permits everyone to have an equal opportunity to view the same material easily.
- *Allows group viewing of student work.* This type of projection permits group viewing and discussion of student work, such as drawings, student compositions, solutions to math problems, and the like.

FIGURE 6.5
The document camera serves as an electronic version of the opaque projector.



Limitations

- *Bulky hardware.* Even though the document camera can be moved easily, it requires a monitor or video projector, which is bulky, heavy, and cumbersome to move without a cart.
- *Monitor or projection required.* You cannot use it without a monitor or video projector.
- *Additional lighting.* Document cameras need additional lights for a good image. Some cameras come with lights, but are more expensive.

Integration

The document camera is useful for small groups, classroom-size groups, or even distant audiences that need to view printed or visual material together. Applications may be found in all curriculum areas at all grade levels. Here are just a few typical examples:

- *All subjects:* Group critique of student work and review of test items
- *Art:* Group discussion of reproductions of paintings and architectural details; study of advertising layouts
- *Business:* Group work on business and accounting forms or close-up viewing of such documents as organization charts, sales territory maps, and parts of a product
- *Home Economics:* Group viewing of sewing patterns, textiles, recipes; close-up views of fabrics and weaving styles
- *Industry:* Projection of blueprints for group study; description of assembly line flow with production diagrams
- *Language Arts:* Group critique of student compositions, picture books, or reference books
- *Medicine:* Group study of anatomical drawings; discussion of diabetic diets and food exchange charts
- *Military:* Review of maps and official documents; illustration of flight plans
- *Music:* Group reading of musical scores
- *Religion:* Religious story illustrations; group examination of religious documents
- *Science:* Magnification of specimens; group study of maps and tables
- *Social Studies:* Map study; viewing of artifacts from other cultures, postcards, and atlas illustrations

OVERHEAD PROJECTION

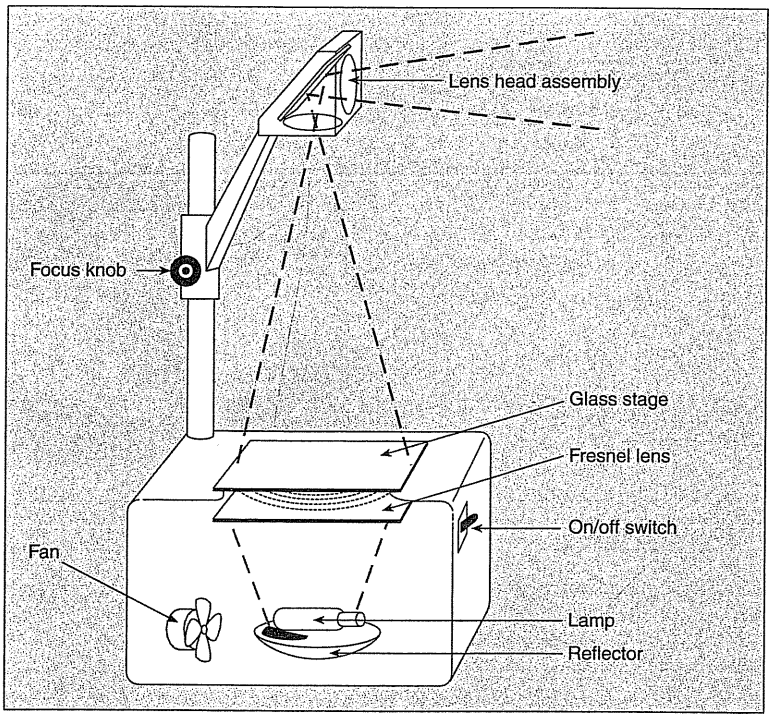
Because of its many virtues, the **overhead projection** system (Figure 6.6) has become the most widely used audiovisual device in North American classrooms and training sites.

The typical overhead projector is a simple device (Figure 6.7). Basically, it is a box with a large aperture, or "stage," on the top surface. Light from a powerful lamp inside the box is condensed by a special type of lens,

FIGURE 6.6
With the overhead projector, the presenter maintains eye contact with viewers.



FIGURE 6.7
The transmissive type of overhead projector; the light from the lamp is transmitted through the glass stage and transparency.



known as a **fresnel lens,** and passes through a transparency (approximately 8 by 10 inches) placed on the stage. A lens-and-mirror system mounted on a bracket above the box turns the light beam 90 degrees and projects the image back over the shoulder of the presenter. This type of projector, in which the light passes *through* the transparency, is referred to as a *transmissive* type. (See "How to . . .Operate an Overhead Projector" on page 152.)

In another sort of overhead projector, the light source is above the projector stage and shines down onto the transparency (Figure 6.8). The light is reflected by a mirrorlike surface beneath the transparency back up and through the lens system. This *reflective* type of projector produces a less brilliant light, so it does not perform as well in rooms with a long projection distance or with a lot of ambient light. Its advantage is its portability, being lighter and more compact than the transmissive type.

Because of the widespread familiarity of overhead projection, the general term **transparency** has taken on, in the instructional setting, the specific meaning of the large-format 8-by-10-inch film used with the overhead projector. Transparencies may be composed of photographic film, clear **acetate,** or any of a number of other transparent materials capable of being imprinted with an image by means of chemical or heat processes. The individual sheets of transparent film are called "acetates" in reference to the chemical composition of the standard type of film.

You may use transparencies individually or make them into a series of images consisting of a base visual with one or more overlays attached to the base with hinges. **Overlays** are sheets of transparent film, each containing additional information, that are laid over the base transparency. You may then explain complex topics step by step by flipping a series of overlays one at a time, adding additional features to a diagram (Figure 6.9).

Advantages

- *Brightness.* Its bright lamp and efficient optical system generate so much light on the screen that the overhead can be used with normal room lighting.
- *Eye contact.* You may operate the projector from the front of the room while facing the audience, allowing you to maintain direct eye contact.
- *Ease of use.* Most overhead projectors are lightweight and portable. All are simple to operate.
- *Abundance of materials.* The machine can project a variety of materials, including cutout silhouettes, small opaque objects, and many types of transparencies.
- *Manipulable.* You can manipulate projected materials. You can point to important items, highlight them with colored pens, add details (notes, diagrams, etc.) during the lesson by marking on the transparency with a marking pen, or cover

FIGURE 6.8
The reflective type of overhead projector; the light from the lamp is reflected off the mirrorlike stage.

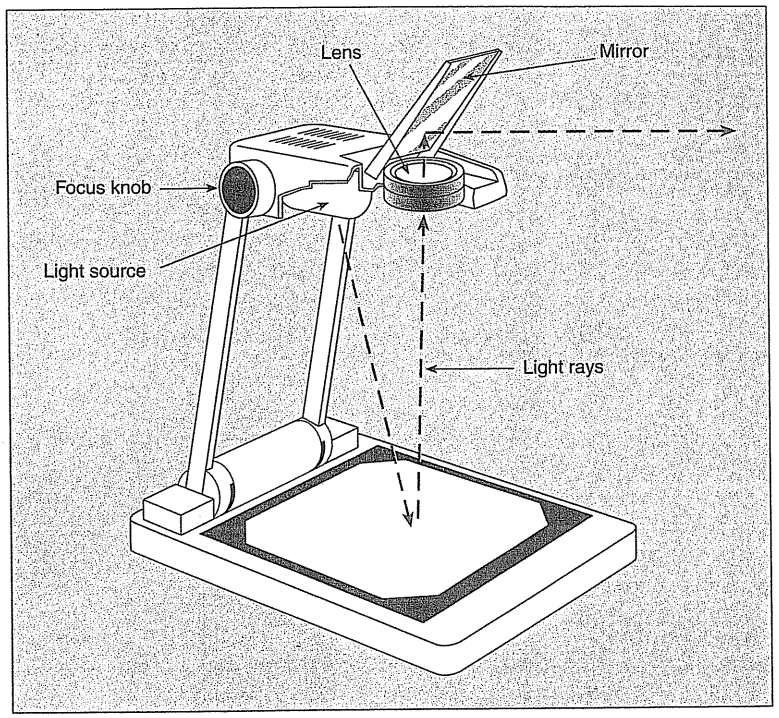
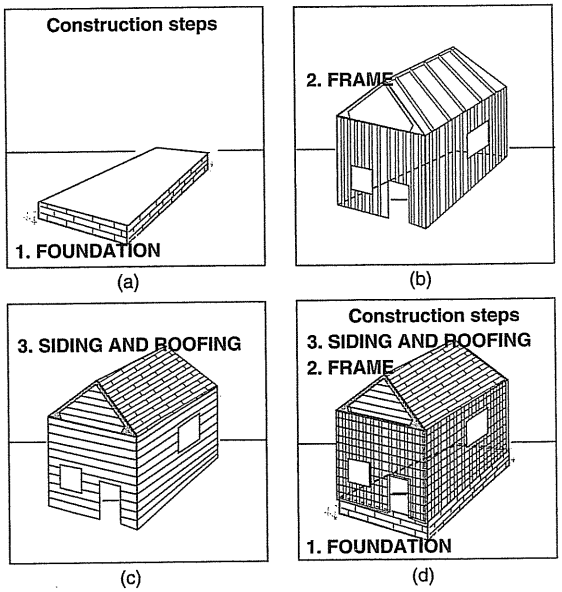


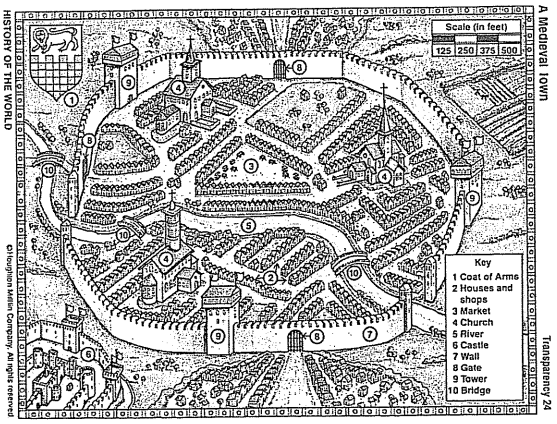
FIGURE 6.9
By means of overlays, the presenter can build up complex visuals step by step. Part (d) shows the result of combining overlays (a), (b), and (c).



MEDIA FILE

History of the World

Overhead Transparencies



Source: Houghton Mifflin Company.

A set of 145 overhead transparencies, including one on "A Medieval Town," accompanies the textbook *History of the World.* They are of many types: maps, charts, tables, diagrams, illustrations, and political cartoons. An accompanying teacher's guide provides suggestions for class discussion.

HOW TO . . . Operate an Overhead Projector

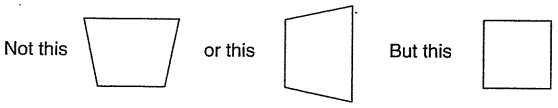
OPERATION

Set Up

- Connect power cord to AC outlet.

Operate

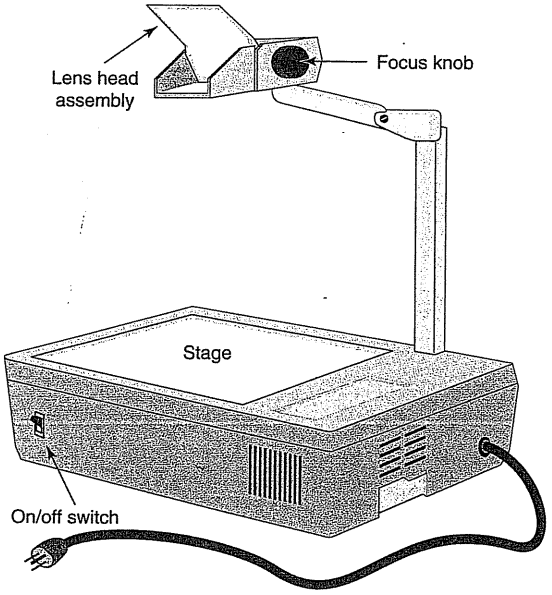
- Turn projector on. (With some projectors you have to click through two positions to reach the "on" position.)
- Position transparency on stage.
- Adjust projector to eliminate keystoning (explained in Appendix B).



- Focus image.
- Practice writing on the transparency and erasing.

Disassemble

- Restore to storage conformation.



TROUBLESHOOTING

Problems/Possible Remedies

- No light after flipping switch:
  1. Be sure projector is plugged into an electrical outlet.
  2. Turn the switch all the way on. Many overheads have a three-position switch: off, fan, and on.
  3. If lamp is burned out, switch to spare lamp within projector if it has this feature. Otherwise, you will need to replace the lamp. Be sure to use a lamp of the same wattage (too high a wattage can cause overheating). Do not handle the lamp while it is hot. Avoid touching the new lamp with bare fingers; this could shorten its life.
  4. Switch may be defective. If so, have it replaced.
- Dark edge with light in center of image: The fresnel lens is upside down. Turn it over if you know how; if not, have a qualified specialist do it.
- Dark spot on area of screen: The lamp socket within the projector needs adjustment. The task is best done by a trained audiovisual technician.
- Dark spot on screen or failure of lens to focus despite all adjustments of focus: After determining that it is not simply a matter of dirt on the lens or improper use of the focus control, check for a warped fresnel lens. This lens is plastic and can become warped from excessive heat, usually caused by the fan not running properly. Have a qualified specialist repair the fan or thermostat and replace the fresnel lens.

part of the message and progressively reveal information. As noted previously, you can present complex visuals in a series of overlays.

- *Availability of materials.* Commercially produced transparencies and transparency masters cover a range of curriculum areas. A list of sources appears on the "Classroom Link Portfolio" CD-ROM.
- *Self-prepared materials.* You can easily prepare your own transparencies (we describe several common production methods later in this chapter).
- *Advance preparation.* Information that might otherwise have to be placed on a chalkboard during a class session (e.g., lesson outlines) may be prepared in advance for presentation at the proper time.

Research indicates that retention of main points improves significantly when outlines are presented.

- *Impact on attitudes.* The use of overhead transparencies also has positive effects on attitude in business meetings. In a study by the Wharton Applied Research Center, candidates for master's degrees in business administration participated in a business simulation that involved group meetings to decide whether to introduce a new product. The study produced the following findings (Wharton Applied Research Center, 1981):
  - More individuals decided to act on the recommendations of presenters who used overheads than on the recommendation of presenters who did not.

- Presenters who used overheads were perceived as better prepared, more professional, more persuasive, more credible, and more interesting.
- Groups in which presenters used overheads were more likely to reach consensus on their decisions than groups where no overheads were employed.

- *Organization and discussion.* Another study suggests that teachers who use the overhead projector tend to be more organized than teachers who rely on notes or printed outlines. Students in this study participated more frequently in discussions in classes where the overhead was used (Cabeceiras, 1972).

Limitations

- *Not preprogrammed.* The effectiveness of overhead projection presentations is totally dependent on the presenter. The overhead projector cannot be programmed to display visual sequences by itself, nor is an audio accompaniment provided.
- *Not self-instructional.* The overhead system does not lend itself to independent study. It is designed for large-group presentation. Of course, an individual student could look at a transparency by holding it up to the light, but because captions and audio tracks are not a part of this format, the material would ordinarily not be self-instructional.
- *Production process required.* Printed materials and other nontransparent items, such as magazine illustrations, cannot be projected immediately, as is possible with the document camera. To use the overhead system such materials have to be made into transparencies by means of some production process.
- *Keystone effect.* Distortion of images is more prevalent with the overhead than with other projection systems. The projector is commonly placed at desktop level to facilitate the instructor's writing on transparencies. The screen, on the other hand, needs to be placed on a higher level for unobstructed audience sight lines. This discrepancy in levels causes a distortion referred to as the **keystone effect.** (This problem and its solution are discussed in Appendix B.)

Integration

Because the image is large and you can manipulate or add to it while projecting, the overhead projector is extraordinarily versatile. It has been used to communicate visually in every subject in the curriculum. Here are a few ideas:

- *Art:* Use strips of colored acetate to demonstrate the composition of primary and secondary colors by overlapping red, yellow, and blue.
- *Consumer Science:* Make thermal transparencies of blank checks and balance sheets; demonstrate how to make out a check and balance the check register.
- *Drama:* Put a floor plan on the base cell and add overlays to show acting circles and how areas are lit.
- *Geography:* Use a clear plastic ruler over a transparency of a map; demonstrate how to measure the distance between any two points.
- *Language Arts:* Use different colored pens to highlight nouns, verbs, and other parts of speech.
- *Library Skills:* Show a floor plan of the layout of the school media center as part of library orientation.
- *Literature:* Visually compare different forms of poetry (e.g., haiku, sonnet) and compare meter patterns.
- *Music:* Show a staff with notes arranged in three-part harmony, with different colored notes for each part.
- *Mathematics:* Use circles and squares that are cut into pieces to illustrate different fractions. These are among the many transparent manipulatives distributed by publishers as adjuncts to math textbooks.
- *Science:* Show how iron filings align to poles of a magnet placed on an overhead projector stage.

Creating Overhead Transparencies

As previously noted, a major advantage of the overhead system is that instructors (and students!) can easily prepare their own transparencies. One of the first methods involved simple hand drawing on clear acetate sheets; numerous other methods of preparing transparencies have evolved over the years. We will look closely at the processes most commonly used in the classroom—direct drawing, electrostatic film process (xerography), and computer printing.

Direct Drawing Method. The most obvious way of quickly preparing a transparency is simply to draw directly on a transparent sheet with a marking pen (Figure 6.10). Clear acetate of 5–10 mils (.005–.010 inches) is recommended. Other types of plastic can be used. Although some of these alternatives may be a great deal cheaper than the thicker acetate, some impose limitations in terms of durability, ease of handling, and ability to accept different inks (i.e., some disintegrate completely under alcohol-based inks). Blue-tinted acetate is preferred because it reduces the glare of the projected image.

Although the glass stage of the overhead projector generally measures about 10 by 10 inches, your drawing and lettering should be restricted to a rectangular "message area" of about 7½ by 9½ inches. This fits the dimensions of acetate sheets, which are commonly cut into rectangles of 8 by 10 inches or 8½ by 11 inches (Figure 6.11).

If you are doing freehand lettering, keep in mind that neatness counts, as does legibility. Your imperfections will be magnified to the size of the projection screen. Viewers can't learn from what they can't decipher. Note

FIGURE 6.10
Most overhead projector users like to draw directly on the transparency, in this case to add significant details to a previously prepared visual.

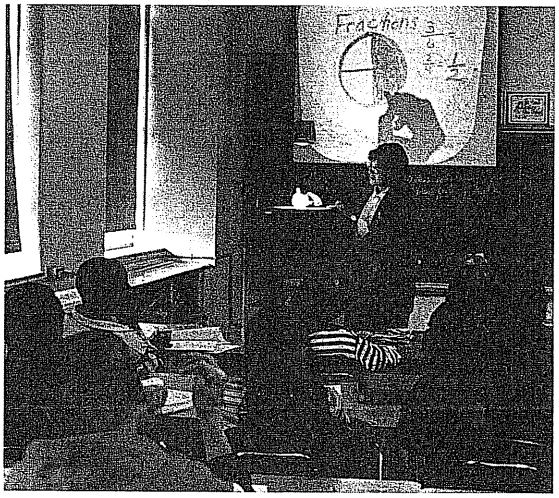
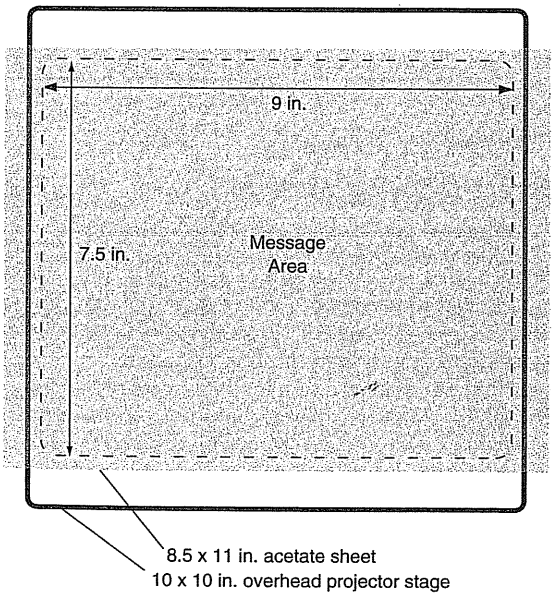


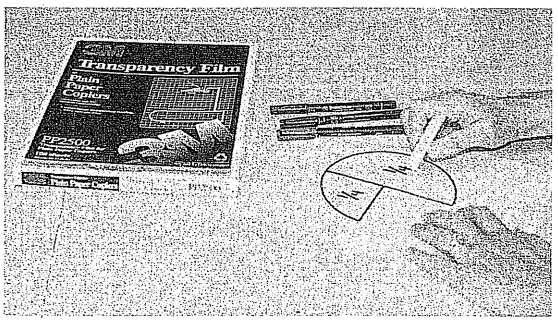
FIGURE 6.11
Comparative dimensions of an overhead transparency and the projector stage.



the guidelines given in "How to . . . Design Overhead Transparencies."

Some overhead projectors come equipped with a pair of roller attachments made to carry long rolls of plastic that can be advanced or reversed by a small hand crank. This assures a steady supply of transparency material for

FIGURE 6.12
Plastic erasers will remove permanent ink, at least that of the same manufacturer.



extemporaneous use. It also allows you to prepare in advance a series of images in proper sequence.

In addition to the transparency, you will need a writing instrument. Felt-tip marking pens are the handiest for this purpose. They come in two general types—water soluble and permanent ink. However, not all are suitable for overhead transparencies. Here are some cautions to keep in mind:

- Ordinary felt-tip pens with water-soluble ink generally will not adhere well to acetate; the ink tends to bead up and evaporate. Look for a label saying, "overhead projector pen"; this indicates it will adhere to acetate and project color. You can erase such special ink with a damp tissue or wash the transparency completely clean and reuse it.
- Virtually any permanent-ink felt-tip pen will adhere to acetate, but only those marked "overhead projector pen" are made to project in color. Other types may project only in black and may even damage the transparency film. Most users choose a permanent ink for hand-drawn transparencies prepared in advance, especially if they are going to be reused, because water-based ink is likely to smear as you work on the different areas of the transparency or as you handle it during use.
- Permanent ink markings can be erased with special plastic erasers or with correction markers containing alcohol-based solvents (Figure 6.12), but it is not practical to clean and reuse transparencies that have extensive permanent ink markings.
- During a presentation, you may use highlighter pens made especially for overhead projection to draw attention to critical information. This can add a dramatic touch, but be careful—they are permanent. Put a clear acetate sheet on top of your finished transparency to protect it.
- Least commonly used are wax-based pencils. Most will project only in black. They can be erased with a soft, dry cloth.

HOW TO . . . *Design Overhead Transparencies*

Assemble the Elements

- When you are choosing elements remember that viewers will stop reading text once they know what it says, but they will continue to look at illustrations, especially when you are talking about them. Use more graphical elements than text on your transparencies and supply the verbal explanations yourself; include text for key ideas only.

FRACTIONS

1/2 + 1/2 = 1

Titles and other text are plain and large so they will project visibly and clearly.

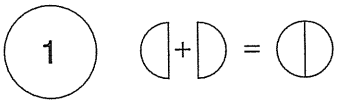
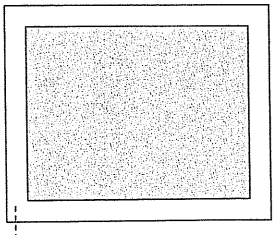


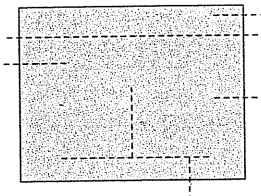
Illustration elements are simply designed and convey only one major concept for each transparency in the set; if they are in color, the colors are bold enough not to "wash out" in the light of the projector.



Protective frames keep fingerprints off transparencies and make them easy to store, label and handle. Decide what type of frame you will use before you design the transparencies so you know how much margin to allow for the frame.

Choose Background and Underlying Pattern

- If you are using a computer presentations program to create transparencies, you will have a choice of underlying patterns, usually called "Masters" or "Templates." Choose the simplest one that fills your needs.



Blue transparencies provide a neutral background for black text and illustrations; yellow transparencies with black text are highly legible; clear transparencies are best if you expect to use color in the content.

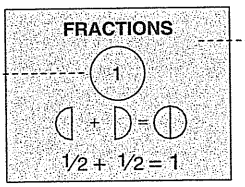
Title area is at the top of the overhead where viewers begin to scan the display.

Content area: content of transparencies should be limited to 1 or 2 images at most for graphical displays; 2 headings and 6 bullet points for text displays.

Inverted "T" pattern gives a focal point at the top with room for expanded content below.

Arrange the Elements

- Since the elements on a transparency must be fairly large in order to project well, one of the challenges of arrangement is to fit the elements into the available space. Resist the temptation to make elements smaller, since they may not be visible to your viewers.

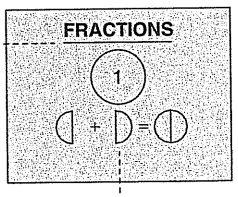


The circle representing a whole is large enough to anchor the display; viewers refer back to it as they process new information.

If there is more than one transparency in this series, others may use different arrangements of illustrations, but all the content will appear within the same area of each slide.

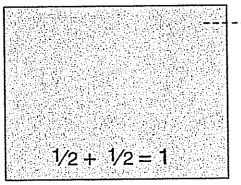
Check and Revise

- Practice with your transparencies and an actual projector. You can double-check the visibility of your elements and discover whether the arrangement of content from one transparency to another actually supports the presentation you expect to make.



Additional line helps separate title from content area more clearly.

Transparency is simplified to 2 major, related ideas.



Second transparency is designed to overlay the first one after viewers have absorbed its content.

© Elizabeth Boling 1995

AV SHOWMANSHIP Overhead Projection

In addition to the general utilization practices discussed in Chapter 3, here are some hints for making the greatest impact with your overhead presentation:

- Get attention. Shift viewers' attention to the screen by turning on the projector; direct it back to yourself by turning it off. Don't turn on the projector again until you are ready for viewers to look at the screen.
- Reveal sections. For a complex visual or wordy illustration, cover the transparency with a sheet of paper and reveal one portion at a time as you talk about that portion.
- Build ideas. Use overlays to add sequential information. Build up a complex idea by superimposing transparencies one on top of another; up to four overlays can be used.
- Make transitions. Avoid jarring viewers with a glaring white screen between transparencies. Instead, simply place the new one on top of the old one, then slide the lower one out. If both hands are free, you can obtain a "dissolve" effect by sliding the existing transparency off the stage while you lower the new one into place.
- Point to images. You can use a pen or pencil as a pointer. Lay the pen directly on the transparency (any elevation would put the pointer out of focus, and any slight hand movement would be greatly exaggerated on the screen).
- Be spontaneous. Plan ways to add meaningful details to the image during projection; this infuses an element of spontaneity and helps maintain viewer interest and active participation. If the transparency is a valuable one, cover it with a blank acetate sheet before writing on it.
- Use notes. Write your presenter's notes (key words) on the frame of the transparency. This will allow you to speak naturally instead of reading from a script.
- Create uniformity. You will make the most professional impression if your transparencies are consistent in size and style. If all of them are framed, you can tape a guide onto the projector stage to keep the images uniformly aligned.
- Avoid doodling. For random notes, use the chalkboard. Don't diminish the dramatic impact of your presentation by using the overhead as a doodle pad.

Electrostatic Film Process (Xerography). The rapidly evolving technology of xerography provides another method of producing transparencies. All plain-paper copiers that operate by the **electrostatic film (xerography)** process can be used to make black-and-white transparencies. Some models can also produce high-quality full-color transparencies from paper originals or slides. These are most often found at commercial copying services.

Electrostatic copying requires a paper master and specially treated film. The film is electrically charged and light sensitive. Any source that yields good opaque markings can be used (e.g., computer printer output, clippings from printed material, drawings made by ballpoint pen or dark felt-tip marker).

Overheads Created by Computer. Computers have eased the task of creating overhead transparencies and similar types of visuals. With any word processing software you can prepare simple verbal overheads—sentences, lists, and the like. You can print each screen on plain paper and use it as a master to make electrostatic transparencies.

With **presentation graphics software,** such as Microsoft's *PowerPoint,* even users without specialized graphics training can create attractive graphic displays in a form suitable for professional presentation. You select a visual style from a menu, specify the desired type of graphic (e.g., outline, bulleted list, graph, map, or combination), then just type in your message where directed by the program (Figure 6.13). The program automatically selects legible type fonts and sizes and organizes the

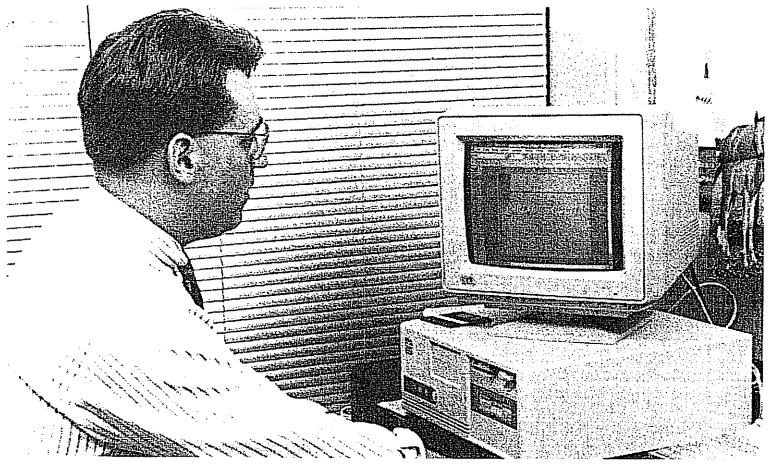


FIGURE 6.13
Presentation graphics software enables you to compose overhead transparencies with ease.

pictures and text into a clean visual layout. The visual can be printed directly onto transparency film by a laser printer or onto a paper copy, which you may then use as a master to make xerographic transparencies. Among the types of graphics software available are the following:

- *Presentation programs*—special software that simplifies creation of slides or transparencies of graphics that combine text, data, and visuals
- *Drawing and paint programs*—allow the user to draw geometric shapes and figures; can also incorporate text
- *Charting programs*—especially suited to making charts, graphs, and reports from spreadsheet data
- *Photo-enhancement programs*—allow the manipulation of color and use of special effects to alter photographs and slides
- *Desktop publishing programs*—combine features of many other methods to create sophisticated products such as newsletters and books

There are several technical processes for producing transparencies directly with a computer printer. You need to select the proper type of transparency film for your printer:

- Laser printers print images directly onto special film.
- Ink-jet printers spray droplets of ink onto specially coated ink-jet film.
- Thermal transfer printers use heat to imprint images onto thermal film.
- Pen plotters draw with pens directly onto specially coated film.
- Impact printers press the ink from ribbons onto impact film.

SLIDES

The term **slide** refers to a small-format photographic transparency individually mounted for one-at-a-time projection. The standard size of slides is 2 by 2 inches (5 by 5 centimeters) measured by the outer dimensions of the slide mount. When 35mm and other popular types of slide film are sent out to be processed, they are mounted in 2-by-2-inch frames. The actual dimensions of the image itself will vary with the type of film and camera.

Advantages

- *Sequencing.* Because you can arrange slides into many different sequences, they are more flexible than filmstrips or other fixed-sequence materials.
- *Automatic cameras.* As photographic equipment is continually refined and simplified, more and more amateurs are able to produce their own high-quality slides. Automatic exposure controls, easy focusing, and high-speed color film have contributed to this trend. Even amateur photographers may now take high-quality color slides.
- *Automatic projectors.* The assembly of slide programs is facilitated by today's projectors, which hold sets of slides in trays and feed them into view in sequence. Most projectors also offer the convenience of remote control advancing of slides, allowing you to remain at the front of the room or off to one side while advancing the slides via a pushbutton unit connected by wire to the projector. Wireless remote control is also available. Certain models can be preset to advance automatically. This feature allows continuous showing in exhibits, display cases, and other automated situations.
- *Collection building.* General availability and ease of handling make it relatively easy to build up permanent collections of slides for specific instructional purposes. You and your fellow instructors may collect and store your own collections, or the slides may be compiled and kept in a learning resource center. Such collections enable you to assemble presentations partially or wholly from existing images, thus reducing the expense required for new production.
- *Individualized instruction.* You may integrate slides into individualized instruction programs. Although slides have been developed primarily as a large-group medium, recent hardware innovations have made slides feasible for small-group and independent study as well (Figure 6.14).

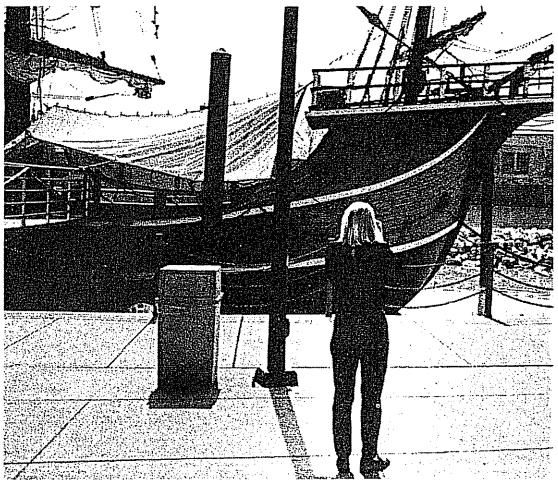
Limitations

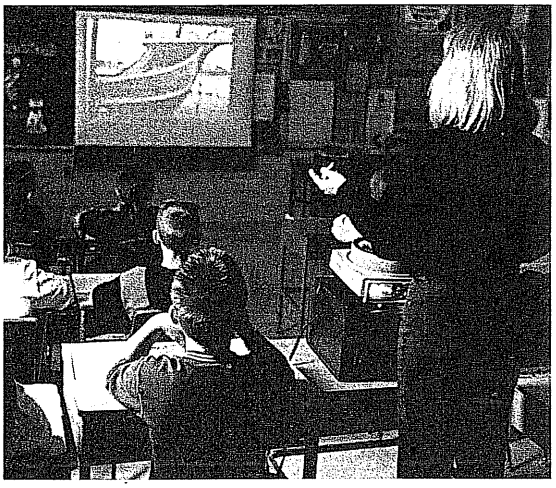
- *Disorganization.* Because slides come as individual units, they can easily become disorganized. Even when they are stored in trays, if the locking ring is loosened, the slides can spill out.

FIGURE 6.14
The slide–tape format has been adapted for use by individual viewers.



FIGURE 6.15
Teacher or students can prepare slide sets showing local landmarks.





- *Jamming.* Slide mounts come in cardboard, plastic, and glass of varying thicknesses. This lack of standardization can lead to jamming of slides in the slide-changing mechanism: cardboard becomes dogeared and the frayed edges get caught in the mechanism; plastic mounts swell or warp in the heat of the lamp; glass mounts thicker than the aperture chamber fail to drop into showing position.
- *Susceptible to damage.* Slides can easily accumulate dust and fingerprints; careless storage or handling can lead to permanent damage.

Teacher- and Student-Produced Slides

A major advantage of slides as an instructional medium is the ease with which both teachers and students can produce them. Modern cameras are so simple to operate that even the most amateur of photographers can expect good results. (General guidelines for photography appear in Appendix A.) To make slides you follow the same procedures but substitute slide film for print film. As with all locally produced materials, slides made by teachers or students have an immediacy, relevance, and credibility lacking in more generic materials (Figure 6.15).

Producing "Slide Shows" by Digital Photography. Digital camera systems are rapidly becoming replacements for conventional film photography. Digital cameras have quickly found a place in the computer realm. They are widely used to capture images for incorporation into documents produced by presentation software or desktop publishing. The images made with this technology can be arranged in a sequence and shown on the computer screen as a kind of slide show.

Producing Slides by Copying Visuals. Many single-lens reflex (SLR) cameras have a combination zoom and macro lens. You can take close-ups using the macro portion of the range, allowing you to copy flat visuals such as maps, charts, illustrations, and even small three-dimensional objects. To photograph the material, pin it to a wall or place it on a horizontal surface. (Detailed procedures appear in "How to . . . Convert Visuals to Slides," in Appendix A.)

Producing Slides with a Computer. Traditionally, slides have been made by shooting photographs of people, places, things, or images drawn by graphic artists. Computers now offer the capability of generating graphic images that can become slides. There are presentation graphics software programs especially adapted to producing output in the slide format. They are capable of producing images of very high resolution—as sharp and clearly defined as those of photos.

Their high quality, ease of production, and flexibility of use have made computer-produced slides popular in corporate training, where they are used to prepare self-instructional units or modules. Sound–slide modules have been found to provide as much of an impact as a video at a fraction of the production cost.

DIGITAL IMAGES

It is possible to store images in a digital (or analog) form and show them on a computer or television monitor or project them before a group. Available digital storage media include CD-ROM, photo CD, DVD-ROM, and computer disks. Videodiscs (or laser discs) look similar but store the images in an analog format. (See, for example, "Close-Up: How a Compact Disc Works," in Chapter 7.)

HOW TO . . . Operate a Slide Projector

OPERATION

Set Up

- Connect power cord to AC outlet (power cord is stored in the bottom of the projector).
- Plug in the remote control cord with white dot on top.
- Insert lens if not already in place.
- Check to see that bottom ring is locked on slide tray. If it is not locked, slides will drop out.
- Load slides into tray and tighten the locking ring on the tray.
- Seat slide tray on projector. Note the notch at "O."

Operate

- Set automatic timer at "m" (manual operation).
- Move on/off switch to "Low" or "High" lamp setting.
- Position image on screen, making it smaller or larger by means of the lens barrel (if equipped with zoom lens).
- Focus image with focus knob.
- Project slides using remote control or buttons on the side of the projector.

Disassemble

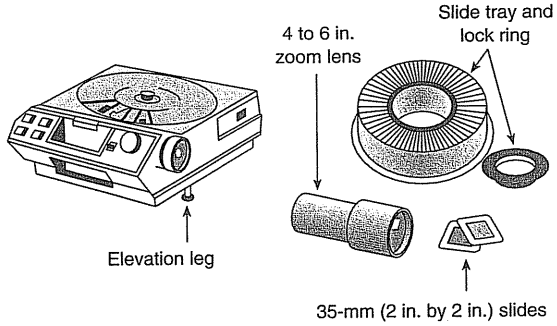
- Press and hold "Select" button while turning the tray to "O." The "Select" function will not operate when projector is off, except on the Ektagraphic III model.
- Remove slide tray.
- If projector is going to be moved immediately, allow lamp to cool before switching off.
- Remove slides from slide tray if desired.
- Restore to storage conformation.

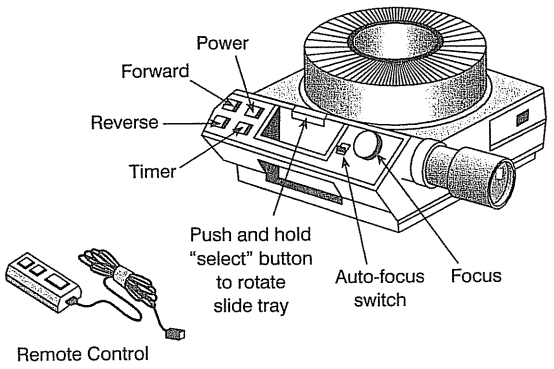
TROUBLESHOOTING

Problems/Possible Remedies

- Can't find power cord: Look for a built-in storage compartment. For example, on the Kodak Carousel the power cord is wrapped around a recessed core on the bottom of the projector.
- No power after plugging in: If you are sure the outlet is live (a fuse or circuit breaker may have killed all electrical power in the room), check the circuit breaker on the slide projector.
- Fan runs but lamp does not light: Some projectors have separate switches for "Lamp" and "Fan" or a two-stage switch for these two functions. Make sure all switches are properly set. Then check for burned-out lamp. If neither of these is the problem, have technician check the projector.
- Image not level: Most slide projectors have an adjustment knob on one of the rear feet. Use the knob to raise or lower that side.
- Slide is distorted: The lenses may be out of alignment or broken. Often they can be adjusted easily by aligning them correctly in their slots.
- Slide mounts begin to warp: For plastic black-and-white mounts, ensure that white side of mount is facing the lamp. If the dark side of mount is facing lamp, a buildup of heat can cause the mount to warp (or even melt, in the case of plastic mounts).
- Slide image upside down or backwards: Remove the slide and reverse it. You can avoid improper loading by thumb spotting slides (see page 160).
- Slide jams in gate:

1. Manually remove the slide. On the Kodak Carousel, press the "Select" button (power must be on). If the slide does not pop up, you will have to remove the tray. Turn off the power and use a coin to turn the screw in the center of the tray; this unlocks the tray, allowing you to lift it off and giving access to the gate for manual removal of the slide.
2. Avoid jamming by not placing bent slides in the tray. Plastic mounts have a tendency to warp; cardboard mounts fray; glass mounts may be too thick for the slide compartment of the tray. For this reason, jamming is more likely with narrow slide compartments, as are found in the 140-slide Carousel trays. Use the 80-slide tray whenever possible.

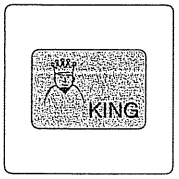




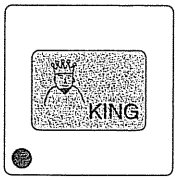
HOW TO . . . *Thumb Spot Slides*

There are eight possible ways a slide can be placed in a projector. Seven of them are wrong (e.g., upside down, backwards, sideways). To avoid all seven mistakes a standardized procedure is recommended for placing a reminder spot, or **thumb spot,** on the slide.

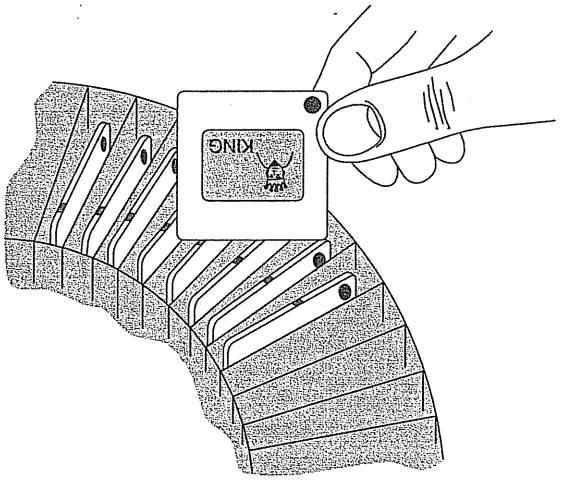
- First, arrange and number your slides in the correct presentation order.
- Then take each slide and hold it the way it is supposed to be seen on the screen—that is, right-side up with the lettering running left to right. If the slide lacks lettering or other orienting information, hold it so that the emulsion side (the duller side) is toward the screen.



- Then simply place a spot (or number) on the bottom left-hand corner.



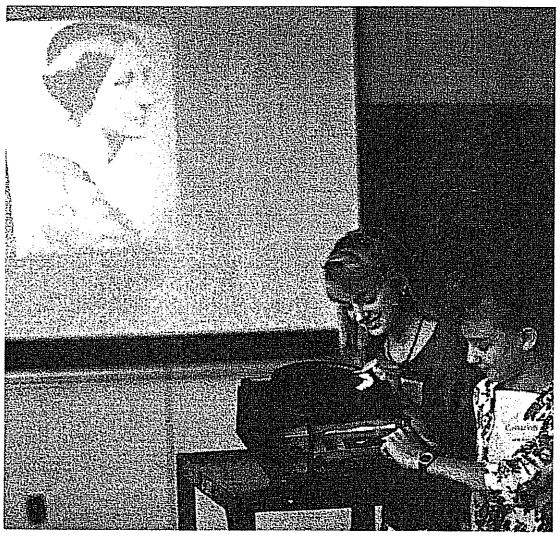
- This spot is referred to as a thumb spot because when you turn the slide upside down to place it in the projector, your thumb will grip the slide at the point of the thumb spot, as shown.
- Before putting all the slides in the tray in proper order, some users like to run a felt-tip pen across the tops of the slide mounts in a diagonal line. This way, if some slides later get out of order, they can be replaced just by lining up the marks on the top of the slide to form a diagonal line.



CLOSE-UP

NATIONAL HISTORY DAY

Each spring, middle, junior high, and high school students gather in each state to present their research on the year's chosen theme. They present their material in a variety of formats: stage performance, videos, exhibits, slide shows, and computer programs. The research these students do is often worthy of graduate students. The state winners in each category go to Washington, D.C., for the final competition. The photo shows two junior high students getting ready to show their slide presentation on Susan B. Anthony. (A five-page report on National History Day by Marilyn Page, "Active Learning in Secondary Schools; Educational Media and Technology," is available from the ERIC [ED 323987]. The report stresses the value of cooperative learning.)



AV SHOWMANSHIP Projected Visuals

In addition to the general guidelines for media utilization discussed in Chapter 3, here are several specific practices that can add professionalism to your presentations using projected visuals:

- *Use visual variety.* Mix the types of visuals, using verbal titles to help break the presentation into segments. Use visuals that are not cluttered with illegible details. Teach your audience to interpret visuals (see Chapter 5).
- *Rehearse.* Plan and rehearse your narration to accompany projected visuals (e.g., slides or *PowerPoint*) if it is not already recorded on tape or other audio medium.
- *Doublecheck slides.* Make certain your slides are in sequential order and are right side up. Disarrangement can be embarrassing to you and annoying to your audience. See "How to . . . Thumb Spot Slides" for a foolproof method of marking slides.
- *Use remote control.* Use a remote control device; this will allow you to stand at the side of the room. From this position you can keep an eye on the visuals while maintaining some eye contact with the audience.
- *Maintain reading light.* Prepare a way to light up your script after dimming the room lights; a penlight or flashlight will serve this purpose.
- *Keep it moving.* Limit your discussion of each visual. Even a minute of narration can seem long to your audience unless there is a complex visual to examine at the same time.
- *Use mood music.* Consider adding a musical accompaniment to your live or recorded narration. This can help to establish the desired mood and keep your audience attentive. But do not have music playing in the background when actually narrating.
- *Pause for discussion.* Get students actively involved by asking relevant questions during your visual presentation. You may want to ask students to take turns reading the captions (if any) aloud; this is a useful reading activity for early elementary students. Provide written or verbal cues to highlight important information contained in the visuals.
- *Avoid irrelevant images.* If there is a "talky" section in the middle of your presentation, use a gray or black visual or turn off the projector rather than hold an irrelevant visual on the screen. Cover irrelevant material until ready for students to view it.
- *Test visually.* Since the visual presentation presumably is providing critical visual information, consider using visuals to test the mastery of visual concepts. You can, for instance, use specific visuals and ask individual students to identify or describe the object or process shown. If visuals are not large enough for all to see, use one of the projection techniques described in this chapter.

CD-ROM

CD-ROM (compact disc–read-only memory) has the capacity to handle not only quality sound but also large quantities of text and visuals. CD-ROM is a storage system that utilizes a compact, rugged, and lightweight disc only 12 centimeters (4.72 inches) in diameter. It is an optical storage medium that uses a tiny laser beam to retrieve the information on the disc. CD-ROM discs are "read only," which means that the user cannot change or modify the information on the disc. Recordable and rewriteable compact discs are available. Students can create their own CD-ROMs. One suggestion might be for students to produce their portfolio materials on a CD-ROM because the storage capacity and ease of access to the information makes this a very valuable way for students to store that information.

Because CD-ROM discs can store many types of digital information, including text, graphics, photographs, animation, and audio, they are popular in school settings, library media centers, and classrooms of all sorts. Anything that can be stored on a computer disk can be stored on a CD-ROM.

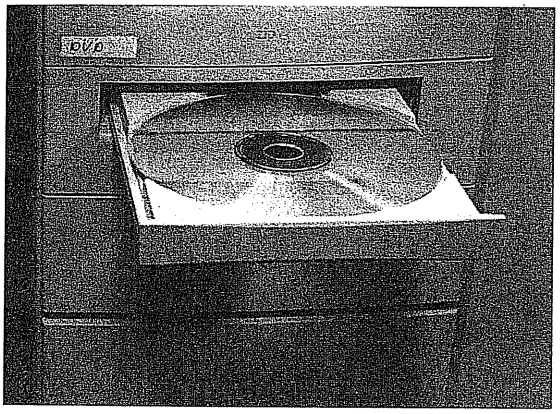
CD-ROM discs require their own special player; the audio CD player attached to your stereo system will not play them. However, most computer CD-ROM players can also play audio CDs. The CD-ROM player must be connected to a computer with an interface cable. Most new computers come equipped with a CD-ROM player built into the system (and many now feature compact disc–rewritable [CD-RW] drives). A computer monitor displays the data from the CD-ROM. You interact with the information in the same way you do with other computer-based multimedia materials.

Many schools and colleges have slide libraries as resources for teaching subjects, such as art history and biology, which require great numbers of visual images. In some schools these visual libraries are being replaced by videodiscs or CD-ROMs, which can hold a whole subject area library on one disc. A single disc is less expensive to purchase and far easier to store and maintain.

Photo CD

The photo CD (photographic compact disc) utilizes digital technology to store photographic images. For only a few dollars you can have your photographs, from a regular camera, developed and placed on a compact disc. You can show the photographs on the photo CD using a special photo CD player and display them on a television set, or using your computer you can project them for a group as described in the next section. You can alter the sequence of visuals and create a "slide show" effect with your photographs.

FIGURE 6.16
Computers have built-in CD-RW or DVD drives for displaying CD or DVD material.



DVD-ROM

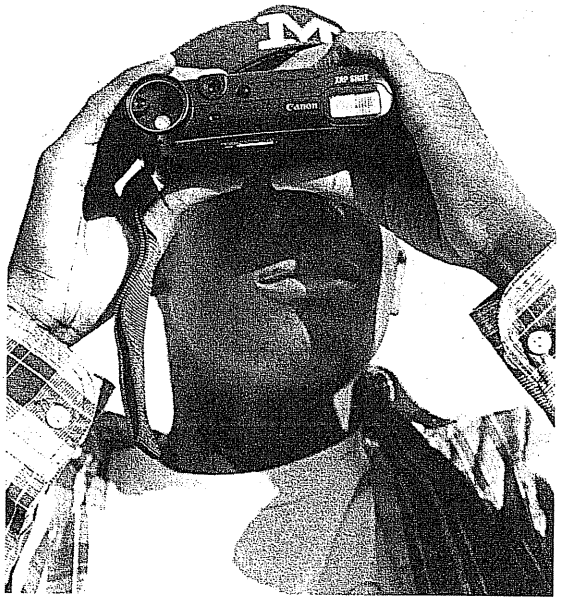
Similar to the CD-ROM, DVD-ROM (Digital videodisc–read-only memory) is also a digital storage format, but with greater capacity. DVD-ROM is an ideal medium for text, visuals, animation, motion video, and audio formats that have large storage requirements. Like CD-ROM, DVD-ROM is a storage system that utilizes a compact, rugged, and lightweight disc only 12 centimeters (4.72 inches) in diameter. It is an optical storage medium that uses a tiny laser beam to retrieve the information on the disc. DVD-ROM discs are "read only," which means that the user cannot change or modify the information on the disc. Recordable and rewriteable DVD discs are available, but are expensive. DVD-ROM is only beginning to have an impact in education. In time, however, because of the ability to hold extensive quantities of data, DVD-ROM will replace CD-ROM. Many models of computers are now being produced with DVD/CD-ROM drives.

Digital videodisc (DVD) is a wholly digital format that has almost totally replaced the previous videodisc standard (Figure 6.16). The advantage of DVD as a video format are that the viewer can decide how to interact with the material from a menu of choices. One limitation in education with DVD is the limited number of titles available outside of full-feature films. This will change as the processing techniques for DVD becomes more available to developers of educational materials. We discuss DVD and how to use it in Chapters 8 and 9.

Digital Camera

Instead of storing the visuals on photographic film, digital cameras connect directly to a computer to place the image onto the computer (Figure 6.17). Others store the images directly onto a computer disk or a small digital "flash memory" card, or "smart card," inside the

FIGURE 6.17
Pictures taken with a digital camera can be incorporated immediately into a computer presentation.



camera. These disks and "smart cards" have increased storage capacities, often megabytes of capacity, allowing you to store hundreds of images on one card. Once the picture is taken, it is easy to connect the camera or use the disk or smart card (which does require a special input device) to put the image onto the computer.

These images can be used in many different ways. You can connect the computer to show the visuals on the monitor, and may in turn connect the computer to an LCD panel or a data projector (see page 164) for group viewing. You can use the images as part of other documents, such as newsletters or word processed papers. These images can also be incorporated into Web pages. Because they are digital, the images are easy to place into these types of files.

It is also possible to use software programs, such as *Photoshop,* to alter the images in ways that enhance or improve their quality or the nature of the image. Images can be edited to eliminate portions of the photo that are unimportant. One word of caution here, it is also possible to alter or distort the image in such a way as to change it from the original. Students need to learn the importance of ethical use of images to convey messages. (See "Copyright Concerns," p. 87.)

Advantages

- *Images are digital.* The great advantage of the digital camera is that it enables you to take pictures that are stored as digital images so you do not have

to have them developed or use any additional devices to capture the images from traditional cameras.
- *Vast capacity.* The digital camera, especially the one that uses a floppy disk or smart ("flash memory") card, can store a great number of visuals.
- *Zoom capability.* Many models of digital cameras have zoom or macro options that make close-up photographs possible.
- *Ease of use.* Digital cameras are very easy to use. Even young children can take pictures with digital cameras.

Limitations

- *Expense.* Digital cameras are more expensive to purchase, but do not require any additional expenditures for film, as traditional cameras do.
- *Fragile.* Digital cameras can be a bit more fragile to handle than some traditional cameras. Some of the controls are smaller than on traditional cameras.

Stills from Videotape or Videodisc

Videodiscs resemble silver, shiny phonograph records. They are also referred to as *laser discs.* Recorded images and sound are stored on these discs in analog format.

Each side of a videodisc can hold up to 30 minutes of motion video images, or up to 54,000 still images, or a mix of both. As with digital formats, many videodiscs are indexed for rapid location of any part of the program material. When a videodisc playback unit is connected to a computer, the information on the disc can become an integral part of a computer-assisted instructional program.

Using a technique called "frame grabbing," you can "capture" (digitize) one frame or image from a videotape or videodisc and store it on a computer disk. You may then modify the still image with a graphics application and either use it in a computer program for individual students or project it before a group. "Frame grabbers," such as the *Snappy,* cost a few hundred dollars. With the development of digital video capabilities, it has become even easier to "grab" an image from videotape.

Advantages

- *Random access.* Digital images stored on discs can be rapidly and randomly accessed, often in fractions of a second, even with 54,000 images to choose from on a videodisc. You can predetermine a random sequence of visuals before a presentation or select visuals based on questions from students.
- *Durability.* The discs are very durable. Fingerprints do not interfere with the quality of the projected visual as is the case with slides and filmstrips. The discs are almost impossible to break unless deliberately abused.
- *Storage capacity.* All the discs store thousands of colorful images at your fingertips.
- *High-quality visuals.* The quality of digital still images is better than the photographic image on slides and does not fade with time as photographic images do.
- *Portable.* Digital discs are extremely portable. While you may carry digital discs without protection, it is best to keep CDs in their jewel cases and videodiscs in their cardboard jackets.
- *Less storage space.* It would require 675 80-slide trays to store the 54,000 still images on a single videodisc. The digitized images are also less sensitive to extreme heat, cold, and humidity.

Limitations

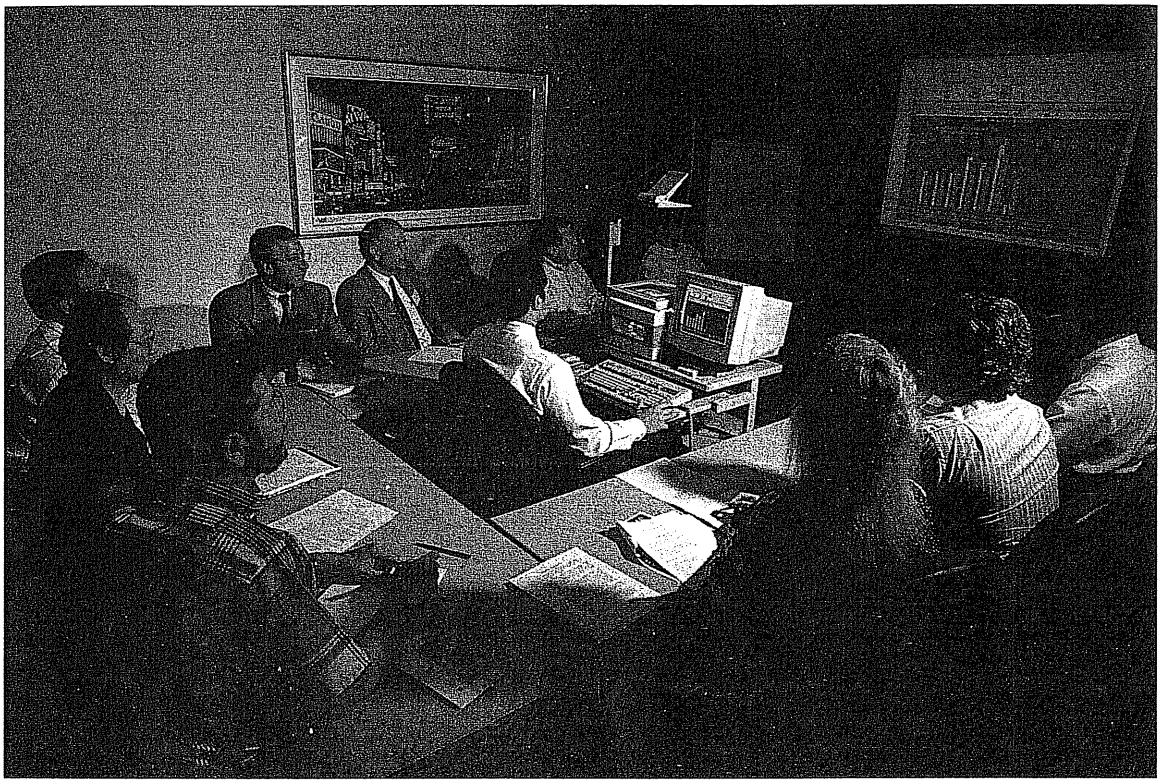
- *Expensive to produce.* Digital images on commercial discs are time consuming and expensive to produce. Digital cameras and "frame grabbers" allow individuals to produce their own visuals, but this equipment is more expensive than photographic equipment, and may be beyond your school's budget.
- *Requires player and projector.* As with slides, viewing digital images requires a projector or viewer. However, compared to slide projectors, digital equipment tends to be more complex, more expensive, and more difficult to operate.
- *Format becoming outdated.* The laser disc format is rapidly being replaced by CD-ROM and DVD, and fewer new titles are available.

Integration

Projected digital visuals are suitable for most of the same applications where you would use overhead transparencies or slides. Common applications of digital media involve individual students viewing on computers images stored on a CD-ROM or computer disk.

- Third-grade students view animals of the world from a CD-ROM as they prepare to present a play for the PTA depicting endangered species.
- A seventh-grade history student prepares an individual report on early American inventors using clip-art visuals from a computer disk.
- A tenth-grade literature class can view a DVD version of a book they have just completed. The teacher can stop the movie at key moments and keep the images on the monitor for discussion in class.
- Five vocational technical students use a digital camera to document the variety of work activities during a visit to a discount department store. They will prepare a class presentation on opportunities for graduates of their school.
- A college biology instructor has thousands of visuals from a videodisc available at her fingertips, which she can use to illustrate her lectures.
- Using a standard camera, a corporate trainer takes individual photos of each student in his training

FIGURE 6.18
LCD panels allow overhead projectors to be used to show computer images.



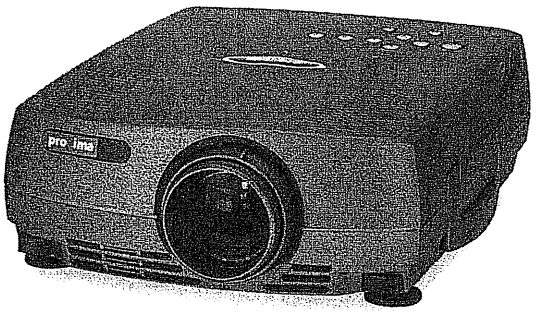
classes. When he sends the film away for processing, he requests a photo CD. Before each future class, the trainer accesses the photo CD to refresh his memory so he can call the students by name when he sees them again.

DIGITAL IMAGE PROJECTION

Digital (and analog) images can be shown to individuals using a computer monitor. For showing these images to a group, you can use a large television monitor (see Chapter 8 for size guidelines), an LCD panel on an overhead projector, or a data projector.

Designed for use with presentation graphics software, **liquid crystal display (LCD)** projection panels project computer images onto a screen—the electronic equivalent of an overhead transparency. An LCD panel is plugged into a computer and placed onto the stage of a high-intensity overhead projector (but not the tabletop reflective type). The overhead projector light shines through the LCD panel, projecting the image on a screen (Figure 6.18). Directions for this process are given in "How to . . . Operate an LCD Panel."

FIGURE 6.19
Computer data or images, as well as videos, can be projected by desktop projectors.



LCD projectors are also available as separate, free-standing units—*data projectors*—that do not require an overhead projector as their light source. The light source is built into the data projector (Figure 6.19). LCD projectors have audio capabilities in addition to the visual output. With an LCD projector, images can be projected from a computer, a video player (video-

HOW TO . . . *Operate an LCD Panel*

OPERATION

Set Up

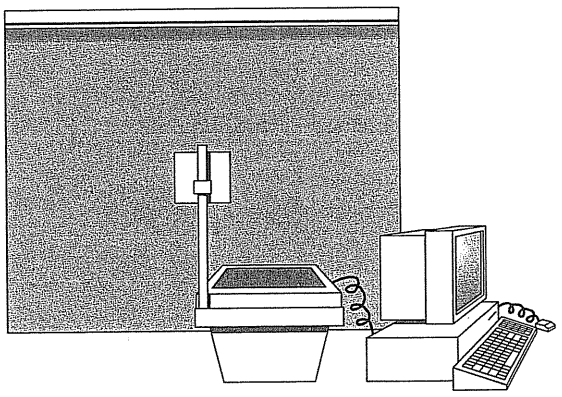
- Position computer and overhead projector on the same sturdy table or projection cart or on adjacent tables or carts.
- Place LCD panel on the overhead projector stage.
- Be sure power switch on LCD panel is off.
- Plug power supply into LCD panel. (See LCD panel instruction manual for specifics; the connection may require special cords.)

Operate

- Turn LCD power switch on.
- Adjust LCD panel for best image.
- Focus overhead projector image on projection screen.
- Whatever appears on the computer monitor can now be projected onto the projection screen.
- You can add writing or markings by placing a sheet of acetate over the LCD panel and writing on that.

Disassemble

- Turn LCD power switch off.
- Disconnect computer from LCD panel.
- Unplug power supply from LCD panel and electrical outlet.
- Carefully pack and store LCD panel.

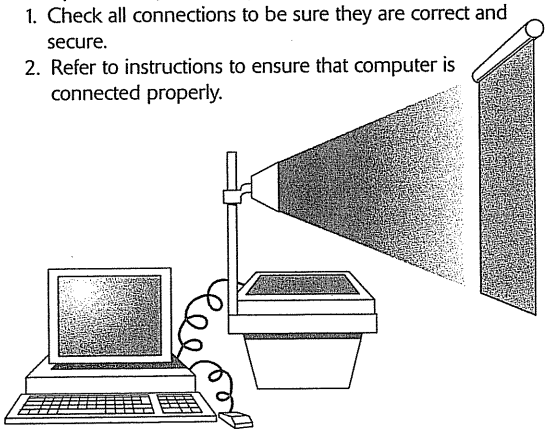


Front View

TROUBLESHOOTING

Problems/Possible Remedies

- No image on LCD panel:
  1. Adjust contrast on LCD panel.
  2. Check computer for instructions on obtaining image.
- Reversed image: See "reverse image" switch on side of panel.
- Image appears on LCD panel but is not centered:
  1. Check LCD panel instructions.
  2. Adjust centering or frequency.
- Flickering image or missing lines on LCD panel:
  1. Check all connections to be sure they are correct and secure.
  2. Adjust stability or frequency.
- Intermittent appearance of image on LCD panel:
  1. Check all connections to be sure they are correct and secure.
  2. Check equipment setup.
- Rolling waves in image on LCD panel:
  1. Check equipment setup.
  2. Adjust stability or frequency.
  3. Try another LCD panel.
- Contrast of display panel not uniform:
  1. Focus overhead projector.
  2. Adjust contrast.
  3. Use higher-wattage overhead projector.
- Test pattern only on LCD panel:
  1. Check all connections to be sure they are correct and secure.
  2. Refer to instructions to ensure that computer is connected properly.



Side View

tape, videodisc or DVD), or a television signal. The advantage the projector brings is the ability to show full-motion video signals in addition to the still images of a traditional presentation software package.

PowerPoint is a presentation software package that has become very popular. It is easy to use and makes very colorful projected presentations. Each slide (the term used to describe the individual projected image) can have a variety of styles. There are templates that provide a set color scheme and font choice. Many of these are very bright and easy to read. Or, the user can decide to select a different color scheme. This is relatively easy to do. Graphics are provided within the program, or visual images can be imported onto the slides. These special digital images customize the presentation.

In addition to using the existing templates for presentations, it is possible to create original backgrounds and color schemes. When a school or company wishes

to have the slides reflect a particular image, it is possible with this type of software.

Finally, *PowerPoint* allows the user to include music and animation. There are times when the presenter does not need to speak about the topic; easily attached audio files can enhance a presentation by providing a musical interlude when there are a set of slides where the visuals or text are all that is necessary. And, it is possible to add hyperlinked buttons to other programs, such as a Web browser, to demonstrate a particular point within a presentation.

Advantages

- *Image choices.* The great advantage of digital image projection is that it enables you to project anything that appears on your computer monitor—text, data, or visual—onto a large screen.
- *Vast capacity.* The computer can store a nearly infinite number of visuals, which you may summon by pressing a key.
- *Interactivity.* You can change the display just before or even during a showing, so digital image projection is ideal for "what-if" displays of spreadsheet data or graphs. This becomes an interactive medium when viewers' decisions or ideas are fed into the program and the outcome is displayed on the screen.

Limitations

- *Lack of brightness.* The room must be darkened more than for LCD panels and data projectors.
- *Legibility.* Low resolution makes LCD presentations best suited to small or medium-size groups (up to about 50 people) in which no one is seated more than four screen widths from the screen.
- *Expense.* LCD projectors still have a higher price tag than do LCD panels, however, this is changing.

Integration

The extra expense and logistical arrangements required by LCD projection would be difficult to justify for simple, static presentations. Where it yields real benefits, though, is in providing dynamic or interactive presentations, such as in the following:

- Demonstrating computer software functions to a group of students
- Searching an electronic encyclopedia (on CD-ROM) with a whole class following along
- Conducting a brainstorming session, capturing all suggestions on the computer display (and then printing them out at the conclusion)
- Presenting color animation sequences or viewing a digital video
- Teaching math or statistics formulas by changing the inputs and watching the output change on the screen graphically

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 6 of the Companion Website (http://www.prenhall.com/heinich).

1. *Planning Lessons Requiring Visuals.* Plan a lesson in which the students will be developing reports or presentations about a topic of study, suggesting strategies they might consider in selecting appropriate print and non-print visuals. What do you need to do to help them select and plan for the use of visuals? (ISTE NETS-T II-D; III-D; V-B)
2. *Written Reflection.* Reflect on a recent learning experience in one of the following settings: (a) lecture; (b) small group activity; (c) independent learning exercise. What visuals were used? How did those visuals enhance your learning experience? How could other visuals have improved your learning experience? If you had designed that learning experience, what visuals would you select and why? (ISTE NETS-T IV-C; VI-B)

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 6 of the Companion Website (http://www.prenhall.com/heinich).

1. Prepare a set of transparencies for a topic you might teach. Use at least two of the following production methods: direct drawing by hand; electrostatic (xerography) process; computer generation of presentation graphics.
2. Describe how you might utilize an LCD panel or data projector in a particular instructional situation.
3. Demonstrate the correct technique for inserting slides into a circular slide tray.
4. Prepare a storyboard for a silent, sound, or multi-image slide presentation.
5. Create an original example of an instructional situation in which you might use a set of teacher- or student-made slides.
6. Produce a set of slides for a topic you might teach. Use either a regular film camera, a digital camera, or computer images presented with an LCD projector. Describe the intended audience and objective(s), and state specifically how you would use the slides. (Alternative: Describe a project for student-produced slides; include audience, objective(s), and plan for guiding students.)
7. Examine a major selection source for visuals (such as "A-V Online") and report on the

☑ APPRAISAL CHECKLIST

VISUALS

KEY WORDS: _____, _____, _____

Title _____

Series Title (if applicable) _____

Source _____

Date _____ **Cost** _____

Subject Area _____

Intended Audience _____

Format

- ❑ **Still picture**
- ❑ **Drawing**
- ❑ **Chart**
- ❑ **Graph**
- ❑ **Poster**
- ❑ **Cartoon**
- ❑ **Overhead transparency**
- ❑ **Slide**
- ❑ **Digital image**

Brief Description

Objectives

Entry Capabilities Required (e.g., prior knowledge, reading ability, vocabulary level, math ability).

Rating	**High**	**Medium**	**Low**	**Comments**
Match with curriculum	❑	❑	❑	
Accurate and current	❑	❑	❑	
Clear and concise language	❑	❑	❑	
Arouse motivation/maintain interest	❑	❑	❑	
Learner participation	❑	❑	❑	
Technical quality	❑	❑	❑	
Evidence of effectiveness (e.g., field-test results)	❑	❑	❑	
Free from objectionable bias or advertising	❑	❑	❑	
User guide/documentation	❑	❑	❑	
Legibility for use (size and clarity)	❑	❑	❑	
Simplicity (clear, unified design)	❑	❑	❑	
Appropriate use of color	❑	❑	❑	

Strong Points

Weak Points

Recommended Action _____ **Name** _____ **Date** _____

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A computer version of this Checklist is available on the "Classroom Link Portfolio" CD-ROM.

A Presentation to Management

Company sales have been on a plateau for three years, and the general sales manager has devised a strategy to expand existing markets and open new ones. His goal is to convince management and the marketing division to adopt this new marketing strategy.

Analyze Learners

General Characteristics

The audience consists of the chief executive officer (CEO), the marketing vice president, the financial vice president, and three regional sales managers. The financial vice president joined the company two years ago, but the others have been with the company at least 10 years. The financial vice president believes a sharp increase in profits would firmly secure her job. The marketing members of the audience feel somewhat threatened by the implication that their efforts have been ineffective; they are apprehensive about the difficulties involved in restructuring the sales force. The CEO is concerned about a board of directors disgruntled over stagnant sales. He wants to be convinced, but not at the expense of creating a hostile sales group.

Entry Competencies

Each member of the audience has successful business experience, but in different areas. The financial vice president appraises all company activities strictly by the balance sheet. The marketing vice president wants to show an interest in overall company performance but looks at proposals from the point of view of the marketing division. The regional sales managers believe they have developed loyal and effective sales forces. All have demonstrated the ability to grasp quickly the ramifications of new ideas.

State Objectives

1. The CEO will endorse the proposal by agreeing to present it to the board of directors.
2. The financial vice president will estimate the impact of the proposal on the profit margin of the company.
3. The marketing vice president will demonstrate support by suggesting a plan to restructure the sales procedures.
4. The regional sales managers will indicate how the sales representatives can benefit from an expanded market.
5. The marketing vice president and the regional sales managers will agree to meet with the general sales manager to develop an implementation strategy, including a training program for sales representatives.

Select Methods, Media, and Materials

The general sales manager is well aware that he has a tough audience to convince. A well-organized and illustrated presentation is a must. Equally important is the need to maintain constant interaction with the audience during the presentation, so he chooses to adopt the discussion method. He consults with the company training director on the media to use. The company training director suggests *PowerPoint* slides as the heart of the presentation, with a flip chart available for spontaneous notes and reactions. Together they go to a local graphics design shop to work out the sketches for the slides based on his notes. The graphics are designed on computer, and, when approved, the slides are generated. Several color photographs are part of the presentation; these are made into *PowerPoint* slides using the color digital images from the company Web site.

Utilize Media and Materials

The general sales manager has selected a meeting room best suited for data projection and has prepared for the meeting by arranging for pads, pencils, and beverages. He reviews past accomplishments of the company, paying particular attention to the important contributions of the people in the room. He stresses how the company has responded successfully to similar challenges in the past. He then starts to unfold his plan, inviting comments as he goes along. On the flip chart, he notes comments to be discussed more fully.

Require Learner Participation

Because the sales manager invites comments, members of the audience become collaborators rather than spectators. As the manager answers questions indicating misgivings, the audience gradually begins adding to his presentation. The presentation ends more like a conference than a sales pitch. Instead of thinking about the plan later, the group talks about it now. The CEO enthusiastically asks the general sales manager to present the proposal to the board. The financial vice president volunteers to work up the sales projections into a financial statement. The marketing personnel set a time and place to put together an implementation strategy.

Evaluate and Revise

The objectives have been achieved, but now the general sales manager must adapt the presentation to a new audience, the board of directors. He particularly reviews the questions and comments of the CEO as guides to the approach to use with the board. He also wants to work closely with the financial vice president on the presentation of the fiscal projections of the marketing strategy.

He is eager to talk to his former associates on the sales force to prepare himself better for the meeting with the marketing vice president and the regional sales managers.

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

sorts of materials that you believe would be useful in your own teaching.

8. Create one graph (line, bar, circle, or pictorial) and one chart (organization, classification, time line, tabular, or flow) for a topic you might teach. Use the "Appraisal Checklist: Visuals" as a guideline.
9. Make a list of 10 possible posters students could make to depict aspects of your teaching area. Prepare one yourself to serve as a model or motivational device.
10. Prepare a *PowerPoint* presentation and evaluate it using the "Appraisal Checklist: Visuals."
11. Plan a lesson in which you have students use the digital camera to prepare a visual display. What issues do you need to address? What concerns would you have? What skills will students need?
12. Plan a lesson in which students will prepare a presentation using digital technologies. What types of technologies will you require them to use? What skills will students need?

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Audio media can make several unique contributions to both teaching and learning: self-study for nonreaders, realistic foreign language practice, stories to stimulate the imagination, and music for physical activity, to name a few. Cassettes, records, and CDs are available in every curricular area and are easy to use. To use audio media effectively requires an understanding of the hearing–listening processes and thoughtful selection of materials based on your objectives.









You can prepare your own audio materials, and so can your students. These recordings can take the form of oral reports, materials for learning center activities, communication skills practice, and the like. By following some basic guidelines you can improve the quality of such recordings.

CHAPTER 7

Audio

OUTLINE

Hearing and Listening
Developing Listening Skills
Audio Formats
Producing Class Materials on Cassette Tapes
Duplicating and Editing Audiotapes
Selecting Audio Materials
Utilizing Audio Materials
Require Learner Participation
Evaluate and Revise

KNOWLEDGE OBJECTIVES

1. Distinguish between *hearing* and *listening*.
2. Identify four areas of breakdown in audio communication and specify the causes of such breakdowns.
3. Describe four techniques for improving listening skills.
4. Describe the two types of audio media most often used for instruction; include advantages and limitations of each type.
5. Compare the advantages and limitations of audio media.
6. Describe one possible use of audio media in your teaching field. Include the subject area, audience, objective(s), role of the student, and evaluation techniques to be used.
7. Describe two procedures for duplicating audiotapes and one procedure for editing audiotapes.
8. Identify five criteria for appraising and selecting audio materials.
9. Demonstrate your ability to follow the proper procedures for utilizing audio materials.

LEXICON

hearing
listening
auditory fatigue
MP3
digital recording
oral history

If you were asked which learning activities consume the major portion of a student's classroom time, would you say reading instructional materials, answering questions, reciting what one has learned, or taking tests? Actually, typical elementary and secondary students spend about 50 percent of their school time just listening (Figure 7.1). College students are likely to spend nearly 90 percent of their time in class listening to lectures and seminar discussions (Figure 7.2). The importance, then, of audio experiences in the classroom should not be underestimated. This chapter discusses various means—referred to as *audio media*—for recording and transmitting the human voice and other sounds for instructional purposes.

Before discussing audio formats in particular and audio media in general, let's examine the hearing—listening process itself as it pertains to encoding and decoding and to the development of listening skills for oral messages.

HEARING AND LISTENING

Hearing and listening are not the same thing, although they are, of course, interrelated. At the risk of oversimplification, we might say that hearing is a physiological process, whereas listening is a psychological process.

Physiologically, **hearing** is a process in which sound waves entering the outer ear are transmitted to the eardrum, converted into mechanical vibrations in the middle ear, and changed in the inner ear into electrical impulses that travel to the brain.

The psychological process of **listening** begins with someone's awareness of and attention to sounds or speech patterns (receiving), proceeds through identification and recognition of specific auditory signals (decoding), and ends in comprehension (understanding).

FIGURE 7.1
Elementary and secondary students spend about half of their in-school time listening to others.

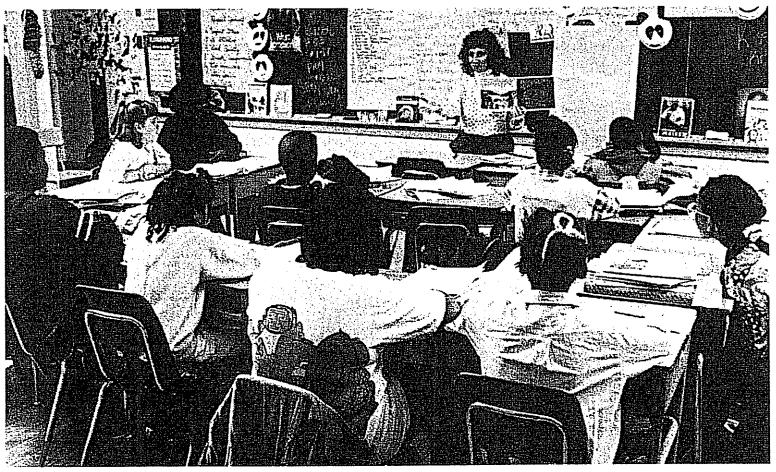
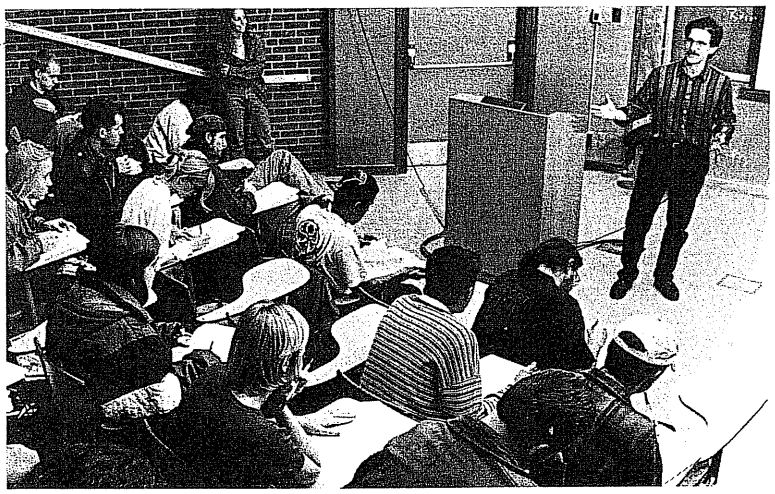


FIGURE 7.2
At the college level, about 90 percent of class time is spent listening.



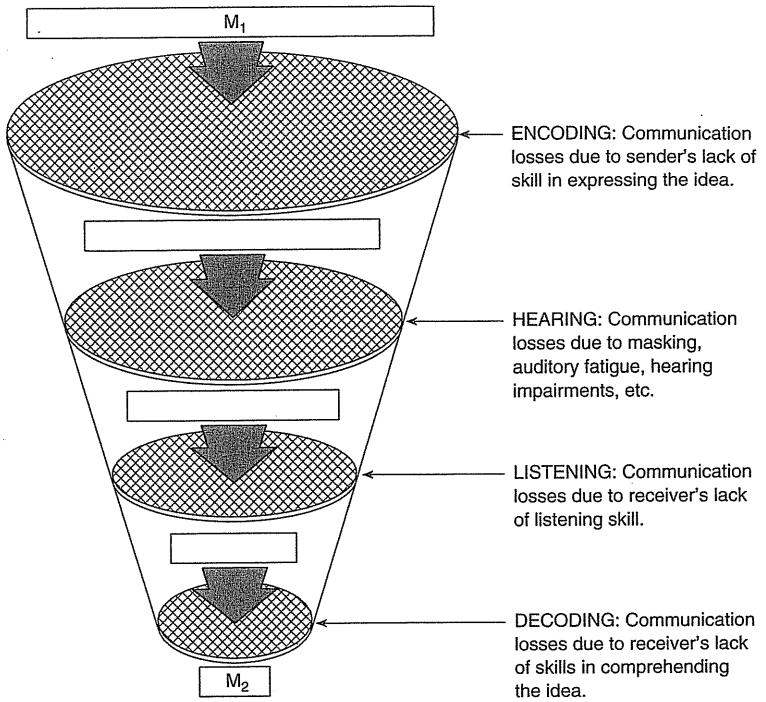


FIGURE 7.3
In the hearing–listening process, impediments at each step act like filters, reducing the perceived meaning to a small fraction of the intended meaning. M_1 = meaning originally intended by the sender. M_2 = meaning as received and comprehended by the receiver.

Hearing and listening are also teaching and learning processes. As with visual communication and learning, a message is encoded by a sender and decoded by a receiver. The quality of the encoded message is affected by the ability of the sender to express the message clearly and logically. The understandability of the decoded message is affected by the ability of the receiver to comprehend the message.

The efficiency of communication is also affected as the message passes from sender to receiver. Breakdowns in audio communications can occur at any point in the process: encoding, hearing, listening, or decoding, as illustrated in Figure 7.3.

Appropriate encoding of the message depends on the sender's skill in organizing and presenting it. For example, the vocabulary level of the message must be within the vocabulary level of the receiver.

Transmission and reception might be inhibited by a number of obstacles. First, the volume of the sound might be too low or too high. If too low, we have trouble picking up the meaning with any accuracy. If too high, we try to shield our ears, shutting out the offending sounds.

Second, a sound that is sustained monotonously, such as the droning voice of a teacher, may trigger **auditory fatigue.** You have probably had the experience of hearing an annoying sound—for example, a noisy muffler on the car you are riding in. But after a while you hardly notice the sound at all. You might stop thinking about it entirely until it stops, and then you notice the cessation. This is an example of auditory fatigue, the process of gradually "tuning out" or losing consciousness of a sound source—a process that is physiological as well as psychological. That is, the neural mechanisms transmitting the sound to the brain literally become fatigued from "carrying the same load" over and over. In addition, your conscious awareness of the noise is diminished because it is "old news" and no longer of interest. The brain has a remarkable capacity for filtering out sounds it doesn't want or need to attend to.

Third, an individual's ability to hear may be physically impaired. When students have a cold, it is possible that their ability to hear in a noisy classroom is reduced. Even a small difference in acuity can cause students to have difficulty discriminating between words and phrases—thus the potential for confusion. And, with the trend toward including students with significant loss of hearing acuity in regular hearing classrooms, teachers may need to be certain that they make special considerations to provide special visual cues to ensure that these students clearly understand the information.

The message can also be affected by the receiver's listening skills or lack of them. Receivers must be able to direct and sustain concentration on a given series of sounds (the message). They must have the skill to think ahead while receiving the message (we think faster than we hear, just as we think faster than we read or write) and use this time differential to organize and internalize the information so they can comprehend it.

Finally, communication can break down because the receiver lacks the experiential background to internalize and thus comprehend the message.

DEVELOPING LISTENING SKILLS

Until recently, much attention in formal education was given to reading and writing, a little was given to speaking, and essentially none was given to listening. Now, however, educators recognize listening as a skill that, like all skills, one can improve with practice (Figure 7.4).

Hearing is the foundation of listening. Therefore, you should first determine whether all of your students can hear normally. Most school systems regularly use speech and hearing therapists to administer audiometric hearing tests to provide the data you need. Standardized tests also measure students' listening abilities. These tests are often administered by the school district, so check on the availability of listening test scores.

You can use a number of techniques to improve student listening abilities:

- *Guide listening.* To guide their listening, give students some objectives or questions beforehand. Start with short passages and one or two objectives. Then gradually increase the length of the passage and the number and complexity of the objectives or questions.
- *Give directions.* Give students directions individually or as a group on audiotape. You can then evaluate students' ability to follow these instructions. With audio instructions, you can examine worksheets or products of the activity. When giving directions orally, observe the "say it only once" rule so that students place value on both your and their time and their incentive to listen is reinforced.
- *Ask students to listen for main ideas, details, or inferences.* Keeping the age level of the students in mind, you can present an oral passage. You can read a story and ask primary students to draw what is happening. Ask students to listen for the main idea and then write it down. Use this technique, too, when you want students to draw details and inferences from the passage.
- *Use context in listening.* Younger students can learn to distinguish meanings in an auditory context by listening to sentences with words missing and then supplying the appropriate words.
- *Analyze the structure of a presentation.* Ask students to outline (analyze and organize) an oral presentation. You can then determine how well they were able to discern the main ideas and to identify the subtopics.
- *Distinguish between relevant and irrelevant information.* After listening to an oral presentation of information, ask students to identify the main idea and then rate (from most to least relevant) all other presented ideas. A simpler technique for elementary students is to have them identify irrelevant words in sentences or irrelevant sentences in paragraphs.

AUDIO FORMATS

Let's examine the comparative strengths and limitations of the audio formats most often used for instructional purposes—cassette tapes and compact discs (Figure 7.5).

FIGURE 7.4
Listening skills are an important component of oral communication.



MEDIA FILE

A Jug Band Peter and the Wolf

Cassette/Compact Disc

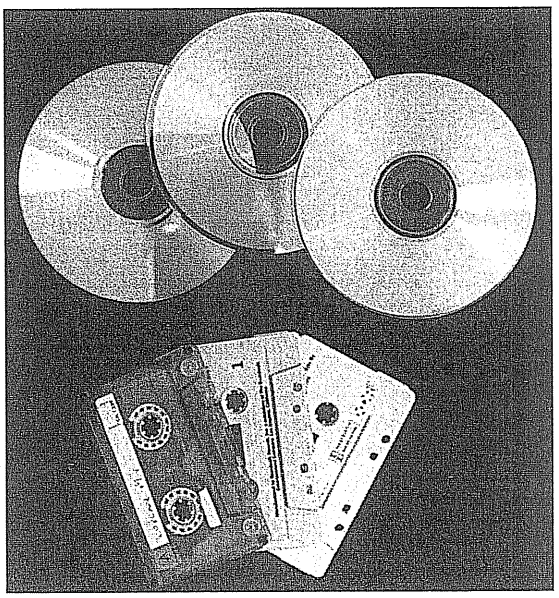


Source: Alacazam!

Here is a fun version of Prokofiev's *Peter and the Wolf* arranged for a band of folk instruments (and a few standard instruments played in folk style). The instruments include fiddle, mandolin, guitar, banjo, kazoo, whistle, mouth harp, jug, washtub bass, and clarinet. The accompanying booklet explains how the music was transcribed to retain the spirit of the original. Though the instruments are different, the story line is the same. This is not recommended as a replacement of the original but should be used as an interesting adaptation. Dave Van Ronk, a folksinger, does the narration. He also sings a group of folk songs that should appeal to children.

FIGURE 7.5

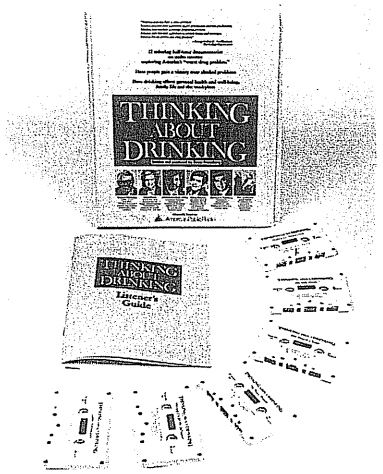
A wealth of recorded material is available in the common audio formats: cassettes and compact discs.



MEDIA FILE

Thinking About Drinking

Six Cassettes



Source: SounDocumentaries.

Teenage abuse of alcohol continues to be a major concern in our society. This series of 12 half-hour programs, originally broadcast by the Public Broadcasting System (PBS), deals in an engrossing manner with many aspects of the problem. A few of the titles are *Media Images of Alcohol, The Lady Drinks, Driving Under the Influence,* and *The Latino Perspective.* By using case histories of well-known national figures (such as former first lady Betty Ford) and dramatizations, the program avoids a deadly lecture format. More than 150 interviews with experts in the field enliven the tapes, which are intended for students, parents, and teachers. The series explains how teachers can contribute significantly to resolving students' drinking problems.

The differences between these media are summarized in Table 7.1.

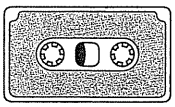
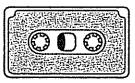
Audiotapes

The major advantages of audiotape are that you can record your own tapes easily and economically, and when the content becomes outdated or no longer useful, you can erase the magnetic signal on the tape and reuse it. Tapes are not easily damaged, and they store easily. Unlike discs, broken tapes can be repaired, although not easily.

Of course, there are limitations to magnetic tape recordings. Background noises or a mechanical hum may sometimes be recorded along with the intended material. Even a relatively low-level noise can ruin an otherwise good recording.

The audio device most commonly found in the classroom is the cassette tape recorder. Cassette tapes are

TABLE 7.1
Common audio formats

FORMAT		SPEED	ADVANTAGES	LIMITATIONS	USES
Cassette audiotape	Size: 2½ by 4 by ½ in.  Tape ⅛ in. wide	1⅞ ips[1]	Very portable (small and light) Durable Easy to use (no threading) Can prevent accidental erasing Requires little storage space	Tape sometimes sticks or tangles Noise and hiss Poor fidelity with inexpensive players Broken tapes not easy to repair Difficult to edit	Listening "in the field" using battery power Student-made recordings Extended discussions Individual listening Assessment tool (e.g., reading)
Microcassette	Size: 15/16 by 13/32 by 21/64 in.  Tape ⅛ in. wide	15/16 ips	Very compact Portable	Not compatible with other cassettes Poor fidelity	Dictation by business executives Amateur recording Recording field notes
Compact disc	Size: 4.72 in. 	Variable high speed	Very durable High fidelity No background noise Random search	Impractical to prepare locally Initial expense of equipment	Music Drama

[1] ips = inches per second.

identified according to the amount of recording time they contain. For example, a C-60 cassette can record 60 minutes of sound using both sides (i.e., 30 minutes on each side). A C-90 can record 45 minutes on each side. Cassettes are available in various lengths. The size of the plastic cassette containing the tape is the same in all cases, and all can be played on any cassette machine.

The cassette is durable; it is virtually immune to shock and abrasion. It can be snapped into and out of a recorder in seconds. It is not necessary to rewind the tape before removing it from the machine.

There are a few drawbacks to cassettes. For instance, longer tapes, particularly C-120s, sometimes become stuck or tangled in the recorder because of the thinness of the tape. If this happens, and unless the content on the tape is unique and of considerable value, you are best advised to throw the tape away. If it sticks or gets tangled in the machine once, it is likely to do so again.

The frequency response and overall quality (fidelity) of cassette playback units are not as good as those of compact disc (CD) players because of the small speakers in most portable cassette playback units. However, for most instructional uses the quality is more than adequate.

It is very easy to copy favorite music from CDs to an audiotape, creating an individual assortment of music from a variety of sources. It is important to check the copyright restrictions as they apply in this circumstance.

Compact Discs

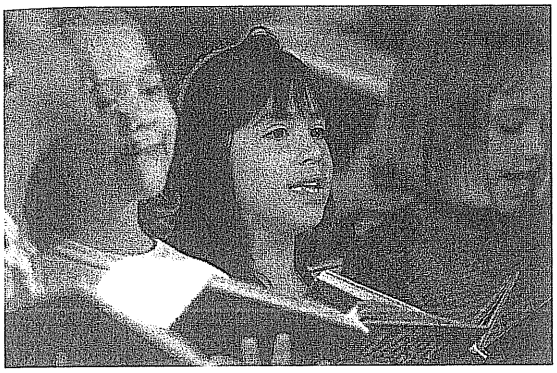
Physically, the compact disc (CD) looks like a small, silver platter. The music or other sounds are stored as digitized bits of information (see "Close-up: How a Compact Disc Works" on page 178). The disc is only 12 centimeters (4.75 inches) in diameter, yet it stores an incredible amount of information. Current CDs contain as much as 80 minutes of music.

The technology of the CD makes it an attractive addition to education programs. Users can quickly locate selections on the disc and can program them to play in

MEDIA FILE

A Kid's-Eye View of the Environment

CD/Cassette



Source: Mish Mash Music.

Michael Mish based this series of songs on his many visits to schools in southern California to talk to children about the environment. He found them to be more aware and concerned about environmental problems than he expected. Mish took the topics that the children were most concerned about (e.g., recycling, water and air pollution, and the greenhouse effect) and put them to music. The songs are engaging, with sing-along choruses. The messages should get primary-age children talking about making this a safer, cleaner world.

any desired sequence. Information can be selectively retrieved by learners or programmed by the instructor. A major advantage of the CD is its resistance to damage. Stains can be washed off, and ordinary scratches do not affect playback. And, if there is a scratch that can affect the quality of the audio signal, a resin is now available to repair the disc.

Compact disc technology has been accepted rapidly for use in the home. But the cost of a CD player as well as individual CDs originally slowed its acceptance in the education market. Today, the CD's advantages, especially its resistance to damage, have made it a standard format in education.

When talking about audio CD, we are in essence talking about the same technology used in CD-ROM. CD-ROM utilizes more of the capacity of the optical technology by adding text and graphics to the disc. We discuss CD-ROM in more depth in Chapter 10. A similar technology, DVD, provides more storage capacity than does CD-ROM. This means that large files, such as audio files, can be stored with little concern for space, while ensuring quality sound reproduction. The equipment to create, or "burn," CD-ROM and CD audio discs has become very affordable for the average audiophile, which makes it easy for an individual to prepare CDs that contain "favorite" music on them. Copyright needs to be checked when doing this (see "Copyright Concerns" on page 178).

CDs have been eagerly accepted by consumers as a preferred audio format, but for audiophiles on the go (walking, jogging, or driving) they have one serious drawback: the size of the portable playback equipment. One additional problem has been the tendency to be sensitive to movement, such as the impact when a person is jogging. To reduce the effects of skipping, the playback head repositions itself after a bump, and a memory chip holds up to three seconds of sound that might have been lost. Portable players of MP3 files (see the next subsection) eliminate this particular problem.

MP3

A new direction for audio is the ability to use your computer and the Internet to obtain audio files. **MP3** (MPEG Audio Layer 3) is an audio compression format that makes large audio files available by shrinking them into smaller files that can quickly and easily be captured on the Internet. These files are *streamed audio*, which means they are sent in packets to the user, giving the user an opportunity to listen to portions of the file while waiting for additional portions to download. MP3 is an "open" standard, which means it is available to anyone who has access to the Internet. Several computer programs that access and play MP3 audio files are free to the user; many others are available for purchase. Many of the audio files are also free. Programs also are available that will convert audio CD tracks to MP3 (a process known as *ripping*). Many portable MP3 players are now on the market as well.

MP3 is a way for audiophiles to enjoy their favorite music. It is also a way to obtain the newest versions of a particular artist's songs. Some Internet sites let users customize their selections so they can create unique "albums." On the downside, a word of caution related to copyright: Not all Internet sites make legal copies of music available. It is the responsibility of the user to respect the copyright laws related to audio (see "Copyright Concerns" on p. 178).

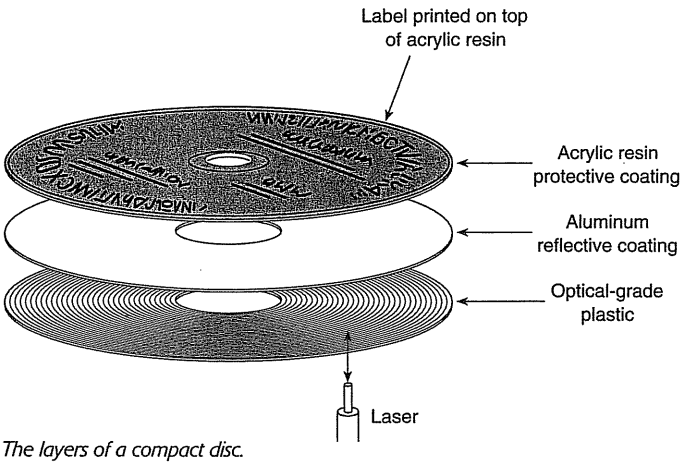
Advantages

- *Inexpensive.* In the case of audiotape, once the tapes and equipment have been purchased, there is no additional cost because the tape is erasable and reusable. Individual audiocassettes are inexpensive. In the case of MP3 files, many are available on the Internet for free.

CLOSE-UP

HOW A COMPACT DISC WORKS

Until the compact disc was developed, all retail audio recordings were analog recordings; that is, they retained the essential waveform of the sound, whether as grooves in a phonograph record or as patterns of magnetized particles on audiotape. CDs are made using digital recording. In **digital recording,** analog information (whether in the form of music, speech, or print) is transformed into *binary* information—a series of 1s and 0s, the same mathematical code used in computers. A powerful laser burns a microscopic pit into the plastic master for each 1 in the digital code. A blank space corresponds to 0. The laser moves in an ever-widening spiral from the center of the master to the edge, leaving on the disc hundreds of thousands of binary bits. As a low-power laser beam in the playback unit picks up the pattern of pits and blank spaces, the beam is reflected back into the laser mechanism, and the digital code is transformed into the original analog sound. The laser mechanism does not come in direct physical contact with the CD and can move independently of the disc, unlike the stylus in a record groove or a tape head. This means that the laser beam can scan the CD and quickly locate desired information. In other words, the CD can be programmed so the user can quickly access any part of the disc. CD players can indicate what track is playing, the sequence in which tracks will be played, how many more tracks are on the disc, and the remaining playing time. Another characteristic of digital recording is the complete absence of background noise.



The layers of a compact disc.

The compact disc, shown approximately one-half its actual size, is a three-layer sandwich. The digital code in the form of pits is on the top side of a clear, tough plastic very much like Plexiglas. A reflective coating of aluminum is placed on top of the pitted plastic surface. A protective coating of acrylic resin is applied on the top of the reflective surface. Label information is printed on top of the resin. This arrangement protects the program information from both the top and bottom surfaces of the disc. The laser beam reads the code through the clear plastic, and it is reflected back by the aluminum layer.

Unlike phonograph records, the recording on a CD begins near the center and ends at the outer rim. Also unlike records, the CD does not rotate at a constant speed as the laser reads the data. The speed varies from 500 rpm at the innermost track to 200 rpm at the outer edge.

© COPYRIGHT CONCERNS: THE INTERNET AND MUSIC

United States copyright law grants the owner of a copyrighted musical work the exclusive right to perform it publicly, which means such performances require the copyright owner's permission. This includes website transmissions of music. Just as you pay for use of other forms of music (e.g., CDs), you must also pay for the use of music you download from the Internet. The copyright owners of sound recordings have rights set forth in the Digital Performance Right in Sound Recordings Act of 1995 and the Digital Millennium Copyright Act of 1998. These laws give sound recording copyright owners rights to online performances of their recordings.

Internet transmissions involve the reproduction and distribution of musical works and the copying of a copyrighted musical work or sound recording onto your server or hard drive (as when you load the file containing the work). Unauthorized copying constitutes exploitation of the reproduction right. You must contact the copyright owner of the sound recording (usually the record label) for authorization to copy the sound recording onto your server or hard drive. Some Internet sites advertise music free from copyright. You are wise to check out sites that offer music files, as it is better to ask than to be caught with illegal copies of music.

For general information on copyright, see the Copyright Concerns on page 87 in Chapter 4. Suggested readings on copyright appear at the end of Chapter 4.

- *Readily available and simple to use.* Most students have been using audiocassette recorders since they were very young. Audio equipment is easy to operate.
- *Reproducible.* You can easily duplicate audiotapes in whatever quantities you need, for use in the classroom, in the media center, and at home. Remember to observe copyright guidelines.
- *Provides verbal message for nonreaders.* Students who cannot read can learn from audio media, which provide basic language experiences. Students can listen to audio and follow along with visual and text material.
- *Ideal for teaching foreign languages.* Cassettes and CDs are excellent media for teaching foreign languages. They allow students to hear words pronounced by native speakers. Students can play back chosen sequences as often as necessary and, with CDs, may use the format's random-access capacity to construct their own sequences. Students may use cassettes to record their own pronunciations for comparison.
- *Stimulating.* Audio media can provide a stimulating alternative to reading and listening to the teacher. Audio can present verbal messages more dramatically than text can. With a little imagination on your part, audio can be very versatile.
- *Repeatable.* Users can replay portions of the program as often as needed to understand it.
- *Portable.* Audiocassette recorders are portable and can even be used "in the field" with battery power. Cassette recorders are ideal for home study; many students already have their own cassette machines.
- *Ease of lesson preparation.* The major advantage of audiotapes over compact discs is that instructors can record their own audiotaped lessons easily and economically, erasing and recording over material that has become outdated or is no longer useful.
- *Selections easy to locate.* In the case of CDs, teachers and students can quickly locate selections on the compact discs and program the machine to play any desired sequence.
- *Resistance to damage.* Cassette tapes are enclosed in a damage-resistant plastic cassette. In the case of CDs, there is no tape to tangle and break. Stains can be washed off, and ordinary scratches do not affect playback. MP3 files can be stored on a computer hard drive, on CDs, or on floppy or Zip ® disks.

Limitations

- *Fixed sequence.* Audiotapes fix the sequence of a presentation even though it is possible to rewind the tape and hear a recorded segment again or advance the tape to an upcoming portion. It is difficult to scan audio materials as you would printed text materials. CDs do not share this limitation, which is why this format now plays a significant role in instruction. MP3 gives the user an opportunity to customize the audio format, which might lead to copyright violations.
- *Doesn't monitor attention.* Some students have difficulty studying independently, so when they listen to audiocassettes their attention tends to wander. They may hear the recorded message but not listen attentively and comprehend. Teachers can readily detect when students are drifting away from a lecture, but a playback machine cannot do this.
- *Difficulty in pacing.* Determining the appropriate pace for presenting information can be difficult if your students have a range of attention spans and experiential backgrounds.
- *Difficulty in locating segment.* It is sometimes difficult to locate a specific segment on an audiotape. Counters on the recorders assist retrieval, but are not very accurate. CDs give much easier accessibility to specific selections.
- *Potential for accidental erasure.* Audiotapes can be erased easily, which can be problematic. Just as they can be quickly and easily erased when no longer needed, they can also be erased accidentally (see p. 183). Be sure to remove the record lockout tab of any cassette you wish to safeguard. And, because they are magnetic, keep audiotapes away from magnets, which can cause erasure.

Integration

The uses of audio media are limited only by the imagination of you and your students. You can use audio media in all phases of instruction—from introduction of a topic to evaluation of student learning. Perhaps the most rapidly growing general use of audio media today is in the area of self-paced instruction. The slower student can go back and repeat segments of instruction as often as necessary because the recorder-playback machine is a very patient tutor. The accelerated student can skip ahead or increase the pace of instruction.

Prerecorded audio materials are available in a variety of subjects. For music classes, tapes and CDs can be used to introduce new material or to provide musical accompaniment. The sounds of various musical instruments can be presented individually or in combinations. In preschool and primary grades, tapes and CDs can be used for developing rhythm, telling stories, playing games, and acting out stories or songs. In social studies, the tape recorder can bring the voices of persons who have made history into the classroom. The sounds of current events can also be presented.

A common application of audio media is in learning centers. Sometimes these are even referred to as "listening centers" because of their use of audio-based materials. (We described learning centers in detail in Chapter 2.)

As another example, a middle school teacher inserts a cassette into the sound system of her car for the 20-minute daily commute to her school. After a few seconds of music, the song fades as the narrator says, "What's new in classroom management techniques? Today we are going to explore together three techniques that will enhance your classroom skills. . . ." The cassette turns the automobile into a learning environment, thereby making use of otherwise unproductive time.

Audiotapes can be prepared by students to use in class presentations. Students can prepare the tapes with special sound effects or elements of music to enhance a portion of their speech. It is also possible that students could use an audiotape of an interview with a special individual as a part of their presentation.

Audiotapes would be an excellent way in which to record student speaking and reading-aloud skills for a portfolio. Students can prepare specific passages or read certain materials to add to a collection of audiotapes to demonstrate progress.

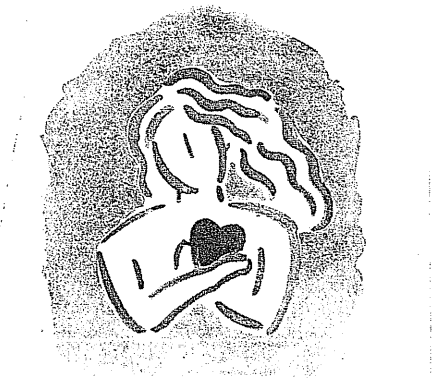
Many self-help and skill training materials are available on audiotape for adults. Audiotapes to teach a person to use a specific computer program provide the necessary step-by-step procedures. Personnel departments often provide materials on tape for their employees to listen to while traveling. This way individuals can learn about new policies or procedures within the company without having to read many pages of text.

One special application of prerecorded audio media is "talking books" for blind or visually impaired students. The National Library Service for the Blind and Physically Handicapped (NLS), Library of Congress, administers a free library program of braille and recorded materials circulated to eligible borrowers through a network of cooperating libraries. At present, over 325,000 braille and recorded book and 70 magazine titles are available. The service is a cooperative effort of the Library of Congress and 57 regional and 81 subregional libraries in the United States. Audiocassettes are the standard format. There is an effort to move toward digital mastering of the materials to ensure the quality of the audio and the longevity of the materials.

MEDIA FILE

Self-Esteem for Women

Cassette Tapes and Workbook



Self-Esteem
FOR WOMEN™
HOW TO INCREASE YOUR
Self-Worth • Self-Respect • Life Satisfaction
With Julie White, Ph.D.

Source: CareerTrack.

These tapes and workbook describe how women can increase their self-worth and life satisfaction. The program helps them feel good about themselves just as they are. It gives them skills they need to grow into the persons they want to become, in both their personal and professional lives. Topics include why eliminating negative self-talk is more powerful than increasing positive self-talk, how to open your mind to new possibilities, and how to recognize and measure your own growth and success.

PRODUCING CLASS MATERIALS ON CASSETTE TAPES

Students and teachers can easily prepare their own cassette tapes (see "How to . . . Record Audiocassettes" on p. 182). Students can use cassette tapes for gathering oral histories and preparing oral book reports. The teacher can prepare tapes for use in direct instruction, as illustrated by the vocational-technical school example referred to later in this section (Figure 7.6). Skills practice, such as pronunciation of a foreign language, can also be provided by audiocassette.

A popular project in 12th-grade social studies classes is the recording of **oral histories.** Students interview local senior citizens regarding the history of their community. Only one student interviews each senior citizen, but the interviewing task is rotated among the students, and the entire class assists in determining which questions to ask. In preparation for this project, students study both national and local history. All the tapes prepared during the interviews are kept in the school media center. Excerpts are duplicated and edited into programs for use with other social studies classes and for broadcast by the local radio station. This audiotape project serves the dual purpose of informing students and local residents about local history and collecting and preserving information that might otherwise be lost.

The cassette recorder can be used for presenting book reports. Students may record their book reports

FIGURE 7.6
Teachers can easily create their own audiotapes.



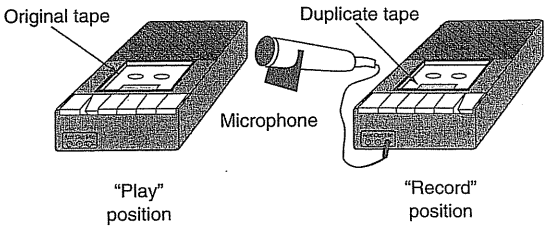
during study time in the media center or at home. You can evaluate the reports and keep the best ones on file in the media center. Encourage other students to listen to them before selecting books to read. Limit reports to three minutes, and require students to extract the main ideas from the book and to organize their thoughts carefully. During the taping, they practice their speaking skills. Encourage them to make the report as exciting as possible to interest other students in reading the book.

Tape recorders can be used to record information gleaned from a field trip. On returning to the classroom, students can play back the tape for discussion and review. Many museums, observatories, and other public exhibit areas now supply visitors with prerecorded messages about various items on display, which may (with permission) be rerecorded for classroom playback.

Students can also record themselves reciting, presenting a speech, performing music, and so on. They can then listen to the tape privately or have the performance critiqued by the teacher or other students. Initial efforts can be kept for comparison with later performances and for reinforcement of learning. Many small-group projects can include recorded reports students present to the rest of the class. These recordings can become part of each student's portfolio. Media portfolios are discussed in Chapter 1.

In a vocational-technical school, dental laboratory technology students are instructed on the procedures for constructing prosthetic devices such as partial plates and bridges by listening to an audiotape their instructor has prepared. To be efficient and effective in their work, these students must have both hands free and their eyes must be on their work, not on a textbook or manual. Audiotapes allow students to move at their own pace, and the instructor is free to circulate around the laboratory and discuss each student's work individually.

FIGURE 7.7
Setup for duplicating by the acoustic method.



A teacher of ninth-grade students with learning difficulties (but average intelligence) provides instruction on how to listen to lectures, speeches, and other oral presentations. The students practice their listening skills with tapes of recorded stories, poetry, and instructions. The teacher also uses commercially available tapes of speeches and narration. After students have practiced their listening skills under teacher direction, they are evaluated using a tape they have not heard before. They listen to the five-minute tape without taking notes and the teacher then gives them a series of questions dealing with important content from the passage.

An often overlooked use of audio materials is for evaluating student attainment of lesson objectives. For example, you may prerecord test questions for members of the class to use individually. You may ask students to identify sounds in a recording (e.g., to name the solo instrument being played in a particular musical movement) or to identify the composer of a particular piece of music. Students in social studies classes could be asked to identify the historical person most likely to have made excerpted passages from famous speeches, or to identify the time period of excerpted passages based on their content. Testing and evaluating in the audio mode is especially appropriate when teaching and learning have also been in that particular mode.

DUPLICATING AND EDITING AUDIOTAPES

It is a relatively simple procedure to duplicate an audiotape. You can duplicate your tapes by one of three methods: the acoustic method, the electronic method, and the high-speed duplicator method.

The acoustic method (Figure 7.7) does not require any special equipment, just two recorders. One recorder plays the original tape, and the sound is transferred via a microphone to a blank tape on the other recorder.

HOW TO . . . Record Audiocassettes

A major advantage of audiotapes is the ease with which they can be prepared by teachers and learners. All that is needed is a blank audiotape, a tape recorder, and a bit of know-how. If your school or organization does not have a recording studio, here are some fast and easy techniques for preparing your own tapes. The results may not be of true professional quality, but most instructors have found products made in this way to be useful and effective.

AUDIO TECHNIQUES

Physical Environment

Record in an area that is as free as possible from noise and sound reverberations. A small room such as an office is preferable to a normal-size classroom. Sparsely furnished rooms with plaster walls and ceilings and bare cement or tile floors are likely to be excessively "live," causing distracting sound reverberations that will interfere with the fidelity of the recording. Such areas can be improved by installing acoustic tiles and carpeting. The recording setup should be at least six feet from the chalkboard, windows, and hard walls. You may have to make do with temporary improvements to increase quality (e.g., put throw rugs, heavy blankets, or sheets of cardboard on the floor). Fabric-covered movable screens and drawn window shades may help.

Tape Recorder

- Expensive equipment is not necessary.
- Familiarize yourself with the operation of the particular tape recorder you intend to use.
- Advance the tape beyond the leader before recording. You cannot record on the clear plastic, nonmagnetic leader of the tape (about 10 seconds).
- Record an excerpt of about one minute and play it back to check volume and tone. Nothing is more frustrating than to record 10 or 15 minutes of a tape only to find that the microphone was not plugged into the recorder. A practice run will avoid this type of problem.
- If you make an error while recording, stop the tape recorder, reverse to a segment of tape containing a natural pause, engage the record mode, and continue recording.
- Refer to the instruction manual. Determine the proper recording level (volume) and tone. Most recorders have an automatic volume control, making adjustment on the machine unnecessary.

Microphone

- Use a separate microphone, if possible, not one built into the tape recorder. Place the microphone on a stand away from hard surfaces such as chalkboards, windows, and bare walls. If a stand is not available, place the microphone on a hand towel or other soft cloth. Because many tape recorders generate unwanted clicking, whirring, and humming noises, keep the microphone as far away from the recorder as possible.
- Place the microphone in a good spot to achieve maximum pickup of desired sounds and minimal pickup of extraneous ones. You want it located in such a place so it will pick up all the voices. Avoid handing the microphone from one person to another. If necessary, move people instead, before recording.
- Maintain a constant distance from the microphone. As a rule of thumb, your mouth should be about a foot from the microphone. If you are much closer, *ps* and *bs* will tend to "pop" and other breathy sounds may become annoying.
- Speak over the top of the microphone, not directly into it.

Tape Content

- Introduce the subject of the audiotape at the beginning of the recording. For example, "This is Introductory Geometry, Interior Angles, Lesson 12, on. . . ." Identifying the tape is particularly important if it is to be used for individual instruction.
- Explore the subject with students; don't just tell them about it. A lecture on tape is deadly!
- Get your listeners involved in meaningful learning activities. You might, for instance, supply a study guide or worksheet for students to use with the tape (see facing example). Include ample space for students to take notes while listening to the tape. Instruct listeners to look at a diagram, specimen, table, or photograph; to use equipment; or to record data—so they don't simply sit and listen. Simple and direct activities are more effective than complex, involved ones.
- Keep the tape short even if it is to be used by adult learners. A length of 15–25 minutes is a good guideline for adults. Make it even shorter for younger students.
- Provide variety throughout the tape by using appropriate sounds, music, short dialogues, and voices of experts in your field. These provide variation and add realism to the study, but should be used functionally.
- Repetition by the tape narrator is usually unnecessary. Repetition can be achieved by having students replay appropriate tape segments.

Presentation

- Use informal notes rather than a complete script. Reading from a script tends to induce boredom. If you feel you must work with a more formal script, remember that preparing a good script requires special writing and reading skills.
- Use index cards for notes rather than handle large sheets of paper near the microphone. If your students will be using a study guide while listening to the tape, make your notes on the study guide and use it while making the recording.
- Use a conversational tone. Talk as you would normally talk to a friend. Explore the subject with students—don't lecture at them.
- Vary your tone of voice frequently.
- Speak cheerfully and enthusiastically.
- Enunciate clearly.
- Speak rapidly (most people can listen faster than the average person talks).
- Minimize *uhs* and other distracting speech habits.
- Direct students' attention to what you will discuss before discussing it. Tell them what to look for. For example, if the diagram is on page 4, tell listeners, "Look at the diagram on page 4. There you will see. . . ." The same technique is necessary if you are using slides in conjunction with the

Objective 3:
Compute Depreciation Using the Straight-Line Method

Straight-Line Method Summarized

Formula: $\frac{\text{Cost of the Asset} - \text{Estimated Salvage Value}}{\text{Number of Accounting Periods in Productive Life}}$

Application: $\frac{\$1{,}250 \text{ Cost} - \$250 \text{ Salvage}}{5 \text{ Years of Productive Life}} = \$200 \text{ to be depreciated each year}$

TURN OFF TAPE AND COMPLETE ACTIVITY NO. 4

Activity 4

A machine costs $2600 and was estimated to have a four-year service life and a $200 salvage value. Calculate the yearly depreciation using the straight-line method.

Answer:

TURN ON TAPE AND COMPLETE ACTIVITY NO. 5 WHILE LISTENING

Activity 5

Advantages of the units-of-production method are

1.
2.
3.
4.

Disadvantages of the units-of-production method are

1.
2.

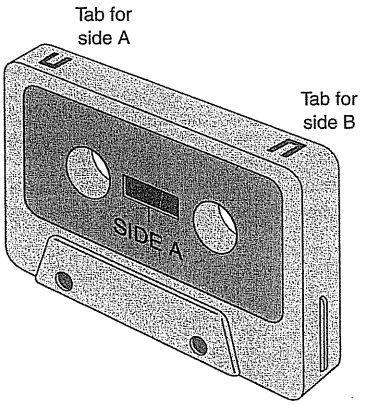
audiotapes: "As you see in Slide 6, the process starts in the upper right-hand corner and proceeds. . . ."

- Provide a brief musical interlude (approximately 10 seconds) as a signal for listeners to turn off the tape recorder and perform any activities or exercises. They can then return to the tape, hear the music again, and know they've missed nothing.
- Include a tone or other nonvocal signal to indicate when to advance slides rather than continually repeating "Change to the next slide." Electronic tone devices are available for this purpose; also, a door chime can be used, or you can tap a pen or spoon on a half-full drinking glass.

Preventing Accidental Erasure

Cassette tapes provide protection against accidental erasure. At the rear corners of each cassette are small tabs (called *record lockout* tabs) that you can break off. The tab on the left controls the top side of the tape (side A); the tab on the right controls the bottom side (side B). No machine will record a new sound on a side of a tape for which you have broken out the appropriate tab.

If you want to rerecord the cassette, carefully place some cellophane tape over the hole where you removed the tab. The tape can then be used for a new recording. Most prerecorded tapes come with both tabs already removed to prevent accidental erasure.



Checklist for Student/Teacher-Prepared Audiocassettes

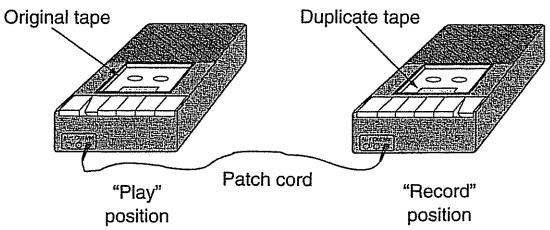
- ❑ Minimize extraneous background noise.
- ❑ Maintain constant volume level.
- ❑ Ensure good voice quality and clarity.
- ❑ Express ideas clearly.
- ❑ Maintain conversational tone.
- ❑ Keep listeners involved.
- ❑ Coordinate with worksheet or study guide, if used.
- ❑ Express content clearly.
- ❑ Keep it short.

CASSETTE RECORDER TROUBLESHOOTING

Problems/Possible Remedies

- *Tape comes out of cassettes and snarls around the capstan of recorder:*
  1. Very thin tape, as found in longer-length cassettes (e.g., C-120), is especially prone to this. Convert to shorter-length (thicker) tapes.
  2. The plastic hub of the takeup reel may be rubbing against the cassette. Try rotating the hub with a pencil to free it.
  3. Takeup spindle is not pulling hard enough because of faulty clutch or belt. Have cassette repaired by qualified specialist.
  4. Tape tension may be inadequate. "Condition" the tape by completely fast-forwarding and then rewinding it. (It is a good idea to condition *all* prerecorded and blank audiocassettes before first using them.)
- *"Record" button on cassette will not stay down:* The record lockout tab on the back of the cassette has been broken out. Place tape over the gap left by the missing tab if you want to record something new on the cassette.
- *Hiss in background:* Demagnetize the heads (performed by media specialist or technician).
- *Lack of high frequencies:* Head out of alignment or worn. Have heads checked.
- *Low playback volumes:* Heads dirty. Clean with head-cleaning fluid.

FIGURE 7.8
Setup for duplicating by the electronic method.



The drawback of this method is that fidelity is reduced as the sound travels through the air to the microphone, and the open microphone may pick up unwanted noise from the environment.

The electronic method avoids this problem (Figure 7.8). The signal travels from the original tape to the recorder via an inexpensive patch cord. The cord is attached to the output of the first machine and the "line," or auxiliary input, of the second. It picks up the signals of the original tape and transfers them electronically to the duplicating tape.

If a dual-well cassette recorder, which holds two cassettes, is available, you can easily copy tapes. Many of these machines can copy a tape at double normal speed, cutting duplicating time in half; however, be sure to check the copy for speed accuracy. Inexpensive dual-well equipment is not noted for its precision; a full-size dual-well tape deck is much more reliable.

The high-speed duplicator method requires a special machine. Master playback machines have a series of up to 10 "slave units," each of which can record a copy of the original tape at 16 times its normal speed. These machines can, for example, create multiple copies of a 30-minute cassette tape in about 2 minutes. Since the master and slave units are connected by a patch cord, fidelity is likely to be very good, and there is no danger of picking up background noise.

You may wish to edit your audiotapes, either to remove errors and imperfections or to adapt a tape to a specific learning situation. Set up two recorders as described for tape duplication and then record just the portion of the original tape that you want on the second tape.

The dual-well cassette recorder facilitates editing. You can easily assemble selected parts of the original by using the copying feature of these machines.

SELECTING AUDIO MATERIALS

Before selecting your audio materials, you should have analyzed your audience and stated your objective according to the ASSURE model (see Chapter 3). Then you are ready to select, modify, or design your audio materials. Part of this process involves locating available materials and appraising them. If nothing acceptable can be found or modified, you can produce your own audiocassette tapes as described in the previous section.

In selecting audio materials to use in your instruction, first determine what materials are available locally. Consult with a media specialist to determine what is available in your media center. If appropriate materials are not available, refer to the appropriate directories (see Appendix C; additional information appears on the "Classroom Link Portfolio" CD-ROM and on the Companion Website [http://www.prenhall.com/heinich]). Selection guides for music CDs include *Best Rated CDs: Classical* and *Best Rated CDs: Jazz and Pop,* published annually by Peri (Voorheesville, NY).

You should preview and appraise both commercially and locally produced materials before using them with your students. You may wish to use the "Appraisal Checklist: Audio Materials" to guide your selection decisions.

UTILIZING AUDIO MATERIALS

The next step after selecting or producing your audio materials is to use them with your students. The five *P*s are appropriate for group use of audio materials: preview the materials, prepare the materials, prepare the environment, prepare the learners, and provide the learning experience.

Preview the Materials

Preview all audio materials, using the "Appraisal Checklist" as part of the process. While previewing them, decide how you are going to use them. What excerpts do you plan to use? How are the students going to be involved with the audio materials? What follow-up activities will you use?

Prepare the Materials

When you are going to use audio media for group presentations, you should practice operating the equipment. Queueing the materials is important to avoid delays and lost time. In addition, cue each item to its starting location when possible. Prepare your introduction and followup. If you must manipulate other materials or objects during the audio presentation, be sure to practice first.

Prepare the Environment

Set up your classroom or learning environment so that all students can hear the audio. Be sure that those who should not be distracted by the sound cannot hear it. For individuals and small groups, use headphones if

☑ APPRAISAL CHECKLIST

AUDIO MATERIALS

KEY WORDS: _____, _____, _____

Format
- ❑ **Cassette**
- ❑ **Compact disc**

Title _____

Series Title (if applicable) _____

Source _____

Date _____ **Cost** _____ **Length** _____ minutes

Subject Area _____

Intended Audience _____

Brief Description

Objectives

Entry Capabilities Required (e.g., prior knowledge, reading ability, vocabulary level, math ability)

Rating	**High**	**Medium**	**Low**	**Comments**
Match with curriculum	❑	❑	❑	
Accurate and current	❑	❑	❑	
Clear and concise language	❑	❑	❑	
Arouse motivation/maintain interest	❑	❑	❑	
Learner participation	❑	❑	❑	
Technical quality	❑	❑	❑	
Evidence of effectiveness (e.g., field-test results)	❑	❑	❑	
Free from objectionable bias or advertising	❑	❑	❑	
User guide/documentation	❑	❑	❑	
Pacing appropriate for audience	❑	❑	❑	
Clarity of organization	❑	❑	❑	

Strong Points

Weak Points

Recommended Action _____ **Name** _____ **Date** _____

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A computer version of this Checklist is available on the "Classroom Link Portfolio" CD-ROM.



© COPYRIGHT CONCERNS: MUSIC

For academic uses other than performances, teachers and students may make copies of up to 10 percent of a musical work provided the excerpt does not comprise a part of the whole that would constitute a performable unit such as a section, movement, or aria. The number of copies should not exceed one copy per student.

Example: From experience you know that recordings of literary works put out by major record labels may disappear from their catalogs in a few years. For example, RCA Victor once made available a recording of Shakespeare's *Midsummer Night's Dream* with Mendelssohn's incidental music inserted appropriately. It is no longer available. If you taped the CDs, put the tapes on the shelf as a contingency, and used the CDs in class, you would at least have the tape available if your CDs were damaged. You would not have intended to deprive anyone of income; you would simply have used the technology to guarantee availability to yourself.

For general information on copyright, see the Copyright Concerns on page 87 in Chapter 4. Suggested readings on copyright appear at the end of Chapter 4.

possible. For a large group, do not use a small audiocassette recorder/playback unit. The speaker is not large enough to provide adequate volume. Be sure that you have a good-quality speaker that does not distort the sound.

Prepare the Learners

Before playing the audio material, communicate to students how the material relates to what they have studied before, what they should be doing or learning from the materials themselves, and what followup activities will occur. If you are going to present new vocabulary words or technical terms, list them on a handout, the chalkboard, or overhead transparency.

Provide the Learning Experience

Ask students to raise their hand if they cannot hear the audio materials during playback. Be particularly sensitive if you have any hearing-impaired learners. Practice with the playback equipment before the session. Make sure that it is working properly. Refer to "Cassette Recorder Troubleshooting" (p. 183) if you have problems.

The classroom environment may not be ideal for the academic achievement of hearing-impaired children. Classroom noise and reverberation can cause problems for these children. Potential solutions include relocating them to the front of the room or adding noise damping devices such as drapes and carpeting. Another strategy is to use a sound field amplification system. Such a system consists of the teacher wearing a wireless microphone and having several small speakers located throughout the classroom. These systems also help children who have colds, those with disorders that might affect their hearing, and those for whom English is a second language (Crandell, Smaldino, & Flexer, 1995).

Student-Based Utilization

We have discussed the group use of audio materials. There are times when students will use audio materials for individual learning and to create their own materials. Applications of student-based utilization were described earlier in this chapter. Your role will vary from that of guide to that of observer, when you have limited involvement.

REQUIRE LEARNER PARTICIPATION

Before you begin the lesson, determine how to get and keep your students actively involved. One technique is to give students a set of questions to answer during the listening. Younger learners may act out the role portrayed in the materials. Foreign language tapes may include pauses for learners to practice pronunciation. After listening to a story they may draw a scene from the audio description.

EVALUATE AND REVISE

Determine how effective the audio materials were. You can gather data by making observations, evaluating test results, or discussing the experience with students. You may decide to revise how you use the materials or to modify the materials themselves.

ASSURE BLUEPRINT

An Author Reads Her Short Story

This is a class in contemporary American literature in a community college in the Pacific Northwest. The instructor has decided on Eudora Welty to represent Southern fiction. She has chosen her short story "Why I Live at the P.O." and plans to include a recording of Miss Welty reading the story.

Analyze Learners

General Characteristics

All the students are taking the class because they plan to transfer to a four-year educational institution. Most are recent high school graduates, but some of the women in the class are using the community college to resume educations interrupted by other events in their lives. Reading abilities range from 8th-grade to 11th-grade levels.

Entry Competencies

The students are fairly well motivated, but the instructor has discovered that they have little familiarity with contemporary literature. Most can locate Mississippi on a map, but very few of the students have been to the Deep South, so Miss Welty's Mississippi accent may be difficult for them to understand. Because the story deals with family squabbles, the instructor is counting on the experiences of the older women in the class to give an important dimension to the class discussions.

Learning Styles

The learning styles of the students vary greatly. Because the class is elective, most students who enroll are verbal learners, although their reading levels tend to be low for college students. However, as a result of growing up with television and audio recordings, they are good listeners and prefer to hear material rather than to read it. They also enjoy discussing content rather than writing about it.

State Objectives

After listening to the recording, the students will be able to do the following:

1. State the main theme of the story.
2. Discuss the motivations of the main characters.
3. Identify the relationships among the main characters.
4. Compare the behaviors of the characters with those of people they know.

Select Methods, Media, and Materials

The instructor selected "Why I Live at the P.O." because she knew about the recording by the author. She believes that hearing as well as reading the short story will help the slower readers. She knows that Miss Welty is an amateur photographer and has published a book of her photographs of people and scenes in her native Jackson, Mississippi. After securing permission from the publisher, the instructor asks the media center to make a series of slides from selected photographs from her copy of the book to give the students the flavor of the environment of the story. The instructor asks the Southern wife of a faculty member to read the narration she has written to accompany the set of slides. This will give the students some practice listening to a Southern accent before hearing Miss Welty.

Utilize Media and Materials

The classroom is acoustically suitable for hearing the tape, but the instructor realizes that a playback unit with better speakers than those on her portable machine will be necessary. She arranges with the media center to obtain a good playback unit. She has also requested a slide projector and screen and has arranged the slides in the tray.

The reading assignment included material on the influence of the South on Southern writers. On the day before the oral reading, the instructor hands out a sheet listing colloquialisms from the story with explanations.

On the day of the reading, the instructor introduces the woman who will read the narration for the slides and proceeds to present the slide set. The slide presentation elicits a number of questions about life in the South. The instructor then introduces the recording, closing with the warning that contrary to what they may have heard about languorous Southern speech, Eudora Welty speaks very rapidly.

Require Learner Participation

The students are encouraged to ask questions during and following the slide presentation. They take notes while the story is being read. After the recording, the class discusses the short story. The older women in the class give their insights into the problems of family relations.

As a culminating exercise, the instructor asks students to write a short essay comparing the characters in the story with people they know.

Evaluate and Revise

From the discussion in class, the instructor determines that the recording added to the understanding of the theme and the motivations of the characters. On the basis of the response to the slide presentation, the instructor decides to use the technique in other units of the course.

The essays demonstrate that the students gave a good deal of thought to the way behavior patterns are influenced by where people live. The instructor gives the class a brief multiple-choice test on the people in the story to determine how well the students understood the interactions among the characters.

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 7 of the Companion Website (http://www.prenhall.com/heinich).

1. *Planning Lessons Using Audio Imput.* Prepare an independent learning module, such as a learning center. Include an audiotape to help learners use the resources in that learning center to accomplish the task(s) you have identified. What do you need to do to prepare an audiotape? What will your learners do to ensure they use the tape to their benefit? What modifications are needed for different students? (ISTE NETS-T III-A & B; VI-B & E)
2. *Written Reflection.* Use an audiotape to collect your thoughts and ideas about what it means to use technology in your teaching. Listen to your tape after a few entries. What have you learned about your ideas? How does keeping your ideas on audiotape impact your collection of reflections? Would you consider your audiotape to be a variation of a journal? Why or why not? (ISTE NETS-T IV-B; V-B)

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 7 of the Companion Website (http://www.prenhall.com/heinich).

1. Prepare an audiotape that features your voice and some music. Have your class evaluate it using the criteria in the Checklist for Student/Teacher-Prepared Audiocassettes in "How to . . . Record Audiocassettes." Include a brief description of each step from the ASSURE model.
2. Obtain any commercially prepared audio materials and appraise them using a given set of criteria, such as that in the "Appraisal Checklist: Audio Materials."
3. Develop a short oral history of your school or organization by interviewing people associated with it for a long time. Edit your interviews into a five-minute presentation.
4. Select the best audio format for a given instructional situation and justify the selection of that format, stating its advantages and limitations.
5. Prepare an outline for a short oral presentation. Deliver your presentation as if you were addressing the intended audience, and record it. Critique your presentation for style as well as content. Revise and present it again.
6. Plan a brief audio-based lesson on a basic skill (e.g., spelling or arithmetic), or prepare a performance aid (e.g., how to complete a bank check or how to fill out an application form). Design the lesson on paper first, then record it on tape.

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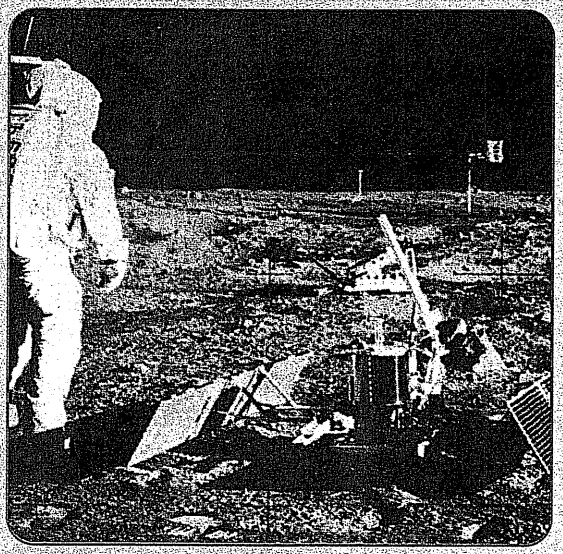
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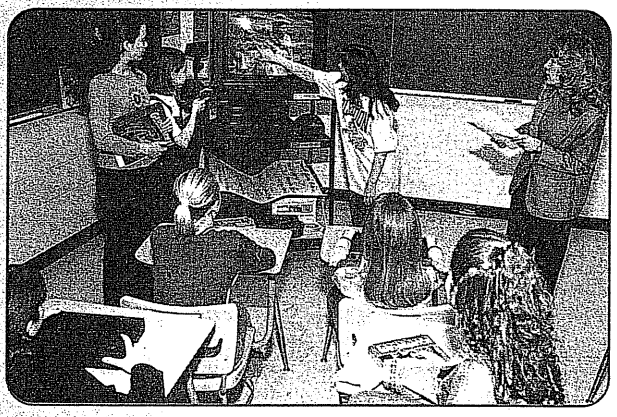
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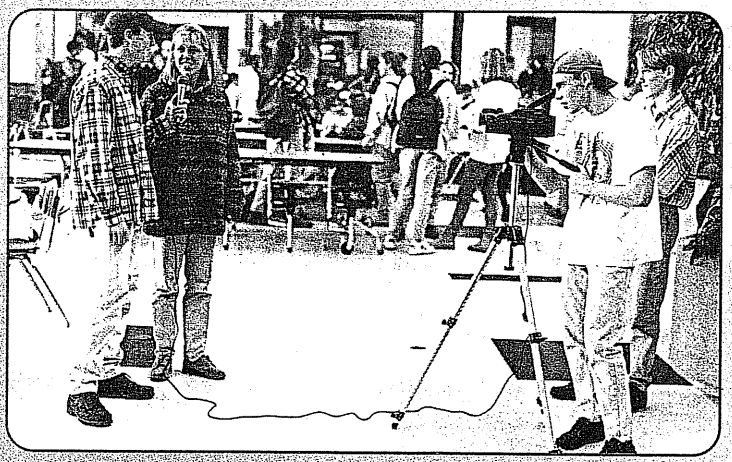
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Video combines motion, color, and sound in ways that can dramatize ideas better than any other medium. Your students can experience the past, present, and future without leaving the classroom. They can be transported inside the human body, around the world, or out beyond the solar system. Video lends itself to all types of objectives—cognitive, affective, psychomotor, and interpersonal.





To get the best results from video you need to select materials wisely and use good showmanship skills. It seems simple, but certain critical steps must be taken to promote student and trainee learning.

Students can produce their own video presentations using digital or analog equipment. This is frequently done as a way of reporting a group project.

CHAPTER 8

Video

OUTLINE

Video Formats
Special Attributes of Video
Advantages
Limitations
Integration
Selecting Video
Producing Video
Utilizing Video
Require Learner Participation
Evaluate and Revise

KNOWLEDGE OBJECTIVES

1. Identify four common video formats and compare the characteristics, advantages, and limitations of the various formats.
2. Describe five attributes of video.
3. Compare the advantages and limitations of video.
4. Create original examples of applications of video in each instructional domain—cognitive, affective, psychomotor, and interpersonal.
5. Describe techniques for video design and production by students and teachers.
6. Identify applications for in-house video production.
7. Outline the process for selecting video, including at least five appraisal criteria.
8. Describe instructional applications that are especially appropriate for video.
9. Discuss the 5 *P*s of video utilization and ways to require learner participation when using video.

LEXICON

video
television
persistence of vision
DVD
digital video
streaming video
time lapse
slow motion
animation
documentary
in-house video
digital video editing
charge-coupled device (CCD)

Originally, the concept of video was synonymous with that of broadcast television, but the concept has expanded dramatically in recent years. In this text we use the term **video** to refer to the electronic storage of moving images (videotapes, videodiscs, DVD, etc.) **Television** is the transmission of live moving images electronically, either through the air or through wires or cables. New technologies connected to television sets have proliferated, such as home computers, videocassette recorders, video games, and specialized cable TV services. Other hybrids are still emerging. These new services continue to multiply because it tends to be cheaper and more efficient to transmit information electronically than to transport information, goods, and people physically.

The Latin word *video* means "I see." Any electronic media format that employs "motion pictures" to present a message can be referred to as video. Thus, we have videocassettes, videodiscs, DVD, interactive video, video games, and so on.

When using a television monitor, the phosphorescent images of video are composed of dots of varying intensity on the screen. Every 30th of a second, 525 lines of dots are "sprayed" onto the back of the cathode-ray screen, creating one full screen. The rapid succession of screens is perceived as a moving image because of an optical phenomenon called **persistence of vision:** the eye and brain retain an image cast on the retina of the eye for a fraction of a second after that image is removed from view. If a second image is presented before the trace of the previous image fades, the images blend together, creating the illusion of continuous motion.

VIDEO FORMATS

Video versions of the moving image are recorded on tape or disc, each packaged in forms that vary in size, shape, speed, recording method, and playback mechanism. The most common video formats are summarized in Table 8.1.

Videotape

The VHS ½-inch format is a preferred medium for commercial distribution of moving images. Virtually all of us have rented a VHS version of a movie, and most of us have recorded a TV program on VHS for later or repeated viewing. Time-shifting the TV schedule has become a major sport in many homes. VHS is also the current preferred format for amateur and nonstudio production of recorded moving images in education.

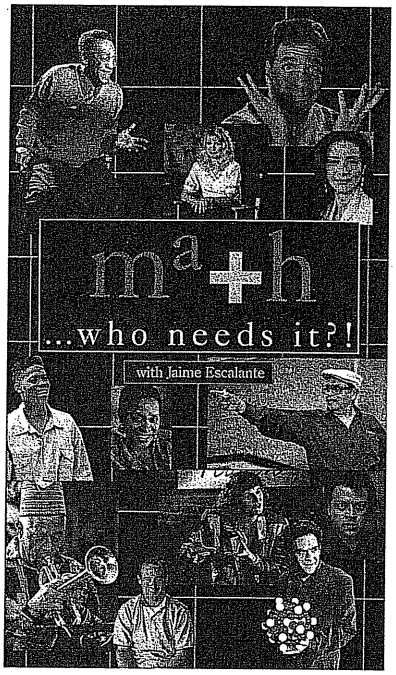
DVD

DVD (digital videodisc) is a medium offering digital storage and playback of full-motion video. Just as audio can be digitized (as described on page 178), video images can be converted into a digital format. **Digital video** images can be manipulated (e.g., content, size, and color can be changed), stored, duplicated, and replayed without loss of quality. Because videodiscs are in analog format, you cannot change the material on them; but with digital video stored on CDs or in a computer, you and your students can edit the content and sequence of the moving images.

The disc is the same physical size as an audio CD or a CD-ROM but can hold enough data for four full-length feature films with high-quality soundtracks, (almost nine hours of video). Like CDs and CD-ROMs, DVD has instant random access and is highly durable. There is no distortion when you watch a DVD in slow motion. DVD discs provide far superior sound and picture quality compared to a standard VHS videotape. Unlike videotape, DVD discs do not deteriorate over

MEDIA FILE

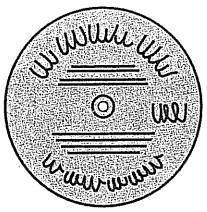
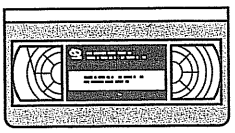
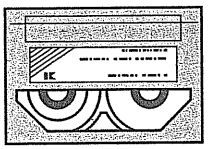
Math . . . Who Needs It?
Video



Source: FASE Productions.

This videocassette is aimed at parents and their kids. It gives a perspective on the rewards and opportunities open to anyone with good math skills. It challenges myths about math, pokes fun at society's misconceptions of the subject, and provokes viewers to think and talk about math in a more positive way.

TABLE 8.1
Common video formats

FORMAT	SPEED	ADVANTAGES	LIMITATIONS
Videodisc  Diameter: 12 in.	30 min. per side	Flexible storage capacity: can hold 54,000 images, still or motion, or audio Fast random access to specific frames Highly durable; no wear with use Inexpensive when mass produced	Not for local production Originals expensive to produce
Videocassette VHS  Tape width: ½ in.	1.31 ips[1] (120 min at standard speed)	Self-contained and self-threading Abundant software available Easy local production	Video quality low; not broadcast quality Quality deteriorates with use
Videocassette (Hi 8)  Tape width: 8 mm (about ¼ in.)	1.31 ips[1] (120 min at standard speed)	Most compact format Full compatibility among all makes and models Easy local production	Video quality lower Limited acceptance in education; little software available
Compact disc (DVD)  Diameter: 4.72 in.	Variable high speed	Easy to use Low-cost hardware and software Worldwide standard Self-contained hardware	Limited educational software

[1] ips = inches per second.

time. They are doing for movies (films and videotapes) what the CD did for music.

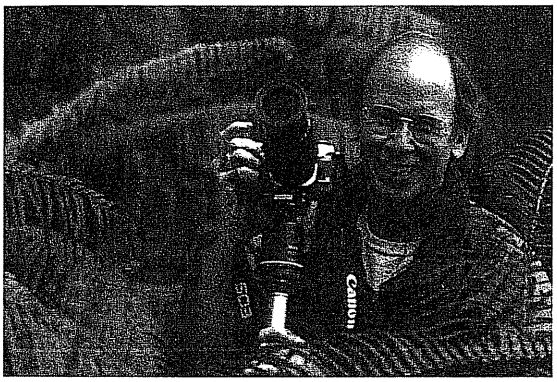
Video-based courses with multiple soundtracks can be aimed at different types of students. Text can be displayed in multiple languages and used to subtitle or annotate video content. Some discs offer the ability to view an object from different angles selected by the student; up to nine different camera angles selected in real time during playback. Discs offer index searching of title, chapter, track, or time-code for instant navigation—random access. A single-layer DVD can store over two hours of high-quality, digital video including eight separate high-quality audio tracks for multiple languages, different grade levels, special video descriptions for blind or visually impaired students. Digital videodisc–recordable (DVD-R) is now available to allow people to record their own DVD as they do videotapes.

All DVD-Videodiscs can be played on all DVD players. The devices also play audio CDs. Many computer makers are adding DVD players to their systems; some, such as Apple Computer, also offer DVD recorders built in.

MEDIA FILE

Everyday Creativity

Video



Source: CRM Learning.

Famed National Geographic photographer Dewitt Jones uses memorable stories and his own inspirational photos to show that everyone can be more creative in everything from problem solving to dealing with others.

MEDIA FILE

One Woman, One Vote

Video



Source: PBS Video.

Witness the 70-year struggle for women's suffrage, from fledgling alliances to a sophisticated mass movement. This video documents the history of the women's suffrage movement from the Seneca Fall Convention in 1848, when Elizabeth Cady Stanton demanded the right for women to vote, to the last battle for passage of the 19th Amendment in 1920.

Videodisc

Laser disc images are sharper than those from videotape. Videodisc images have a horizontal resolution of 350 lines, compared with 240 lines for a videocassette. Also, the audio quality of videodisc is significantly better than that of videotape.

Several educationally valuable features of videodisc are not available with videotape. Videodisc images can be "stepped through" frame-by-frame, can be "scanned" (fast forward), or played at various speeds in both forward and reverse. In addition, videodiscs have two audio tracks, for either separate narrations or stereo sound. For example, two different languages can narrate the moving images; the narrations can be at two different levels of difficulty; or one narration can be for the learners and the other for the instructor.

One drawback, however, is that currently it is difficult and expensive to record your own videodiscs. The playback equipment for videodiscs is nowhere near as common as videotape player/recorders. One reason for this is that videodisc equipment can only play back; videodiscs cannot be recorded on. Additionally, DVD is rapidly supplanting videodisc as the format of choice.

Internet Video

Video also can be delivered via the Internet, usually using **streaming video.** The same technique can also be used with sound alone. *Streaming* means that the file doesn't have to be completely downloaded before it starts playing. Instead, as soon as the user clicks on a link that contains streaming video (or audio), the content begins to play. The video content is actually downloading to the user's computer in a series of small information packets that arrive shortly before the viewer sees (or hears) the material. Any video (or audio) materials can be delivered over the Internet using the streaming technique. The content is not stored in your computer. It "flows" into your active memory, is displayed (or played), and is then erased.

SPECIAL ATTRIBUTES OF VIDEO

Because most of us are inclined to think of video as media designed to produce a realistic image of the world around us, we tend to forget that a basic attribute of video is its ability to manipulate temporal and spatial perspectives. Manipulation of time and space not only serves dramatic and creative ends; it also has important implications for instruction.

MEDIA FILE

Planning Your Approach to Reading

Video

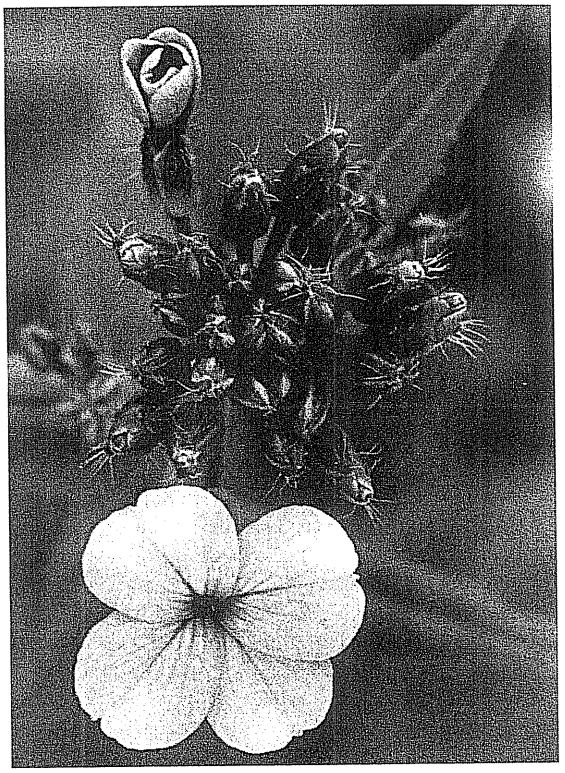


Source: Agency for Instructional Technology.

Four members of a rock band use reading strategies to help them organize their group, acquire costumes, find an engagement, and play at a dance. Other readers use strategies to carry out research on pilgrims in a library and to read a wrestling magazine. Rappers explain how to preview, and a magician's assistant skims and scans to save the magician from a falling ax.

FIGURE 8.1

In time lapse, a slow event is condensed into a short screen time by allowing several seconds to elapse between shooting each frame of film.



Manipulation of Time

Video permits us to increase or decrease the amount of time required to observe an event. For example, it would take an impossibly long time for students to actually witness a highway being constructed, but a carefully edited videotape of the different activities that go into building a highway can recreate the essentials of such an event in a few minutes.

We can also take out pieces of time. For example, you are familiar with the type of sequence in which a scene fades out and then fades in the next day. Time has been taken out of the sequence, but we accept that the night has passed even though we did not experience it in real time.

Compression of Time. Video can compress the time it takes to observe an event. We have all seen moving images of flowers slowly opening before our eyes (Figure 8.1). This technique, known as **time lapse,** has important instructional uses. For example, the process of a chrysalis turning into a butterfly is too slow for easy classroom observation. However, through time-lapse videography, the butterfly can emerge from the chrysalis in a matter of minutes on the screen.

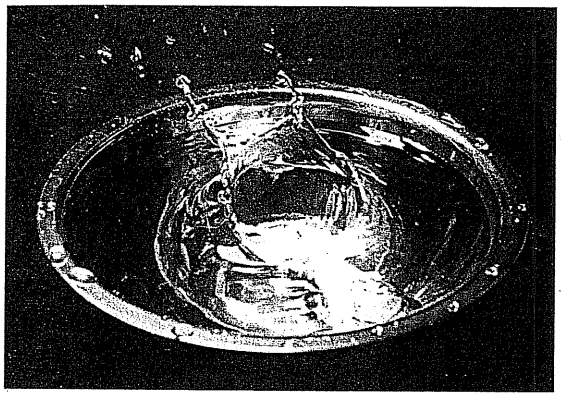
Expansion of Time. Time can also be expanded in motion media through a technique called **slow motion.** Some events occur too fast to be seen by the naked eye. By photographing such events at extremely high speeds and then projecting the image at normal speed, we can observe what is happening (Figure 8.2). For example, a chameleon catches an insect too rapidly for the naked eye to observe; high-speed videography can slow down the motion so that we can see it.

Manipulation of Space

Motion media permit us to view phenomena in microcosm and macrocosm—that is, at extremely close range or from a vast distance. Your students can view the earth from the space shuttle (macro view). At the other extreme, they can observe cell division under a microscope (micro view).

Video and live television allow us and our students to observe two events occurring simultaneously but many miles apart using split screen. During the arrival of the

FIGURE 8.2
In slow motion, a fast event is expanded into a longer screen time by shooting film at a speed greater than 24 frames per second.



"new millennium" we were able to observe celebrations happening simultaneously around the world without leaving our living rooms.

Animation

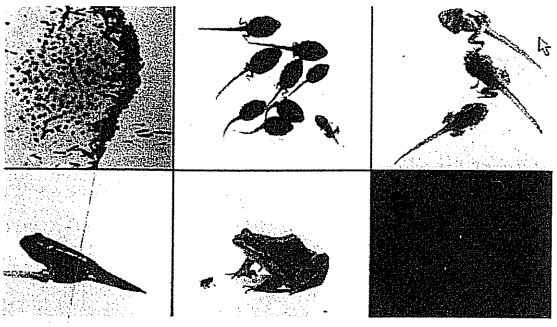
Time and space can also be manipulated by **animation.** This is a technique in which the producer takes advantage of persistence of vision to give motion to otherwise inanimate objects. There are various and more or less sophisticated techniques for achieving animation, but basically animation is made up of a series of photographs or drawings of small displacements of objects or images. If such an object is photographed on a single film frame, then moved a very short distance and rephotographed, moved again, rephotographed, and so on, the object when projected will look as though it has been continuously moving through space.

With the continuing evolution of computer programs that can manipulate visual images, we are experiencing a rediscovery of the art of animation through the video display format (Figure 8.3). Computer-generated animation sequences are being used more and more in instructional video programs to depict complex or rapid processes in simplified form.

Understanding Video Conventions

The devices and techniques used in video to manipulate time and space employ what are for most of us readily accepted conventions. We understand that the athlete whose jump is stopped in midair is not actually frozen in space, that the flashback is not an actual reversal of our normal time continuum, that the light bulb does not really disintegrate slowly enough for us to see that

FIGURE 8.3
Sequential stills can be used to produce the effect of animation or video.



it implodes rather than explodes. Teachers, however, must keep in mind that the ability to make sense out of video conventions is an acquired skill. When do children learn to handle flashbacks, dissolves, jump cuts, and so on? Unfortunately, we know very little about when and how children learn to make sense of manipulation of reality, and much research on the matter remains to be done.

Video is not alone in its reliance on accepted conventions for interpretation and appreciation. Flashback techniques are regularly used in literature and usually accepted by readers. The theatrical convention of the aside is readily accepted by playgoers. The following anecdote about Picasso illustrates how a new artistic convention may seem to the uninitiated as merely a distortion of reality rather than, as intended, a particular and valid view of reality. It also illustrates how a convention (in this case a convention of photography) can become so readily accepted and commonplace that we are amusingly surprised at being reminded it exists.

Picasso showed an American soldier through his villa one day, and on completion of the tour the young man felt compelled to confess that he didn't dig Picasso's weird way of painting, because nothing on the canvas looked the way it really is. Picasso turned the conversation to more acceptable matters by asking the soldier if he had a girl back in the States. The boy proudly pulled out a wallet photograph. As Picasso handed it back, he said: "She's an attractive girl, but isn't she awfully small?" (Forsdale & Forsdale, 1966, p. 609).

ADVANTAGES

- *Motion.* Moving images have an obvious advantage over still visuals in portraying concepts in which motion is essential to mastery (such as psychomotor skills).

MEDIA FILE

Recycling Is Fun

Video



Source: Bullfrog Films.

Three captivating young children explore the three *R*s of recycling–reduce, recycle, and reuse. To educate themselves, they visit a landfill, a recycling center, and their local supermarket to find out what they can do to help with our solid waste crisis. They discover their own power to recycle and choose what they buy, for the benefit of their world. A study guide is provided for the teacher and students.

- *Processes.* Operations, such as assembly line steps or science experiments in which sequential movement is critical, can be shown more effectively.
- *Risk-free observation.* Video allows learners to observe phenomena that might be dangerous to view directly, such as an eclipse of the sun, a volcanic eruption, or warfare.
- *Dramatization.* Dramatic recreations can bring historical events and personalities to life. They allow students to observe and analyze human interactions.
- *Skill learning.* Research indicates that mastery of physical skills requires repeated observation and practice. Through video, students can view a performance over and over again for emulation. They can also observe video of their own performance for feedback and improvement.
- *Affective learning.* Because of its great potential for emotional impact, video can be useful in shaping personal and social attitudes. Documentary and propaganda videos and films have often been found to have a measurable impact on audience attitudes.
- *Problem solving.* Open-ended dramatizations are frequently used to present unresolved confrontations, leaving it to the viewers to discuss various ways of dealing with the problem.
- *Cultural understanding.* We can develop a gut-level appreciation for other cultures by seeing depictions of everyday life in other societies. The whole genre of ethnographic videos can serve this purpose. Feature-length ethnographic films available on video include *The Hunters, The Tribe That Hides from Man, The Nuer,* and *River of Sand.*
- *Establishing commonality.* By viewing video programs together, a disparate group of people can build a common base of experience to discuss an issue effectively.

LIMITATIONS

- *Fixed pace.* Although videos can be stopped for discussion, this is not usually done in group showings. Because the program runs at a fixed pace, some viewers may fall behind while others are waiting impatiently for the next point.
- *Talking head.* Many videos, especially in-house productions, consist mostly of close-ups of people talking. Video is not a great oral medium—it is a visual medium! Use audio tapes for verbal messages.
- *Still phenomena.* Although video is advantageous for concepts that involve motion, it may be unsuitable for other topics where detailed study of a single visual is involved (e.g., a map, a wiring diagram, or an organization chart).
- *Misinterpretation.* Documentaries and dramatizations often present a complex or sophisticated treatment of an issue. A scene intended as satire might be taken literally by a young or naive viewer. The thoughts of a main character may be interpreted as the attitudes and values of the producer.
- *Abstract, nonvisual instruction.* Video is poor at presenting abstract, nonvisual information. The preferred medium for words alone is text. Philosophy and mathematics do not lend themselves well to video unless the specific concepts discussed lend themselves to illustration using historical footage, graphic representation, or stylized imagery.
- *Logistics.* In schools videos tend to be stored in the media center rather than in the classroom. Consequently the appropriate video and the equipment must be ordered in advance. Training programs usually rent videos from a distributor or from corporate headquarters. This again means that videos must be ordered well in advance of their intended use. Arrangements have to be made so that the correct title arrives at the right place at the right time and that the proper equipment is available and in operating condition. The complexity of these arrangements may discourage many instructors.

INTEGRATION

Videos are available on almost any topic and for all types of learners in all the domains of instruction described in Chapter 3—cognitive, affective, psychomotor, and interpersonal. As noted previously, video can manipulate both time and space. It can take learners almost anywhere and extend students' interests beyond the walls of the classroom. Objects too large to bring into the classroom can be studied as well as those too small to see with the naked eye. Events too dangerous to observe, such as an eclipse of the sun, can be studied safely. The time and expense of a field trip can be avoided. Many companies and national parks provide video tours to observe assembly lines, services, and the features of nature.

Certain special effects, such as slow motion, can be obtained during videodisc presentation. Videocassette recorders (VCRs) can be remotely controlled, meaning that the instructor (or operator) does not have to stay close to the machine. Because of the ease of operating the equipment, video lends itself to individual study. All of this means that video can be incorporated easily into a variety of pedagogical methods. It is possible to alter the motion sequence, preprogram that sequence, and operate video equipment by remote control. A VCR and TV set are easy to use. Most people have learned to operate a VCR.

You can use video to provide baseline knowledge for all learners. The packaged media can serve as an alternative to lectures. You can give students a viewing assignment before coming to class. Class time is then available for hands-on experiences, discussion, or applications of knowledge.

Educational Applications

Cognitive Skills. In the cognitive domain, learners can observe dramatic recreations of historical events and actual recordings of more recent events. Color, sound, and motion make personalities come to life. The textbook can be enhanced by showing processes, relationships, and techniques. Students can read books in conjunction with viewing videotapes. You may have students read the books before the showing as an introduction to the topic, or use the program to interest students in reading about the topic.

Demonstrations. Video is great for showing how things work. For example, there is a short educational video called *Colonial Cooper.* Made at Colonial Williamsburg, it shows how an eighteenth-century artisan made a barrel. Demonstrations of motor skills can be more easily seen through media than in real life. If you are teaching a step-by-step process, you can show it in real time, sped up to give an overview, or slowed down to show specific details. With DVD and videodiscs you can even stop the action for careful study or move forward one frame at a time. Recording student performances on videotape can provide practice with feedback. Learners can observe their own performances and also receive feedback from colleagues and the instructor.

Virtual Field Trip. Videos can take students to places they might not be able to go otherwise. You can take your students to the Amazon rainforest, the jungles of New Guinea, or the tundra of the frozen Arctic. Most of us will never take a safari to Africa or spend several months in the Alaskan bush to observe the behavior of animals in the wild. We can go to these places and many others on video.

Documentary. Video is the primary medium for documenting actual events and bringing them into the classroom. The **documentary** deals with fact, not fiction or fictionalized versions of fact (Figure 8.4). It attempts to depict essentially true stories about real situations and people. The commercial networks (broadcast and cable) and the Public Broadcasting System regularly produce significant documentaries. Special programs, such as *The Second Russian Revolution,* present in-depth analyses of recent events and issues. The miniseries *The Civil War* is an example of a documentary presentation of a critical period in U.S. history. Programs such as *Nova* and the National Geographic specials offer outstanding documentaries in science, culture, and nature. Virtually all television documentaries are available for purchase as videos.

Dramatization. Video has the power to hold your students spellbound as a human drama unfolds before their eyes. For example, television programs such as *ER* can take them into an emergency room to observe what goes on there. Reenactments of many important events in history are available on video. Feature films on videotape and DVD offer teachers and students hundreds of choices.

Discussion Basis. By viewing a video program together, a diverse group of learners can build a common base of experience as a catalyst for discussion. When students are learning interpersonal skills, such as dealing with conflict resolution, counseling, sales techniques, and peer relationships, they can observe others on video for demonstration and analysis. They can then practice their interpersonal skills before a camera, watch themselves, and receive feedback from peers and instructors. Role-play vignettes can be analyzed to determine what happened and to ask the learners what they should do next. Open-ended dramatizations can present unresolved confrontations, leaving it to the viewers to discuss various ways of dealing with the problem.

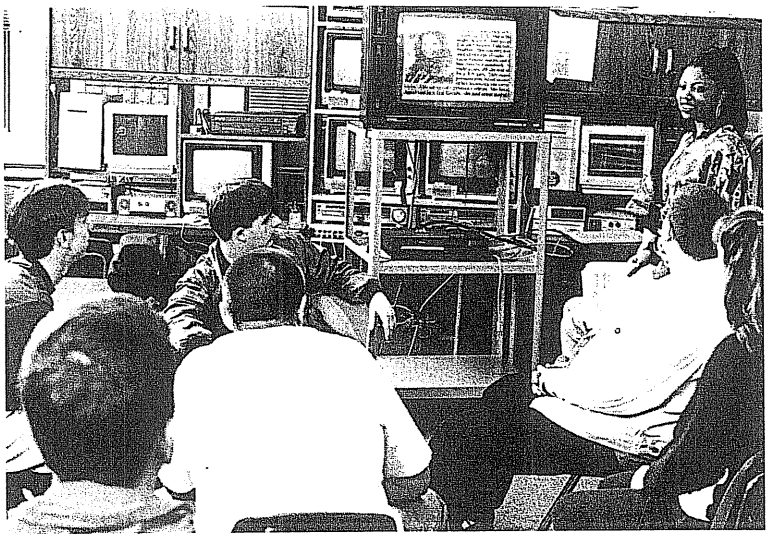


FIGURE 8.4
Documentaries bring real-world experiences into the classroom.

Attitude Development. Most educational presentations target recipients' cognitive or psychomotor domains of learning. However, when there is an element of emotion or the desire for affective learning, video usually works well. Attitudes can be influenced by role models and dramatic messages on video. Because of its great potential for emotional impact, video can be useful in shaping personal and social attitudes. Documentary programs have often been found to have a measurable impact on audience attitudes. Documentaries made during the Great Depression, for example, bring the hardships of that era to students who have never known hard times. Cultural understanding can be developed through viewing video depicting people from all parts of the globe.

Reports and Portfolios. Students can use excerpts from videos as a part of oral reports, turning the sound off and using their own narration. Student-produced videotapes and video segments on computers are being used for evaluation. Student portfolios with a multimedia approach are being used instead of word processed term papers. Students can research a topic using books, databases, videotapes, videodiscs, CD-ROMs, and other media. Relevant content can be "captured" on video, edited, and displayed for classmates, parents, and the teacher.

Training. Video is the most frequently used training medium by businesses. According to *Training* magazine ("Industry Report," 2000), videotapes are used by 78 percent of U.S. organizations with 100 or more employees. The amount of videotape use, although less than that of lectures (used in 96% of these organizations), is comparable to that of one-to-one instruction (used in 76% of these organizations).

In addition to the advantages already cited, production of video is much easier to handle in house. With internal production, all phases of production can be managed internally at fairly low cost. While educational institutions have relatively similar curriculum needs and therefore can rely primarily on commercially produced materials, training needs for the most part are situation specific, making in-house production of video a necessity (see "Producing Video," later in this chapter).

In addition to customization, there is the factor of rapid change. Increasing competition and technological change dictate an instructional medium that can turn out updated and modified programs rapidly.

Corporate use of video therefore contrasts sharply with school use in terms of the amount of locally produced material used. Most large corporate users maintain professional-quality production studios and equipment for in-the-field location shooting. Of course, many corporate skills are generic in nature—such as supervisory skills, management of meetings, and stress management. These lend themselves to off-the-shelf, or commercially produced, media.

Many organizations use video for the following:

- Orientation of new employees
- Training in job-related skills
- Development of interpersonal abilities for management
- Introduction of new products, policies, or markets
- Customer training
- Standardization of training among dispersed offices

Portability and ease of use are advantages in all these uses of video. For example, a life insurance company can send a video to its sales representatives for them to study at their local office or at home. Also, each representative can take the video to a potential client's home

knowing a VCR will probably be available. Video is so common and easy to use that many companies now distribute tapes to potential customers to promote products and services.

Classroom Access. School-owned video collections are increasing in size—more than doubling, on average, every few years. School library media centers are becoming equipped with computer-controlled media distribution systems. These allow teachers to schedule videocassette and videodisc showings and have them sent to the classroom by cable or fiber optics when activated by controls in the classroom. Equipment and materials do not have to be moved around the school. Because of these distribution systems and the ability to receive and record educational and news cable channels, and the growing availability of streaming video delivery directly over the Internet, the classroom of the future will have access to a variety of instructional video materials within the school.

SELECTING VIDEO

Locating Materials

Program guides and directories can help keep you abreast of available materials in your areas of interest and guide you toward selection of materials best suited to your particular teaching needs. Librarians, media specialists, and teachers working as partners should communicate constantly concerning the resources needed for instruction. A basic resource for you, then, is a collection of catalogs of rental agencies you are most likely to use. To be more thorough in your search you will want *The Educational Film/Video Locator,* a comprehensive list of the videotapes available in various college and university rental collections. The most comprehensive list of current educational video is "A-V Online," which is in CD-ROM format. Other broad listings are *Bowker's Complete Video Directory* and *Video Source Book.* (These and other more specialized catalogs are described in Appendix C; additional information may be found on the Companion Website [http://www.prenhall.com/heinich].)

Appraising Videos

After you have located some potentially useful videos, you will want to preview and appraise them. Some schools and organizations have standard appraisal forms ready to use. Some of these are meticulously detailed, covering every possible factor; others are much more perfunctory. A good appraisal form will be brief enough not to be intimidating but complete enough to help individuals choose materials that may be useful for current and future applications. It should also stand as a public record that you can use to justify the purchase or rental of specific titles. The "Appraisal Checklist: Video" includes the most commonly used criteria, particularly those that research indicates really do make a difference. See page 205.

Sponsored Videos

Private companies, associations, and government agencies sponsor videos for a variety of reasons. Private companies may make them to promote their products or to enhance their public image. Associations and government agencies sponsor videos to promote causes, such as better health habits, conservation of natural resources, and proper use of park and recreation areas. Many of these sponsored videos make worthwhile instructional materials. They also have the considerable advantage of being free.

A certain amount of caution, however, is called for in using sponsored programs for instructional purposes. Some privately produced materials may be too flagrantly self-serving. Or they may deal with products not very suitable for certain instructional settings; for example, the manufacturing of alcoholic beverages or cigarettes. Some association and government materials may contain a sizable dose of propaganda or special pleading for special causes along with their content. You must *always* preview sponsored materials.

Properly selected, many sponsored materials can be valuable additions to classroom instruction. Modern Talking Picture Service is one of the major distributors of sponsored videos. The best single source of information on sponsored films is *Free Videotapes.* Details on this and other sources appear in Appendix C and on the Companion Website (http://www.prenhall.com/heinich).

PRODUCING VIDEO

In-house video refers to videos produced within one's own classroom or company. With in-house video production, students and instructors are not limited to off-the-shelf materials but can with reasonable ease prepare custom materials (see Clendenin, 1998). This feature sets video apart from some of the other media. Do-it-yourself video has become commonplace since the popularization of the battery-operated portable video recording systems.

The development of the camcorder (camera and recorder built into a single book-size unit) has increased the ease and portability of ½-inch recording. It allows video production to be taken into the field, wherever that might be: the science laboratory, the classroom, the counseling office, the athletic field, the factory assembly line, the hospital, the neighborhood, and even the home. Equally important, the simplicity of the system has made it feasible for nonprofessionals, instructors, and students alike to create their own video materials.

Locally produced video can be used for virtually any of the purposes described earlier. Its unique capability is to

capture sight and sound for immediate playback. This medium thus works well with activities that are enhanced by immediate feedback: group dynamics sessions, athletic practice, skills training, and interpersonal techniques.

Other applications that emphasize the local aspect of video production include the following:

- Dramatization of student stories, songs, and poems
- Student documentaries of school or neighborhood issues
- Preservation of local folklore
- Demonstrations of science experiments and safety drills
- Replays of field trips for in-class followup
- Career information on local businesses

Growing numbers of school media and technology centers are adding to their environments a small video studio for student productions. Many students come to school with home experiences in using portable cameras. Student production will increase as equipment continues to become less expensive, more light sensitive, and easier to use. Elementary and secondary students can be involved in scripting, recording, editing, and revising their own video productions.

As with all media production, preproduction planning is necessary. Storyboarding (see page 131) can be used by students of all ages to facilitate planning and production of video. Storyboarding is particularly helpful when a group of students is cooperatively involved in designing a video.

Analog Video Production

Video production requires a camera, a recorder, a microphone, and perhaps editing equipment. Most cameras are of the viewfinder type. The viewfinder camera is so named because it has built into it a small TV set that allows the operator to monitor the image being received by the pickup tube. Even small hand-held cameras typically contain built-in viewfinders with one-inch screens (see "Close-up: How a Video Camera Works").

Hand-held cameras usually come with a microphone built into the front of the camera. This microphone has an automatic level control, a feature that automatically adjusts the volume to keep the sound at an audible level. The camera "hears" as well as "sees." The problem is that these microphones amplify all sounds within their range, including shuffling feet, coughing, street noises, and equipment noise, along with the sounds you want. You may therefore want to bypass the built-in microphone by plugging in a separate microphone better suited to your particular purpose.

The *lavaliere,* or neck mike, is a good choice when recording a single speaker. It can be clipped to a tie or dress, hung around the neck, or even hidden under lightweight clothing. A desk stand may be used to hold a microphone for a speaker or several discussants seated at a table. For situations in which there is unwanted background noise or the speaker is moving, a highly directional microphone is best. For practical tips on video production, see "How to . . . Set Up a Single-Camera Video Production" on page 203.

Standard video editing equipment is expensive. However, you and your students can do your own video editing with two VCRs, connecting them by a patch cord or cable to record from one tape to another. It is also possible to record from a videodisc to videotape using a similar setup. In all cases be sure to follow the copyright guidelines in Chapter 4 and in the "Copyright Concerns" in this chapter.

Digital Video Editing

Recent developments in chip technology make it possible to edit videotape, and even create special effects, by simply installing a special circuit board called a "card" in a personal computer. Some cards allow you to add special effects such as dissolves, wipes, and fades to live or recorded video. The card also makes it possible to superimpose images from different video sources, including its own character generator for titles and captions. Some camcorders have this feature built in. Even color characteristics can be manipulated by the card.

Several cards are available that can rearrange segments of a videotape. With these cards you can select specific parts of various tapes, store them, and then rearrange them in the desired sequence. If the new arrangement is not effective, you can just re-edit.

Video cards have revolutionized the production of video in education and in corporate settings. It is not an exaggeration to say that the right combination of such cards and appropriate software makes it possible to do studio-quality production without the studio. Student-produced videos are becoming more common and much more sophisticated. Students and teachers are able to produce instructional videos for local curriculum needs, such as community study in the primary grades.

Digital video editing refers to the means by which video can be taken apart and put back together nonlinearly using a computer and associated software. Digital video camcorders are smaller than analog video cameras and can record up to 90 minutes in the long-play mode. With digital video there are usually no videotapes. Most camcorders record on a standard 3.5-inch floppy disc. Some camcorders use an ultraminiature 2.5-inch disc. The ultraminiature discs can record 20 minutes of video.

After shooting, you can watch the video on the camcorder's built-in LCD monitor. You can also connect the camcorder to a TV monitor or transfer the images to a computer. Many camcorders allow you to edit right in the camera.

CLOSE-UP

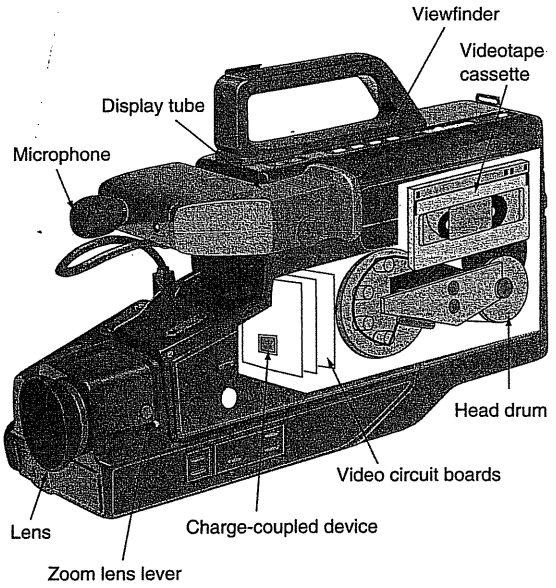
HOW A VIDEO CAMERA WORKS

Light enters a video camera through the lens. In a portable camera (camcorder), the light is focused onto a light-sensitive electronic assembly called a **charge-coupled device (CCD),** which changes the wavelengths into electrical charges. A filter connected to the CCD separates the charges by color. These video signals are amplified and sent to the recording mechanism in the camera. The audio is picked up by a microphone attached to the camera (or by a detached microphone) and recorded on one edge of the videotape.

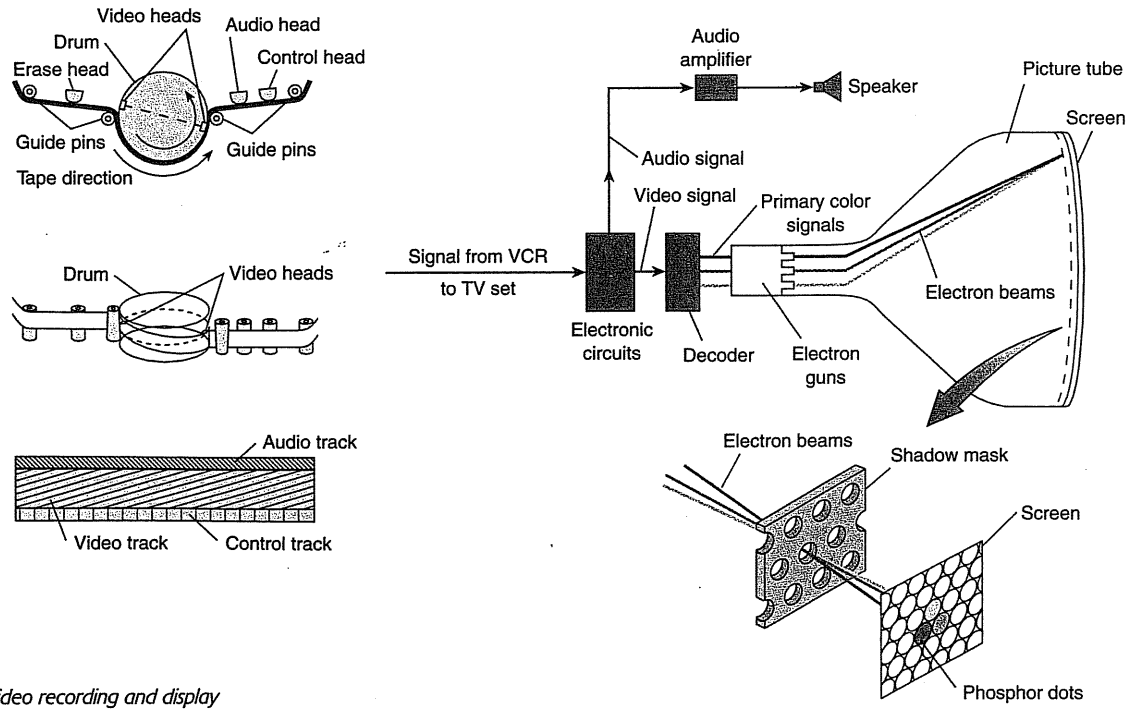
Before the development of the CCD, the video camera had to house three tubes, one for each primary color. A system of dichroic mirrors sent each color to its respective tube. This made the camera so bulky that the signals had to be sent to a separate videotape recorder. The CCD made it possible to include the recording mechanism in the camera, thus creating the portable units so much in favor for nonstudio videotaping. Because of its superior quality, the dichroic mirror system is still preferred for studio production.

The recorded videotape can be played back through the camera itself or through a videotape player. A video signal is so complex that the videotape speed must be much greater than that for an audio recording. This is achieved by rotating the record/playback head, called the drum, at high speed while the tape moves across it in a helical path. The video signal occupies the greater part of the tape while the edges carry the audio and the signals that frame the image on the screen.

The magnetic signals on the tape are converted to electrical impulses that are decoded into the primary colors of light: blue, red, and green. These signals are amplified and projected onto the screen by an electronic gun. The screen surface is covered with more than 300,000 phosphor dots arranged in groups of three for the three colors. A metal perforated mask behind the screen keeps each electron beam in line with its own color dots and away from the other colors. The electronic gun scans the picture tube 30 times a second. Persistence of vision converts these scans into a moving image.



Parts of a video camera

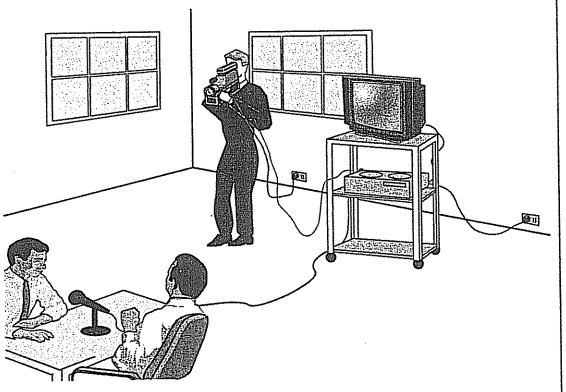


Video recording and display

HOW TO . . . Set Up a Single-Camera Video Production

Here are some tips for arranging and using equipment for single-camera video recording.

1. Set the monitor/receiver and recorder on a sturdy mobile cart. This allows easy movement of the equipment around the room. The cart can be swiveled around so that the monitor/receiver faces the camera operator (to allow monitoring when a nonviewfinder camera is being used). In most cases it is advisable to turn the monitor/receiver away from on-camera performers to avoid distracting them during recording. It can easily be swiveled back for later instant replay viewing.
2. Mount the camera on a sturdy, wheeled tripod, maximizing mobility and stable support.
3. Use a camera with a zoom lens. This lens, having a variable focal length, can be adjusted to provide a wide-angle view, a medium view, or a close-up view with just a twist of the wrist. You should, however, resist the impulse to zoom in and out during a shot unless there is very good reason for doing so.
4. Place the camera and mobile cart close to the wall. This arrangement helps reduce the likelihood of passersby tripping over the cables that connect the components to each other and to the power source.
5. Aim the camera away from the window (or other bright light source). Cameras used in this system usually are equipped with automatic light-level control enabling them to adjust automatically to the brightest light striking the lens. If there is a window in back of your subject, the camera will adjust to that light, thus throwing your subject into shadowy darkness. An important caution when recording outdoors: one of the greatest hazards to the pickup tube in your camera is exposure to direct sunlight. Aiming at the sun can cause its image to be burned into the pickup tube, possibly causing irreparable damage. (This problem does not occur with CCD cameras.)
6. Ensure that the subjects are well lighted. If natural light is insufficient, you may supplement it with incandescent or fluorescent lighting in the room. Today's pickup tubes operate well with a normal level of artificial light.



A generalized setup for single-camera recording

7. Place the camera so that the faces of all subjects can be seen. A common mistake in taping a classroom scene is to put the camera at the back of the room. This provides a nice full-face view of the teacher but makes reaction shots of the students nearly impossible to see. Placement of the camera at the side of the classroom is a reasonable compromise when recording classroom interaction.
8. Use a desk-stand microphone. This allows pickup of the voices of all subjects, while reducing the pickup of unwanted background noises.

TROUBLESHOOTING

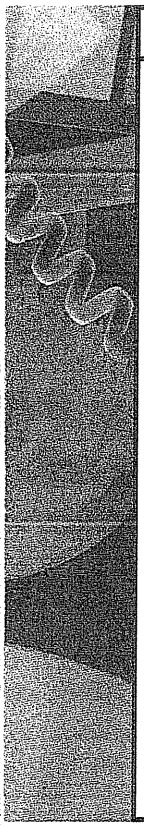
Problems/Possible Remedies

Recording

- *Videotape is running but there is no picture on the monitor:*
  1. Check that all components are plugged in and turned on. Make sure the lens cap is off the camera and the lens aperture is open.
  2. Check the monitor. Switch it to "TV" and try to tune in a broadcast channel; make sure the brightness and contrast controls are properly set. If you still fail to get a picture, check to see whether there is a circuit breaker on the back of the monitor that needs to be reset. If you get a picture while switched to "TV," you should then check the connection between camera and monitor.
  3. Check the cable connections from camera to recorder and from recorder to monitor.
  4. Check the settings of the switches on the recorder. Is the input selector on "Camera"? Is the "Record" button depressed?

Playback

- *Videotape is running but there is no picture or sound on monitor:*
  1. Make sure the monitor input selector is set at "VTR" and all units are plugged in.
  2. Check connectors between playback unit and monitor (e.g., make sure "Video Out" from playback is connected to "Video In" on monitor). Wiggle the end of the cable to see if there is a loose connection.
  3. Check switches on playback unit.
- *Fuzzy sound or snowy picture:*
  1. Video or audio heads may be dirty. Clean with approved tape or fluid cleaning system.
  2. Brushes under head-drum cover may be dirty or damaged. Have a technician check this possibility.
- *Picture slants horizontally across screen (the audio may also sound off-speed):* If adjustment of the horizontal hold knob does not clear up the situation, you may have a tape or cassette that is incompatible with your playback unit. Obtain a playback machine that matches the format of the tape or cassette.



© COPYRIGHT CONCERNS: OFF-AIR VIDEOTAPING

The Copyright Act of 1976 did not cover educational uses of videotaped copies of copyrighted broadcasts. A negotiating committee composed of representatives from industry, education, and government agreed on a set of guidelines for video recording of broadcasts for educational use. According to these guidelines, you may do the following:

- Ask a media center to record the program for you if you cannot do so or if you lack the equipment.
- Retain a videotaped copy of a broadcast (including cable transmission) for a period of 45 calendar days, after which you must erase the program.
- Use the program in class once during the first 10 school days of the 45 calendar days, and a second time if instruction needs to be reinforced.
- Have professional staff view the program several times for evaluation purposes during the full 45-day period.
- Make a limited number of copies to meet legitimate needs, but you must erase these copies when erasing the original videotape.
- Use only a part of the program if instructional needs warrant.
- Enter into a licensing agreement with the copyright holder to continue use of the program.

You (and media centers) may *not* do the following:

- Videotape premium cable services such as HBO without express permission.
- Alter the original content of the program.
- Exclude the copyright notice on the program.
- Record a program in anticipation of a request for use; the request to record must come from an instructor.
- Retain the program, and any copies, after 45 days.

Remember that these guidelines are not part of the copyright act but are rather a "gentleman's agreement" between producers and educators. You should accept them as guidelines in good faith.

Example: Suppose a video you frequently use drops out of the distributor's catalog; it is now "out of print." To protect the print you now have, it would seem reasonable, after unsuccessful attempts to reach the copyright owner to get permission, to copy the video and use the copy in class. If, at a later date, the title is put back on the market by the same or another distributor, you must go back to using your original copy. This is not uncommon. For example, *Pacific 231,* an effective film to demonstrate editing, was originally distributed by Young America Films. After Young America Films was purchased by another company, *Pacific 231* was dropped from the catalog. It was not available for almost 20 years. Then, Pyramid Films secured the distribution rights, and it is now available for purchase. During the period of unavailability, it would have been reasonable to use a videotaped copy.

For general information on copyright, see the Copyright Concerns on page 87 in Chapter 4. Suggested readings on copyright appear at the end of Chapter 4.

A video interface allows the user to connect analog 8-mm and VHS camcorders to a computer so you can edit video digitally regardless of its format. You can also transfer analog videotapes to digital video. Any analog video image from broadcast television, videotape, videodisc, or a video camera can be digitized and stored on a computer. You and your students can then edit the video within the computer, without using videotape editing equipment. You can also use the computer as a display device: using a digitizing camera for motion media, moving images from any of the analog sources can be displayed on the screen without being stored.

There are several methods for storing moving images in a computer. One format is *QuickTime,* for use with Apple Mac OS and Windows operating systems. Applications include *Compton's Multimedia Encyclopedia,* which incorporates *QuickTime* "movies." Students can incorporate moving images with graphics, visuals, and text for portfolios and projects. One limitation of *QuickTime* is that the moving images are shown at only 15 frames per second (full-motion video is shown at 30 frames per second), so the movement is jerky. Also, the moving image is often limited in size to about 25 percent of the monitor screen, although faster processors and higher computer memory capacities now often enable full-motion, full-screen playback.

By doing your own video productions, you can target a specific audience with specific content. The productions can be readily and easily updated. Once the equipment (cameras, computers, and software) has been purchased the production of in-house video is very inexpensive. Software for in-house video production includes Apple's *iMovie* and Avid Technologies' *Cinema* and *VideoShop.* These types of software are readily available, inexpensive (*iMovie* comes preloaded on new Apple computers), and easy to use. Very young children learn to use the software and video cameras quickly. Remember you and your students must follow copyright guidelines (see the "Copyright Concerns" in this chapter and in Chapter 4). You should be a role model!

UTILIZING VIDEO

The next step after selecting your materials is to put them into actual use in the classroom. Be sure to follow the guidelines in "AV Showmanship: Video" (page 209).

Preview the Materials

You should always preview video materials for appraisal and selection, and should also check them after they arrive in the classroom. Avoid potential embarrassment by

☑ APPRAISAL CHECKLIST

VIDEO

KEY WORDS: _____, _____, _____

Format
- ❑ **VHS**
- ❑ **Videodisc**
- ❑ **DVD**
- ❑ **Internet video**

Title _____

Series Title (if applicable) _____

Source _____

Date _____ **Cost** _____ **Length** _____ minutes

Subject Area _____

Intended Audience _____

Brief Description

Objectives

Entry Capabilities Required (e.g., prior knowledge, reading ability, vocabulary level, math ability)

Rating	**High**	**Medium**	**Low**	**Comments**
Match with curriculum	❑	❑	❑	
Accurate and current	❑	❑	❑	
Clear and concise language	❑	❑	❑	
Arouse motivation/maintain interest	❑	❑	❑	
Learner participation	❑	❑	❑	
Technical quality	❑	❑	❑	
Evidence of effectiveness (e.g., field-test results)	❑	❑	❑	
Free from objectionable bias or advertising	❑	❑	❑	
User guide/documentation	❑	❑	❑	
Pacing appropriate for audience	❑	❑	❑	
Use of cognitive learning aids (e.g., overviews, cues, summary)	❑	❑	❑	

Strong Points

Weak Points

Recommended Action _____ **Name** _____ **Date** _____

Prentice Hall grants the reader permission to reproduce this checklist for personal use only. Heinich, Molenda, Russell, and Smaldino, *Instructional Media and Technologies for Learning* (2002).

A computer version of this Checklist is available on the "Classroom Link Portfolio" CD-ROM.

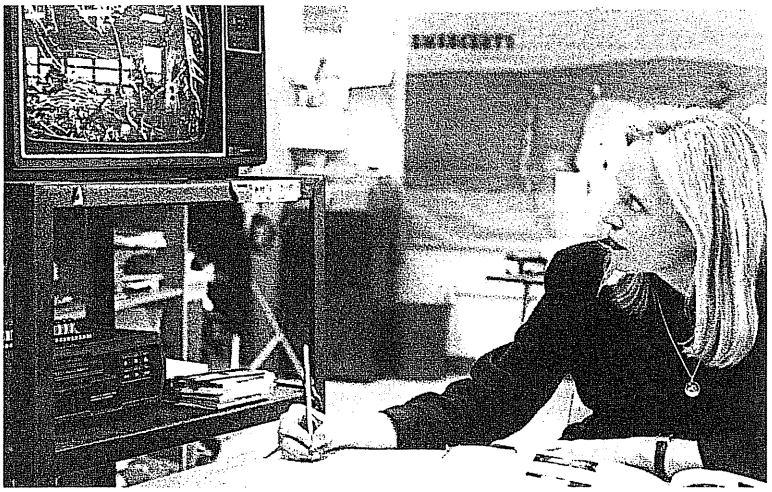


FIGURE 8.5
Previewing the material allows the teacher to properly introduce and follow up the material.

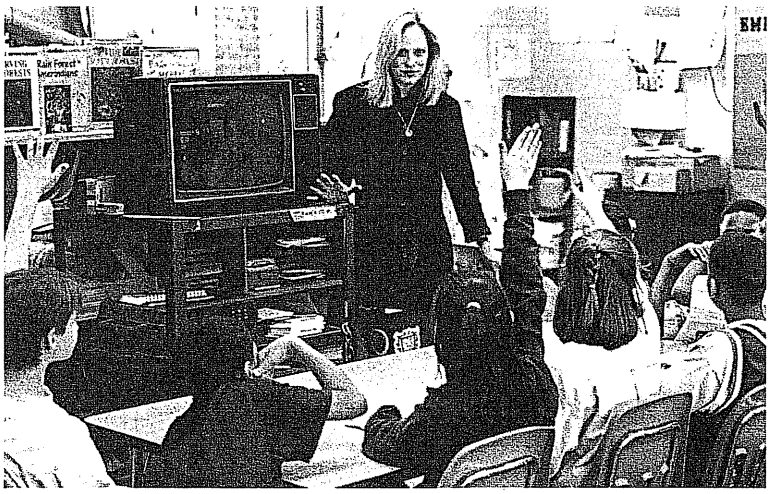


FIGURE 8.6
Class discussion can be used before and after viewing material.

making sure the material is what you ordered and that it contains the subject matter and treatment that you expected (Figure 8.5).

Prepare the Materials

You will need to schedule the video and the appropriate playback equipment. Set up and check the equipment for proper operation before the students arrive.

Decide how you are going to introduce the material and what the followup activities will be (discussion, presentation, project, etc.). Assemble or create your adjunct media and materials, such as handouts, charts, and/or visuals.

Prepare the Environment

Before students can learn from any media presentation, they first have to be able to see it and hear it! Provide proper lighting, seating, and volume control. We describe these elements in Appendix B.

Prepare the Learners

Research in educational psychology as well as the practical experiences of thousands of teachers in all sorts of settings demonstrate that learning is greatly enhanced when learners are prepared for the coming activity (Figure 8.6).



FIGURE 8.7
Video materials can be stopped to explain key points.

Before a video lesson, review previous related study. Help students see how today's lesson fits into the total picture. Create a need to know. Stimulate curiosity by asking questions, and evoke questions that students would like to have answered on the subject.

Clarify the objectives of the lesson. Mention specific things to look for in the presentation. It helps to list such cues on the chalkboard, overhead, or handout so that students can refer to them as the lesson proceeds and during followup activities. If you are presenting large amounts of new information, give students some advance organizers, or give them "memory hooks" on which they can hang the new ideas. Be sure to preview any new vocabulary as needed.

Provide the Learning Experience

Videotape recorder/players are far from standardized in their various mechanisms and modes of operation. You should therefore refer to the manufacturer's manual for information about the operating principles and procedures of the particular piece of equipment you are using. The troubleshooting guide found in "How to . . . Set Up a Single-Camera Video Production" is limited to general problems that occur with virtually any video system and that can be remedied by the nonspecialist.

Studies have shown that audiences are attentive to images projected onto a large screen. Video images can be projected using video projectors. They connect to any videocassette recorder, videodisc player, DVD player, live television, or video camera. Some models include a self-contained VHS videocassette player. Other models can also project computer-generated graphs.

Video projectors work well with large audiences (up to several hundred) and for visuals requiring a high degree of detail. Most project an image up to 4 feet by 6 feet. Other features available include built-in speakers and remote control (see "How to . . . Operate a Video Projector"). Video projectors vary in weight from about 20 pounds to 150 pounds. See the section, "Video Setups" in Appendix B for guidelines on the use of video monitors and video projectors.

Be enthusiastic about the material! Situate yourself so that you can observe learner reactions. Watch for cues indicating difficulties or boredom (Figure 8.7). Note individual reactions for possible use in the followup discussion. Deal with individual discipline problems as quickly and unobtrusively as possible.

REQUIRE LEARNER PARTICIPATION

If active participation was not explicitly built into the video program, it is all the more important to stimulate response after the presentation. The ability to generalize new knowledge and transfer it to real-life situations depends on learner practice under a variety of conditions. The possibilities for followup activities are virtually limitless. Common techniques include the following:

- *Discussion*—Question-and-answer sessions, buzz groups, panel discussions, debates
- *Dramatization*—Role playing, skits, oral presentations
- *Projects*—Experiments, reports, exhibits, models, demonstrations, drawings, story writing, bulletin boards, media productions

Learners are quick to detect and act according to your attitude toward the material. Many studies have indicated that the instructor's attitude—often conveyed nonverbally—significantly affects students' learning from media. So if students are expected to be active participants, you should lead by example.

HOW TO . . . Operate a Video Projector

OPERATION

Setup

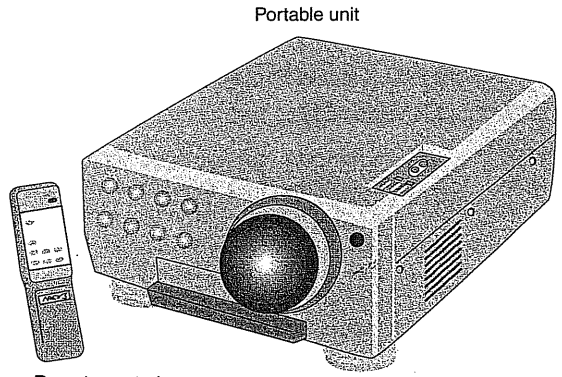
The video projector usually will be delivered to you connected to the VCR and audio amplifier.

- Check all connections.
- Turn on the power to the VCR, amplifier, and projector.
- Insert the videocassette and fast-forward for a few seconds to get into the program.

Operate

- Turn on the projector lamp and wait for it to warm up (about one minute).
- Put VCR on "Play" and adjust the size of the image using the zoom lens ring; then focus the image.
- Push the "Reset" button. The following image will be superimposed on the screen:

	+		−
Picture	_____	0	_____
Brightness	_____	0	_____
Color	_____	0	_____
Tint	_____	0	_____
Sharpness	_____	0	_____



- Correct the image for each by using the appropriate controls. The corrections will be evident in the image and will also be shown graphically on the screen.
- Adjust the sound level with the volume control of the amplifier.
- Rewind the tape to the beginning of the program. If the audience will arrive shortly, push the "Blue Screen" button. If you have to wait a while for your audience, turn off the lamp, but remember that it must first cool off before you can turn it on again.

Disassemble

- After presenting the video, rewind the tape.
- Turn off all power switches.
- Disconnect cord(s) from wall sockets.

TROUBLESHOOTING

Problems/Possible Remedies

- *No picture:*
  1. Ensure that projector and player are plugged into active AC outlet and turn power switches on.
  2. If using remote control, be sure batteries are charged and unit is within effective operating distance.
  3. Check all cords for proper connection.
- *Picture not clear:*
  1. Check focus adjustment.
  2. Adjust picture controls.
- *Picture but no color:* Check settings on video unit.
- *Picture inverted or left-right reversed:* Check settings of horizontal and vertical polarity plugs.
- *Color and picture distorted:*
  1. Check connection of leads between video unit output terminals and projector input terminals.
  2. Confirm that the signal is compatible.
- *No operation from remote control:*
  1. If using wired remote control, check to see if it is plugged into the video unit, and check connection of remote lead between the video unit and the video projector.
  2. If using wireless remote control, confirm that batteries are charged and wireless remote control is within effective operating range.

AV SHOWMANSHIP Video

The following generic tips apply to the enhancement of video presentations:

- *Sightlines.* Check lighting, seating, and volume control to be sure that everyone can see and hear the presentation.
- *Mental set.* Get students mentally prepared by briefly reviewing previous related study and evoking questions about the current topic.
- *Advance organizer.* List on the chalkboard the main points to be covered in the presentation.
- *Vocabulary.* Preview any new vocabulary.
- *Short segments.* Show only 8 to 12 minutes of a video at any one time (even shorter for younger students). Rather than showing a 30-minute video from start to finish, increase viewer learning and retention by using the following technique: Introduce the first segment and show about 10 minutes of the video, stopping at a logical breaking point. Discuss the segment and then introduce the second segment, tying it to the first. Show the second 10-minute segment and repeat the procedure. Of course, you may choose to show only part of a video. You do not have to show it all.
- *Role model.* Most important, get involved in the program yourself. Watch attentively and respond when the presenter asks for a response. Highlight major points by adding them to the chalkboard during the lesson.
- *Follow up.* Reinforce the presentation with meaningful followup activities.
- *Light control.* When using video projection with videotape or videodisc, dim the light. Turn lights off if dimming is not available. If you are using a video monitor (TV), you can use normal room lighting. Dim the lights above and behind the monitor if possible.

EVALUATE AND REVISE

You can informally assess student learning by observing performance during followup activities. Individual projects can be good indicators of successful learning. In many cases, though, more formal testing serves a valuable purpose. First, tests that are followed by feedback of correct answers can provide an efficient review and summary of the main points of the lesson. Second, objective tests can help pinpoint gaps that need to be followed up in the classroom, and can identify individuals who need remedial help. In this way, you can complement the media component by catering to individual differences in ways the media cannot.

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 8 of the Companion Website (http://www.prenhall.com/heinich).

1. *Planning Lessons Using Videos.* Plan a lesson for a subject area or standard of your choice in which you will incorporate the use of a video. Follow the outline shown in the ASSURE Blueprint in this chapter. For that video, brainstorm a variety of assessment techniques to measure student learning of the content. (ISTE NETS-T II-B; IV-A)
2. *Written Reflection.* Thinking back on your experiences when videos were used as a part of instruction, what were the benefits and drawbacks of using videos as part of instruction? What changes could have been made to maximize the experience? (ISTE NETS-T II-C & D)

INTEGRATION ASSESSMENT

To complete the specified activities online go to the Integration Assessments module in Chpater 8 of the Companion Website (http://www.prenhall.com/heinich).

1. Preview a video and appraise it using the "Appraisal Checklist: Video."
2. Observe a teacher using a video program in a classroom situation and critique his or her practices.
3. Use one or more of the video directories listed in Appendix C to compile a list of video programs available on a topic of interest to you.
4. Preview one of the videos described in this chapter. Prepare a review, either written (about 700 words) or recorded on audiotape (approximately five minutes). Briefly summarize the content and describe your reaction to it.
5. Demonstrate your ability to use the steps to utilize video effectively in a lesson.
6. Set up, operate, and troubleshoot a video player/recorder and a video projector.

Elementary School Social Studies

The teacher wishes to introduce his students to the Panama Canal. Many students have never heard of it. He wants to show his students what it looks like, so he selects a videotape.

Analyze Learners

General Characteristics

This urban elementary school class is self-contained, with 29 fifth graders (16 girls, 13 boys). The average age is 11 years; the average reading level is fourth grade.

The class has an ethnic and racial mixture typical of an urban setting, with socioeconomic status being lower middle class. Seventeen come from single-parent families. Motivation is usually a challenge with this class.

Entry Competencies

Regarding today's topic, the Panama Canal, awareness is low. In yesterday's discussion of Central America, only Nicaragua and El Salvador were mentioned without prompting. There is an old barge canal on the north side of town, so many students were able to identify canals as human-built waterways but were vague about their purposes.

Learning Style

Learning styles are varied in the class. Most students do not like to read and have very low comprehension when they do. They do enjoy viewing videotapes and tend to remember what they see and hear. They have very good human interaction skills and enjoy discussions.

State Objectives

The fifth-grade social studies students will be able to do the following:

1. Locate the Panama Canal on a wall map of North and South America.
2. Explain the main advantage of the Panama Canal as a shortcut between the Atlantic and Pacific oceans.
3. Visually recognize a canal, distinguishing it from other waterways.
4. Discuss the Panama Canal's historic importance, citing at least its commercial and military advantages and the achievement of overcoming the obstacles to its construction.
5. Demonstrate that they value the cooperative effort represented by the building of the Panama Canal by participating actively in a group project.

Select Methods, Media, and Materials

The teacher decides to begin the class with a large-group discussion, then show a video, and follow up with small-group discussion and projects. He surveys the *Educational Film/Video Locator* under the topic "Panama Canal" and finds four titles that look promising. Two of these are in the school district media library. After previewing both, he selects one because its content and vocabulary come closest to the level of his class. He notes that the political description of Panama is no longer accurate, so he prepares some comments to correct it.

Utilize Media and Materials

Because motivating interest is predictably difficult, he begins to stimulate students' curiosity by rolling down the wall map of North and South America and asking how a traveler in the days before airplanes and automobiles might get from New York to San Francisco. What if you were a merchant who wanted to ship tools and work clothes to the miners of the gold rush in Alaska in 1898? What if you were an admiral needing to move his fleet rapidly from the Atlantic to the Pacific?

Having identified the problem, the teacher states that the video is going to show the solution developed early in the twentieth century. He lists several key questions on the overhead projector.

After reviewing the questions by having students take turns reading them, he asks them to look for the answers to these questions while viewing the video. He has cued the videotape to the most relevant part and then shows just 15 minutes that relate to the problem.

Require Learner Participation

After showing the video, the teacher divides the students into groups of three to discuss the questions. Each group elects a recorder who will write the answers agreed to by the group.

After a few minutes of discussion the teacher brings the whole class back together in a large group and calls on two or three recorders to give their answers to question 1, with the whole class reacting to these. He repeats this process for the rest of the questions.

The teacher concludes by going back to question 3, focusing on how the builders of the canal succeeded because of their systematic plan and determination to overcome all obstacles. If we were going to construct a display to tell the story of the Panama Canal, what steps would we have to carry out? What ideas would we put into our display? With questions such as these the teacher builds interest in constructing a display, works out a timeline, and organizes students into groups to carry out the assignment.

Evaluate and Revise

The teacher collects the recorders' written notes and checks to see how accurately the questions were answered. He makes note of test items keyed to the objectives to be included on the written test at the end of this unit. As students work on the display project, he will be able to check the accuracy of the information being put into the display and, regarding the affective objective, will circulate among the work groups to assess the enthusiasm exhibited in their work.

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

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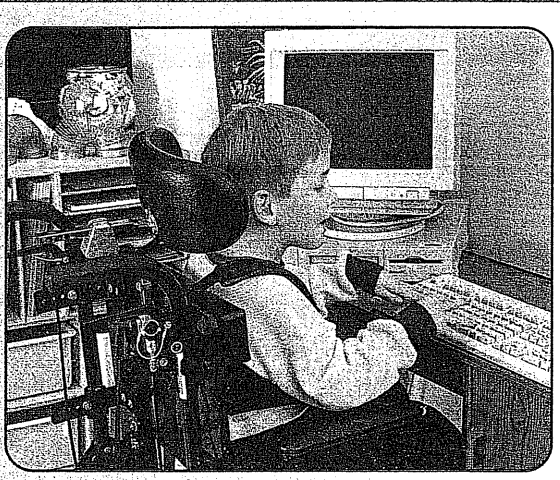
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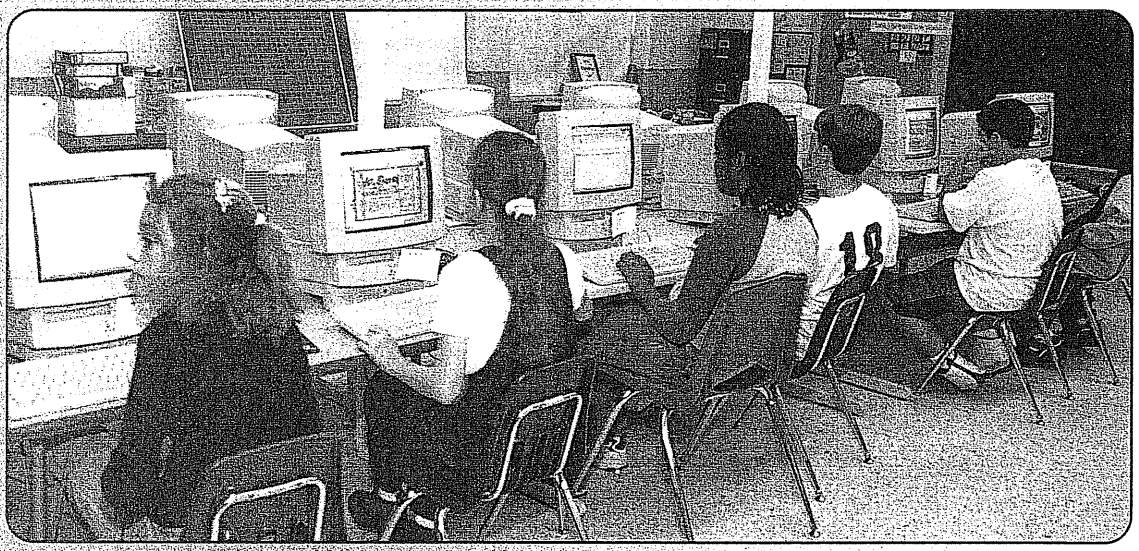
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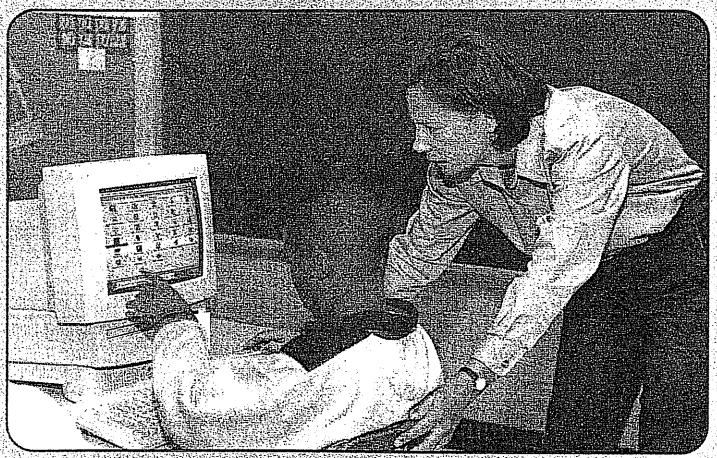
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Since the advent of the personal computer in the mid 1980s, computers have rapidly become one of the key instructional technologies used in both formal and informal education. Teachers can use the computer as an aid to managing classroom activities; it has a multitude of roles to play in the curriculum, ranging from tutor to student tool. To make informed choices, you need to be familiar with the various computer applications—games, simulations, tutorials, problem-solving programs, word processing, graphic tools, and integrated learning systems.







It is extremely important to develop critical skills in appraising instructional software because there are so many available programs. The hardware, too, becomes much less intimidating when you know some of the basic terminology. Whether you teach with a single computer in the classroom or a roomful of them, these basic guidelines will help you make optimal use of them.

CHAPTER 9

Computers

OUTLINE

Roles of Computers in Learning
Integrating Computers into the Curriculum
Integrated Learning Systems
Software Selection
Computer Hardware
Computer Facilities

KNOWLEDGE OBJECTIVES

1. Distinguish between *computer-assisted instruction (CAI)* and *computer-managed instruction (CMI)*.
2. Create examples of the role of the computer as an object of instruction, as a tool, as an instructional device, as a means of teaching logical thinking, as a media center resource, and as a performance support.
3. Discuss the advantages and limitations of the use of computers in learning.
4. Describe techniques for and examples of integrating computers into the curriculum.
5. Compare and contrast the six types of computer-assisted instruction in terms of the role of the computer and the role of the learner, including a specific example of courseware for each.
6. Describe two applications, two advantages, and two limitations of integrated learning systems.
7. Outline the process and materials needed for selecting and integrating computer-based programs.
8. Identify five criteria besides cost that are important considerations in purchasing a computer for instructional purposes.
9. Discuss the difference among a one-computer classroom, a multiple-computer classroom, and computer laboratories in terms of setups and uses.

LEXICON

computer-assisted instruction (CAI)
computer-managed instruction (CMI)
software
database
performance support system
lab pack
site license
integrated learning system (ILS)
hardware
read-only memory (ROM)
random access memory (RAM)
byte
bit
kilobyte (Kb)
megabyte (Mb)
gigabyte (Gb)
terabyte (Tb)
removable-storage device
CD-ROM (compact disc–read-only memory)
computer classroom
computer laboratory

The computer provides virtually instantaneous response to student input, has extensive capacity to store and manipulate information, and is unmatched in its ability to serve many students simultaneously. It has become a tool of choice in instruction. The computer's role has changed because of its ability to provide rich learning experiences for students, giving them the power to influence the depth and direction of their learning. It has the ability to control and integrate a variety of media—still and motion pictures, graphics, and sounds, as well as printed information. The computer can also record, analyze, and react to student responses typed on a keyboard or selected with a mouse (Figure 9.1).

There are two major applications of computers in instruction: **computer-assisted instruction (CAI)** and **computer-managed instruction (CMI).** In CAI students interact directly with the computer as part of the instructional activity. This may be in the form of material presented by the computer in a controlled sequence, such as a drill-and-practice program, or as a student-initiated creative activity, like a desktop-published book of student poems. In CMI the computer helps both instructor and students in maintaining information about students and in guiding instruction. That is, the computer can organize and store easily retrievable information about each student and about relevant instructional materials. Learners may take tests on the computer or input information into a personal portfolio. Further, the computer can diagnose the learning needs of students and prescribe optimal sequences of instruction for them.

In addition, the computer can be an object of instruction, as in courses on computer science and computer literacy. It also is a tool that can be used during instruction to do complex calculations, data manipulations, word processing, and presentations.

FIGURE 9.1
Computers have become pervasive in education and training. Most learners have access to and are influenced by computer-based instruction.



ROLES OF COMPUTERS IN LEARNING

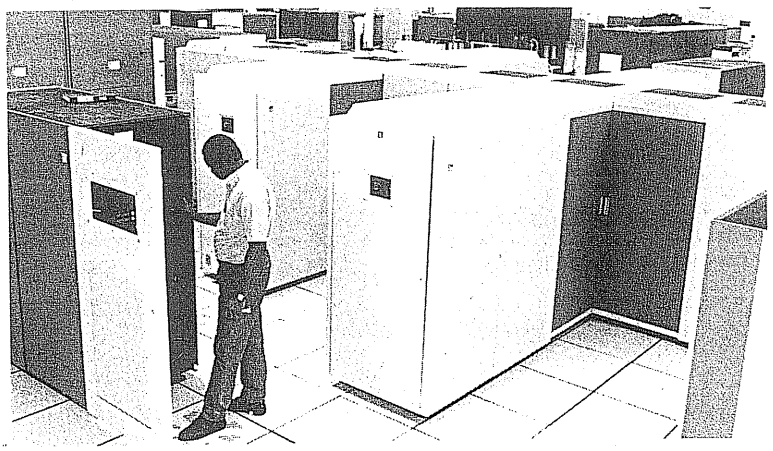
Continual advances in microprocessor technology have allowed today's devices to greatly surpass their predecessors in speed, flexibility, and raw computational power (Figures 9.2 and 9.3). The potential uses of computers in educational settings go far beyond direct instruction. One function is administrative—keeping school records, scheduling classes, doing payroll, and managing student assessment data. Another is service oriented, as when guidance programs use computers to deliver career planning assistance. In the domain of instruction there are four broad classes of computer applications:

- As an object of instruction
- As a tool
- As an instructional device
- As a means of teaching logical thinking

FIGURE 9.2
Innovative computer systems such as Palm V have helped popularize the use of microcomputers in business and at home.



FIGURE 9.3
The mainframe computer with its massive components was the norm before the advent of the microcomputer.



Within each of these categories, the role of the computer is varied and extensive.

Object of Instruction

The computer may itself be the object of instruction. For example, in computer literacy courses students learn about computers, and in vocational courses students learn to use computers on the job for data processing and analysis purposes. In this role, the computer is treated like any other machine one is learning to use.

When a learner is studying computer programming, the computer and the associated **software** (programs and applications) are the objects of instruction. The various programming languages and the techniques for constructing a program using these languages are beyond the scope of this book.

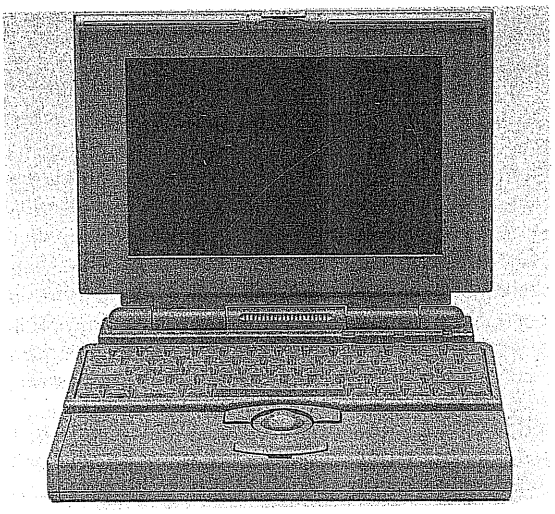
Tool

In its role as a tool, the computer assists both teachers and students. Some of the roles of the computer are relatively simple, such as a sophisticated calculator and typewriter. Other roles are more advanced, such as multimedia composer, presentation aid, communication device, and data retrieval source. Whatever the reason for using the computer, as a tool it has become indispensable (Figure 9.4).

Traditionally, computers were used for reinforcing traditional instruction. The software was designed to provide direct instruction or practice to students, often programmed to branch to other segments of the lesson based on student responses. Many of these types of programs are still in use today.

In an effort to recognize the constructive nature of learning, current methods are based on engaging students in learning in such ways that allow them to develop, or construct, their own mental structure (schemata) in a particular area of study (Figure 9.5). To engage students

FIGURE 9.4
Computers have become indispensable educational tools.



in this type of learning, the environment must provide them with materials that allow them to explore. Papert's "microworlds"—environments that permit students to freely experiment, test, and invent—allow students to focus on a problem area and to create solutions that are meaningful to them (Papert, 1982, 1993). Many computer software packages are available to create such learning environments and assist students in constructing their schemata. Programs such as *Inspiration* (see the "Media File" on p. 223), a cognitive mapping program, facilitate the construction of concept maps, providing students with the means to relate the information to their lives and to alter those relationships as they continue to explore. Other programs, such as *HyperStudio* (discussed in Chapter 10), permit students to develop files of data that are related in meaningful ways.

FIGURE 9.5
As a tool, the computer can be useful to students as they search for new information.

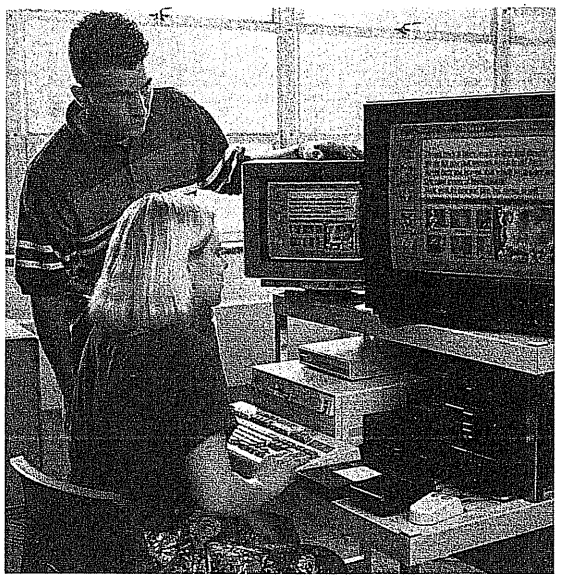
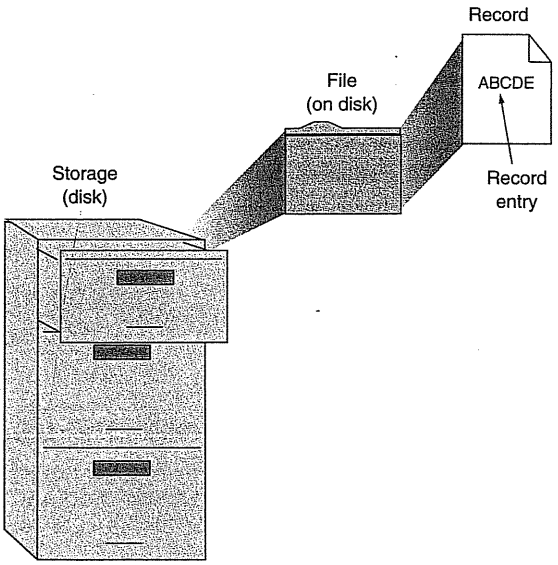


FIGURE 9.6
A database is used to organize information so the user can easily sort, rank, calculate, and store it.



Writing. Computers are being used widely for word processing and desktop publishing. Most students have access to word processing programs with which they complete term papers and assignments. Some students create multimedia term papers, integrating such media as graphics, sound, and motion for a more complete presentation. Presentation software, which incorporates the computer with video projection, can be used for student presentations. Computers also allow students to communicate with others around the world via e-mail (electronic mail; discussed in Chapter 11).

Calculating. The computer can also serve as a tool during instruction. Learners can use them to solve complex mathematical calculations, as a pocket calculator is used, but with increased power and speed. Any computer can analyze data, perform repeated calculations, or even gather data when hooked up to laboratory equipment.

Retrieving Information. Today's students need to learn to manage information—to retrieve, sort, and organize it—and to evaluate their findings. For inquiry and research, students can use a **database,** a collection of related information organized for quick access to specific items. Whereas a telephone book is a printed database, databases can also be stored in a computer (e.g., a computer database can include a list of telephone numbers by name or company). A database is a versatile and easy-to-learn computer tool. It can be thought of as an electronic file cabinet (Figure 9.6).

There are two types of databases. Classroom databases are created by students. For example, students can design information sheets and questionnaires, collect data, input relevant facts, and then retrieve data in a variety of ways. The facts selected might include student information, book reports, or sample math problems. Having constructed databases as part of their research, students are in a position to engage in higher-level thinking skills as they analyze and interpret the data.

Another type of database is the commercial database. These are either purchased on disks or CD-ROMs or accessed via either telephone hookup to a computer in another location or on the Internet (see Chapter 11). For example, *Fifty States,* a database on disk, contains information such as population, capital, area, major rivers, and state bird, flower, and tree for all the states in the United States. Several companies have developed database materials for use in the classroom. Other larger computer databases are available online and via telephone and contain medical information, historical data, census figures, and the like.

Instructional Device

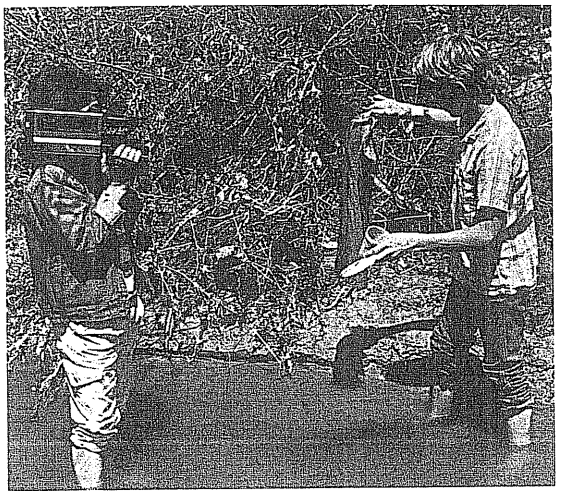
Computer-assisted instruction (CAI) helps students learn specific skills. For example, *Math Blaster Plus* assists students in learning math facts (addition, subtraction, multiplication, and division) through drill-and-practice using an arcade game format. Software is now capable of providing students with complex tasks to engage them in

CLOSE-UP

IT ALL STARTED WITH A BAD SMELL

A school in Ann Arbor, Michigan, had a small park with a stream next to its property. A distinct odor was rising from the stream and people were beginning to complain. A trio of science teachers decided to integrate their classes and present their students with the problem of the smelly stream. They introduced students to the scientific inquiry model and provided them with an array of technologies that could help them analyze and hypothesize. Soon, as groups of students worked together, solutions to the problem of the bad odor began to materialize. Further, the students began to investigate the source of the problem and initiated community action to alleviate it. The success ensuing from this reorganization of the science classes and integration of technologies demonstrated to the administration that problem-based learning is a constructive and beneficial way for students to learn.

Source: Hi-C Research Group, University of Michigan (http:ai.eecs.umich.edu/highc/)



real-world problems. Programs such as *National Inspirer* ask students to engage in activities related to geography. Video technologies can easily be incorporated, focusing attention on tangible examples. Word processing, graphics, and a host of computer software help students organize and communicate their ideas.

Summaries of research with students at various levels—elementary, secondary, college, and adult education—show that computer-based instruction generally has positive effects on student achievement. One set of summaries by James Kulik and his colleagues (1986) concluded that, on the average, computer-based instruction assisted students in raising their achievement test scores by 10 to 18 percentage points compared with conventional instruction.

Teaching Logical Thinking

Seymour Papert, in his 1982 book, *Mindstorms,* and again in his 1993 book, *The Children's Machine,* suggests that the computer should be an "object to think with," not a dispenser of information. Using LOGO, a procedural language that was designed for learners, students can learn about the complexity of mathematics within their daily lives. Children can build and test theories about mathematics. Beyond the nature of the computer language itself, there is an underlying educational philosophy based on the concept that learners need to manipulate their environment in order to understand the concepts they are exploring. They begin to explore mathematics, seeing relationships between it and other daily activities. Papert suggests that when students have the opportunity to use programs such as LOGO, they begin to develop "powerful ideas" and, in doing so, begin to develop a sense of mastery over their learning environment.

Because LOGO is very easy to learn, many believe that it is a children's computer language. Yet it is a very sophisticated language, capable of engaging even the expert computer programmer. LOGO is attractive even to younger learners because they find the problem-solving activities to be challenging.

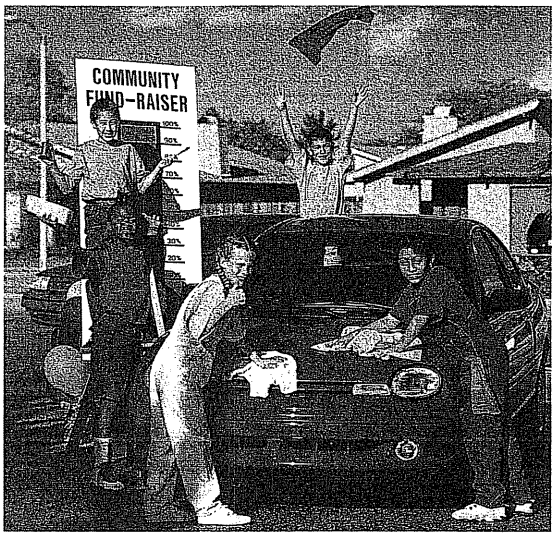
Computers in the School Library Media Center. There are many types of applications of computers in schools today. Nearly all school library media centers have at least one station that is designated for database searches using CD-ROMs and the Internet. Among the types of materials available are encyclopedias and research databases.

CD-ROM encyclopedias can be complete and unabridged. These appear to be similar to the bound-book format familiar to most students. The advantage of the CD-ROM encyclopedia is that it allows options within the search process. For example, when a student wants to search for information about Queen Elizabeth I, the encyclopedia is a natural place for the student to begin the search. In the traditional bound-book format, the student might choose the "E" volume and look up "Elizabeth, Queen" and that might be the extent of the search. However, with the CD-ROM version of the encyclopedia, when the student types in "Elizabeth," a large menu of choices is displayed on the screen, including "Shakespeare," "Spanish Armada," "Philip II of

CLOSE-UP

A RURAL COMMUNITY BUILDS ITS FUTURE

Teachers in the Traer, Iowa, school district collaborated to provide the students in this rural community with many educational advantages. They carefully examined the school curriculum and looked closely at its articulation. Starting with nothing, they purchased technology and integrated it into the curriculum where appropriate. Together, teacher and students conducted community fundraisers and attended school board meetings to bring about change and to increase the amount of technology available to students in the school. Today, students have ready access to the school's rich array of resources through a school-wide network and several computer labs, as well as access to resources outside the school walls through America Online™. Now students can use these technology-rich resources to enhance their learning by using online databases and word processing to complete assignments.



Spain," and "England's colonial empire." Kenilworth might even be shown because of its retelling of the legend of Sir Walter Raleigh. Also, each of these options is linked not only with "Queen Elizabeth I" but also with each other. The student is thus encouraged to explore the interrelationships between people, places, and events.

Most CD-ROM encyclopedias include color photographs, animation, and sound (Figure 9.7). Thus, a student searching for information about lions would not only be able to find text-based information but also could view a photograph or short video clip about lions and hear a lion's roar. These encyclopedias tend to be abridged because of the large memory requirements of graphics and video (CD-ROM seems to have limitless capacity, but visuals and audio use a large amount of memory).

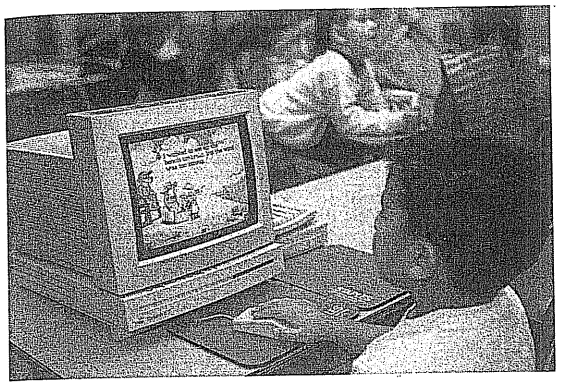
FIGURE 9.7
Multimedia feature a point-and-click approach, allowing the user to move around within an information database such as an encyclopedia.



In addition to encyclopedias, other types of books are being produced on CD-ROM, such as the Arthur series from Living Books. Discis Books was one of the earliest companies to produce such classics as Beatrix Potter's *Peter Rabbit* and Edgar Alan Poe's *The Tell-Tale Heart* on CD-ROM discs (see "Media File: *The Tell-Tale Heart*" in Chapter 10). These books not only appear as a text with pictures but are also interactive. The student who is having difficulty with a particular word on a page can point and click on that word and get it pronounced or even defined. Further, if the student's reading skills are weak, the whole story can be read by the computer. A child's voice reads many of the stories; for others, a pleasant adult voice reads the story. In the case of *The Tell-Tale Heart,* the student can experience two different readers' interpretations, thus gaining even further insight into Poe's short story. Background music or other sounds enhance the pleasure of reading. Many of the discs come with two audio tracks—one in English and the other in a designated language, such as French.

These CD-ROM books provide additional help to you as a teacher. A list can be maintained of all the words that a student identified while reading. You can quickly glance at the list and determine the vocabulary words for which that student might need assistance. Further,

FIGURE 9.8
Students can enjoy books on CD-ROM.



comprehension and reading analysis questions are presented to students for independent study of the story. Along with the questions are suggestions for the types of responses they might consider. You might use these aids to inspire students to explore other answers to those or similar questions (Figure 9.8).

In the classroom, you might find that CD-ROM books are essential to use with students who are having difficulty with the assigned reading. Another possible application might be to provide students with CD-ROM books to supplement their reading and writing experiences. Using a CD-ROM story such as *Just Grandma and Me,* you may have students write their own version of the story. Or, without finishing the story in class, the students could try to write their own endings. Think of the potential vocabulary development and creative writing experiences these might provide for your students.

As instructional activities employ a wider variety of media and printed materials (other than regular textbooks), the task of keeping track of the ever-increasing supply of materials becomes more demanding. Many courses of instruction use booklets and worksheets. The computer can keep a record of the number of such items on hand and signal you when additional copies are necessary. In some cases you can store the text of the booklets and worksheets in the computer and print copies on demand.

You can use the computer to access lists of materials available in your media center. Using the Internet, you also can access other databases, including materials available in nearby public and university libraries.

With increased concern for efficient allocation of limited funds and other resources, the computer is a handy tool for developing budgets and keeping records of expenditures. Many instructors store in their computer a list of desired materials and equipment for future purchase. As funds become available, they may quickly generate a request for these materials, along with necessary purchasing information.

Performance Support Systems. In the world of work, an educational and training concept borrowed from Japanese manufacturing is *kanban,* or "just-in-time training." Rather than teaching people many skills and much knowledge that they might use in the future, just-in-time training delivers knowledge and expertise when workers need it. At the heart of this type of training is the use of performance support systems on the job.

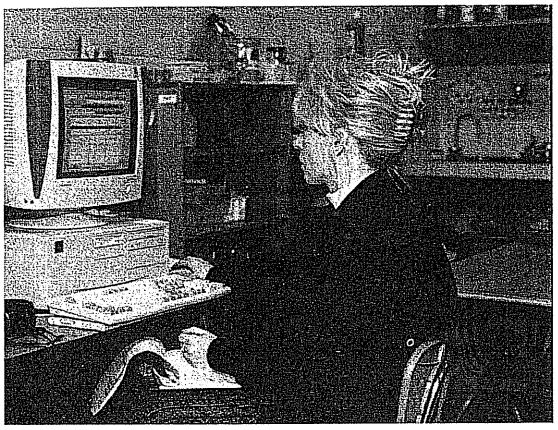
A **performance support system** uses a variety of online aids both to improve current job performance and to plan further career development. Computer-based systems allow access to specific reference documents when they are needed and may even advise workers if they are having difficulties on the job. The consequence of just-in-time training is that it changes the role of formal education from teaching content to having students learn how to learn. Raybould (1990) describes an electronic performance support system that improves worker productivity by providing on-the-job access to integrated information advice and learning experiences.

In the introduction to their book *Future Work,* Winslow and Bramer (1994) discuss the emergence of Integrated Performance Support (IPS) systems. They believe that, "above all, Integrated Performance Support anticipates the next phase of the world economy: the movement from an information economy to a knowledge economy. Here, the basic economic resource will not be capital, not labor, nor natural resources, but rather knowledge" (p. 4). IPS systems support worker performance with knowledge whenever and wherever a worker needs support. They may include advice, tools, reference, and training provided to workers at their work location at the moment of need. Using performance support systems, workers will take a fraction of the time to reach basic proficiency levels. Employees will be able to meet customer expectations because the knowledge they need to respond to a customer's request is right there at their fingertips. The result will be more satisfied customers. Future workers, while they are still in school, will need to learn how to effectively and efficiently use performance support systems.

Advantages

- *Learner control.* Computer-based instruction allows students some control over the rate and sequence of their learning (individualization). High-speed personalized responses to learner actions yield a high rate of reinforcement.
- *Special needs.* Computer-assisted instruction is effective with special learners—at-risk students, students with diverse ethnic backgrounds, and students with disabilities. Their special needs can be accommodated and instruction proceeds at an appropriate pace.

FIGURE 9.9
Computerized gradebooks are an easy and convenient way for teachers to manage student information.



- *Record keeping.* The record-keeping ability of the computer makes individualized instruction feasible; teachers can prepare individual lessons for all students (particularly mainstreamed special students) and monitor their progress (Figure 9.9).
- *Information management.* Computers can cover a growing knowledge base associated with the information explosion. They can manage all types of information: graphic, text, audio, and video. More information is put easily at the instructor's disposal.
- *Diverse experiences.* Computers provide diverse learning experiences. These can embody a variety of instructional methods and can be at the level of basic instruction, remediation, or enrichment.
- *Communication precision.* One serendipitous effect of working with computers is that they literally force us to communicate with them in an orderly and logical way. The computer user must learn to communicate with explicit, exact instructions and responses.

Limitations

- *Copyright.* The ease with which software can be duplicated without permission has inhibited some commercial publishers and private entrepreneurs from producing and marketing high-quality instructional software (see "Copyright Concerns" on page 222).
- *High expectations.* Users, both learners and teachers, may have unrealistic expectations for computer-based instruction. Many view computers as magical and expect learning to happen with little or no effort, but in reality (and as with all other learning tools) users derive benefits proportional to their investments.
- *Limited range of objectives.* Currently, computers are used to teach only a limited range of objectives. Most computer-based instruction does not teach effectively in the affective, motor, and interpersonal skills domains. Even in the cognitive domain, current programs tend to teach at the lower levels of knowledge and comprehension.
- *Controlled environment.* Creativity may be stifled in computerized instruction. The computer is slavish in its adherence to its program. Creative or original learner responses will be ignored or even rebuked if the program's designer has not anticipated such possibilities.
- *Lack of social interaction.* Computer-based instruction often lacks social interaction. Learners tend to work on their own at a computer, and there may be little if any face-to-face interaction with teachers or other learners.
- *Novelty effect.* The novelty associated with CAI in its earlier days has decreased. As learners have become more familiar with computers in the home and the workplace, the newness of the computer experience has worn off and may now have less motivational value.

INTEGRATING COMPUTERS INTO THE CURRICULUM

Putting computers in classrooms is only part of the task. The ultimate value of technology in education and training depends on how fully they are integrated into the curriculum. Instructors need a framework for using computer technology that covers a variety of learning styles and accommodates varied teaching methods (Figure 9.10). Most important, results need to be measurable against a clear set of goals and objectives—the second step in the ASSURE model. In classrooms where computer technology is integrated successfully, students use it with the same ease with which they use books, maps, pencils, and pens. In technology-rich classrooms students and teachers engage in problem solving, cultivate creativity, collaborate globally, and discover the value of lifelong learning.

More emphasis is placed on providing opportunities for problem solving and cooperative learning methods. With increasing ease of use, the computer is becoming a more natural tool to use in these types of learning situations. Software is now available to provide students with experiences in working together to solve complex problems. Often students incorporate several different types of applications to explore a problem situation. For example, when assigned to prepare a report on ecology, a group of students used computer databases to search for resources they could use in their report. They sent e-mail messages to people in several locations requesting information. They used database and spreadsheet

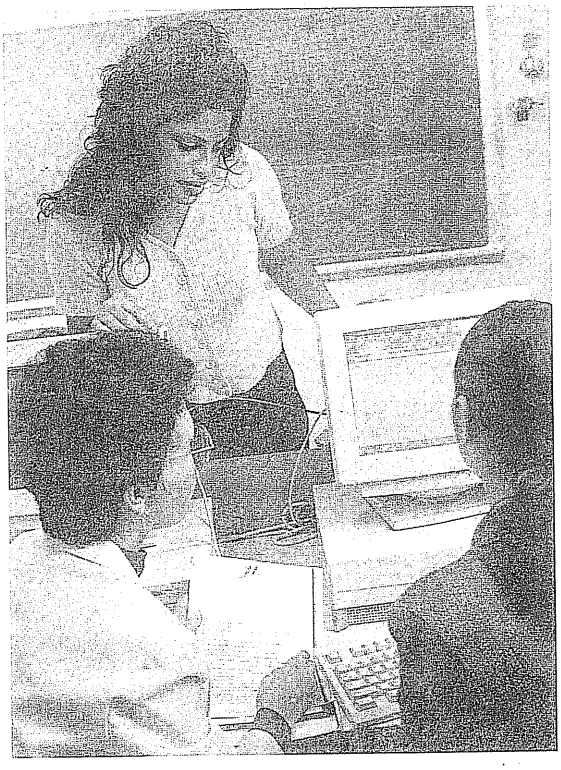
HOW TO . . . Integrate Computers into the Curriculum

- Content must balance fundamental skills with higher-order thinking and match curriculum standards.
- Content must be stimulating and draw students into learning.
- Content should offer interdisciplinary, multisensory paths to learning and help students to find not just one answer to a problem, but a range of solutions.
- Content should be readily available whenever and wherever it is needed—in the classroom, on field trips, at home, or in the community.
- Content should take students beyond mere facts and teach them to assess information and draw independent conclusions.
- Students should not be simply users of content. They should be creators of content and builders of knowledge.

programs to store and sort their information (Figure 9.11). For their report they used a word processor and a hypermedia program to prepare written material and used a data projector to display for their classmates the information they had collected about the topic.

The procedure for educating students has shifted from providing them with information to opening doors for them to explore topics and to create meaningful learning experiences for themselves. Computer technology has been avidly incorporated into this process. The implication is that educators are moving away from the idea of school as a place to get knowledge to the view that *school is a place to learn how to learn.* The example of the students working on an ecology report is not new in the school curriculum, but the approach certainly is. The challenge for you as a teacher is to provide opportunities for all students to use technology in meaningful ways to accomplish learning tasks. This may mean that you select specific software for individual students—for example, to practice specific math skills or to search online databases.

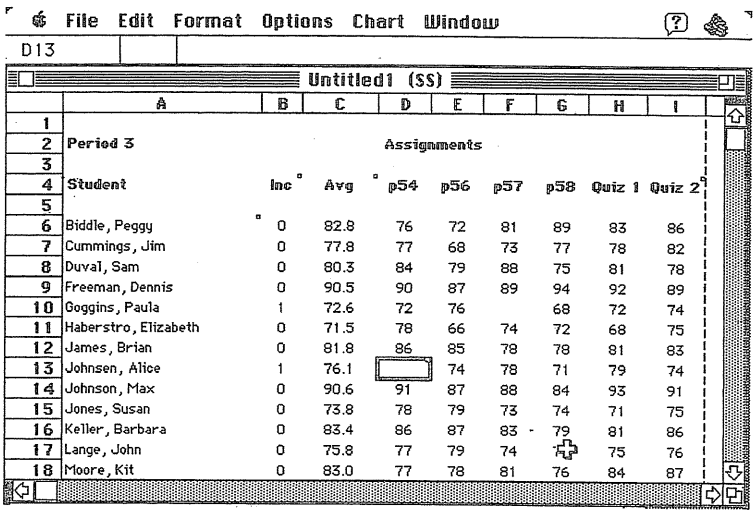
FIGURE 9.10
To ensure good utilization of computers in the curriculum, teachers need continued inservice training.



You should be a model user of computer software for your students. Students will quickly notice if the teacher makes illegal copies of programs and doesn't follow copyright guidelines. Remember, actions speak louder than words. (See "Copyright Concerns" on page 222.) Also check with your technology coordinator, library media specialist, and/or principal for specific guidelines for your school. In general, you or your school may make *one* archival or backup copy of a copyright computer program. The backup may be used *only* to make another copy if the original is damaged or lost. Only one copy may be used at a time. You may *not* make multiple copies of a copyrighted program without permission of the copyright holder. Some programs, depending on licensing, may be used on a computer network within your school. Be sure to check the licensing arrangements for each piece of software. If in doubt, ask! Ignorance is no excuse!

Most pieces of software list the rights and limitations of their use on the container or in documentation that accompanies the program. A program may not be put on multiple computers in a classroom or laboratory unless specifically licensed to do so. Most software may only be used on one machine at a time. Your school usually pays more for software that may be used on multiple computers simultaneously. A **lab pack** specifies the number of simultaneous uses of the software, usually 5 or 10. A **site license** allows a school or a school district to make unlimited copies of the program or to put the software on a server for multiple uses by students and teachers. A site license costs more but provides greater flexibility in software use.

FIGURE 9.11
A spreadsheet is a page of rows and columns that displays word, numeric, and formula entries. A spreadsheet can be used to record, average, and manipulate data.



	A	B	C	D	E	F	G	H	I
1									
2	Period 3			Assignments					
3									
4	Student	Inc	Avg	p54	p56	p57	p58	Quiz 1	Quiz 2
5									
6	Biddle, Peggy	0	82.8	76	72	81	89	83	86
7	Cummings, Jim	0	77.8	77	68	73	77	78	82
8	Duval, Sam	0	80.3	84	79	88	75	81	78
9	Freeman, Dennis	0	90.5	90	87	89	94	92	89
10	Goggins, Paula	1	72.6	72	76		68	72	74
11	Haberstro, Elizabeth	0	71.5	78	66	74	72	68	75
12	James, Brian	0	81.8	86	85	78	78	81	83
13	Johnsen, Alice	1	76.1		74	78	71	79	74
14	Johnson, Max	0	90.6	91	87	88	84	93	91
15	Jones, Susan	0	73.8	78	79	73	74	71	75
16	Keller, Barbara	0	83.4	86	87	83	79	81	86
17	Lange, John	0	75.8	77	79	74		75	76
18	Moore, Kit	0	83.0	77	78	81	76	84	87

Computer systems can deliver instruction directly to students by allowing them to interact with lessons designed especially for the assigned task. As mentioned earlier, this type of teaching tool is referred to as *computer-assisted instruction (CAI)*. The possibilities can be discussed in terms of the various types of available software and the instructional methods used. These types of software have been changing over time, allowing for more flexibility and complexity while giving students more freedom to learn.

Concept Processing

When engaged in thinking, students explore the possible connections between related ideas. Often they employ a technique referred to as *concept mapping*. Ideas about a topic are linked, forming a complex web of interrelated thoughts. Software packages such as *Inspiration* are designed to facilitate this process (see "Media File"). Students map their ideas in boxes on the computer screen—moving the idea boxes, connecting them,

© COPYRIGHT CONCERNS: COMPUTER SOFTWARE

Congress amended the Copyright Act to clear up questions of fair use of copyrighted computer programs. The changes defined the term *computer program* for copyright purposes and set forth permissible and nonpermissible use of copyrighted computer software programs. According to the amended law, with a single copy of a program, you may do the following:

- Make one backup or archival copy of a computer program; also, you may use a "locksmith" program to bypass the copy-prevention code on the original to make the archival copy.
- Install one copy of the program onto a computer hard drive.
- Adapt a computer program from one language to another if the program is not available in that language.
- Add features to a copyrighted program to make better use of the program.
- Adapt a copyrighted program to meet local needs.

Without the copyright owner's permission, you may *not* do the following with a single copy:

- Make multiple copies of a copyrighted program.
- Make additional copies from an archival or backup copy.
- Make copies of copyrighted programs to be sold, leased, loaned, transmitted, or given away.
- Sell a locally produced adaptation of a copyrighted program.
- Make multiple copies of an adaptation of a copyrighted program even for use within a school or school district.
- Put a single copy of a program onto a network without permission or a special site license.
- Duplicate the printed copyrighted software documentation unless allowed by the copyrighted program.

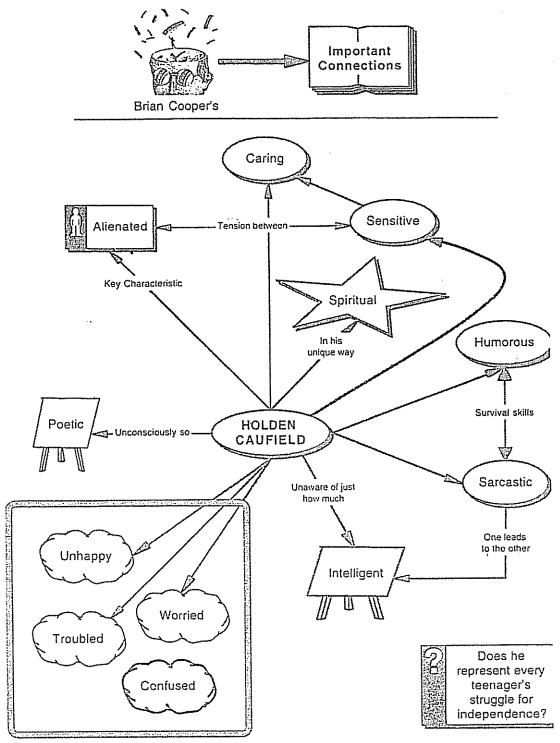
These guidelines seem to be reasonable while still protecting the proprietary rights of copyright holders. In fact, the guidelines are more liberal than those affecting the use of audiovisual materials.

For general information on copyright, see the Copyright Concerns on page 87 in Chapter 4. Suggested readings on copyright appear at the end of Chapter 4.

MEDIA FILE

Inspiration

Concept-Processing Program



Source: Inspiration Software, Inc.

Inspiration is a software package that facilitates brainstorming, concept mapping, and planning. It creates a visual diagram of the ideas generated by an individual or group. Use the program to create overviews, presentation visuals, and flow charts. It is designed to help younger students develop skills in concept mapping. Once their thoughts have been visualized, *Inspiration* easily converts the concept map into a word processing outline.

matching them with other ideas, and ultimately creating a graphic representation of their ideas. The program allows students to weigh the importance of each of the concepts mapped. Further, *Inspiration* will convert the concept map into a formal outline to help students in their writing.

Drill-and-Practice

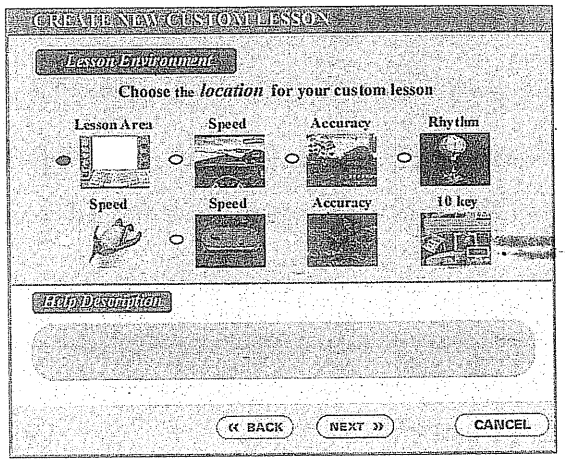
Drill-and-practice programs lead learners through a series of examples to increase dexterity and fluency in a skill. The computer does not display impatience and goes ahead only when mastery is shown. Drill-and-practice is used predominantly for math drills, foreign language translation, vocabulary building, and the like. For example, the program *Sentences* lets learners practice sentence construction.

Drill-and-practice programs provide a variety of questions with varied formats. The student is usually allowed several tries before the computer presents the correct answer. Several levels of difficulty can be available within the same drill-and-practice program. The program gives correction, remediation, or encouragement as appropriate.

MEDIA FILE

Mavis Beacon Teaches Typing

Tutorial Program



Source: Software Toolworks: Mindscape.

Mavis Beacon Teaches Typing teaches the learner to keyboard. Included are carefully guided instructions at each level, as well as practice opportunities to improve speed and accuracy. Graphics, charts, and appearances by Mavis herself encourage novice typists to continue to work on their skills. Progress records are maintained for each learner, providing the teacher with information and allowing the learner to resume following an interruption in the instruction.

Tutorial

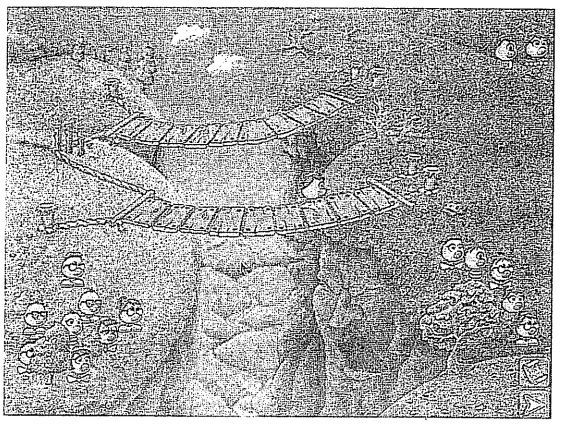
In the tutorial role, the computer acts as the teacher. All interaction is between the computer and the learner. An example is *Mavis Beacon Teaches Typing,* which guides students to learn touch typing skills (see "Media File").

In this method, the pattern followed is basically that of branching programmed instruction (explained in

MEDIA FILE

Logical Journey of the Zoombinis

Game



Source: Broderbund, Inc.

Logical Journey of the Zoombinis is a fascinating and challenging game designed to help students explore and apply fundamental principles of logic, problem solving, and data analysis. It contains 12 puzzles, with levels of difficulty, to support growth in mathematical concepts and thinking skills. Because the game engages students in creative and divergent thinking, they are able to solve many of the puzzles in a nonlinear, intuitive manner, which is one valued problem-solving approach.

MEDIA FILE

Decisions, Decisions

Simulation



Source: Tom Snyder Productions.

Decisions, Decisions is a series of role-playing software packages designed specifically to generate informed discussion and decision making in the classroom using only one computer. The program has a mode for whole-class discussion with the teacher leading the entire group, as in a traditional classroom. In addition, it offers a small-group option for managing a cooperative learning environment. Up to six small groups of students move through the simulation independently directed by the computer. Titles include *Substance Abuse, Violence in Media, Immigration, The Environment,* and *Town Government.* Additional multimedia sets include *Rainforest Researchers* and *The Great Ocean Rescue.*

Chapter 2); that is, information is presented in small units followed by a question or task. The computer analyzes the student's response (compared with responses supplied by the designer) and gives appropriate feedback. A complicated network of pathways, or branches, can be programmed. The more alternatives available to the computer, the more adaptive the tutorial can be to individual differences. The extent to which a skilled, live tutor can be approximated depends on the creativity of the software designer.

Games

In Chapter 2 we discussed the distinction between gaming and simulation. A game activity may or may not entail simulation elements. Likewise, a game may or may not be instructional. It depends on whether the skill practiced in the game is an academic one—that is, related to a specific instructional objective or a workplace skill.

Recreational games can serve a useful purpose in building computer literacy in an enjoyable, nonthreatening manner. But the ultimate goal of useful learning must be kept in mind. Instructors experienced in computer utilization recommend rationing purely recreational game use, using it as a reward for completing other assignments. Games range from those with specific learning outcomes, such as *Logical Journey of the Zoombinis* (see "Media File"), to those that emphasize entertainment while teaching problem-solving strategies, such as *King Arthur's Magic Castle.*

Simulation

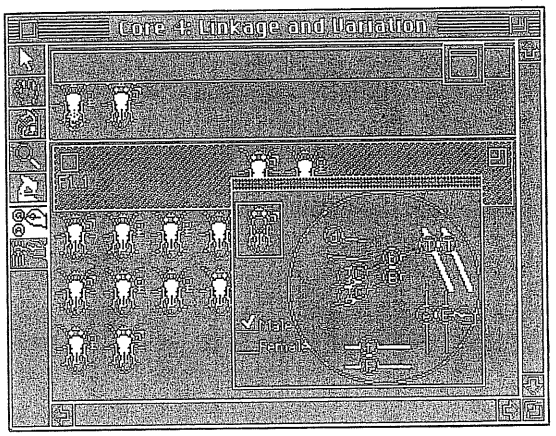
The simulation method of instruction is described in Chapter 2. In this method, learners confront an approximation of a real-life situation. It allows realistic practice without the expense or risks otherwise involved.

The computer-based simulation *SimCity* puts the user in charge of a growing city. Students can build a city from

MEDIA FILE

Explorer Series

Discovery Program



Source: LOGAL® Software, Inc.

Every classroom is filled with students of varying abilities and learning styles. This innovative series of programs focuses on the everyday experiences students are most likely to have in common and uses them as a springboard for helping them to learn abstract scientific concepts. The three programs in this series are *Biology Explorer, Chemistry Explorer,* and *Physics Explorer.* Each program includes a series of guided activities that engage learners, incorporating a learning model that leads students from simple to more complex concepts.

the ground up or choose to manage one of several well-known cities around the world. They control the city budget, construction, and location of city services. Their decisions affect pollution, crime, and traffic. Students learn the consequences of actions in a complex environment.

In military and industrial settings, training for operation and maintenance of complex equipment—aircraft, weapons systems, nuclear power plants, oil rigs, and the like—is often given on computer-based simulators. As discussed in Chapter 2, these large-scale simulators allow trainees to experience lifelike situations without the danger and expense involved in practice with the actual equipment.

Discovery

Discovery is a general term to describe activities using an inductive approach to learning; that is, presenting problems that students solve through trial and error or systematic approaches. It approximates laboratory learning outside the classroom.

Using the discovery method in CAI, learners employ an information retrieval strategy to get information from a database. For example, a salesperson interested in learning about competitors' products can select from a set of critical product features, display them on the computer, and draw conclusions about the comparisons of the products. Some discovery lessons analyze large databases of election information, population statistics, or other user-built databases.

Problem Solving

In problem solving, learners use previously mastered skills to resolve a challenging problem. Students must examine the data or information presented, clearly define the problem, perhaps state hypotheses, perform experiments, then reexamine the data and generate a solution. The computer may present the problem, process the data, maintain a database, and provide feedback when appropriate.

One commercially available problem-solving program is *Memory: A First Step in Problem Solving.* It provides students in kindergarten through sixth grade with opportunities to practice the skill and strategies involved in problem solving. The program introduces a generic approach to problem solving across all subject areas as well as in common lifelike situations. The goal is not to present a fixed problem-solving model but to promote the use of an individualized, systematic approach in which students establish a model that is appropriate to a specific problem, using strategies from their personal repertoire. The multimedia kit includes a chart showing a problem-solving skill matrix, classroom lessons, software summary sheets, program descriptions for each computer disk, computer disks, and a hand puppet for use with younger students.

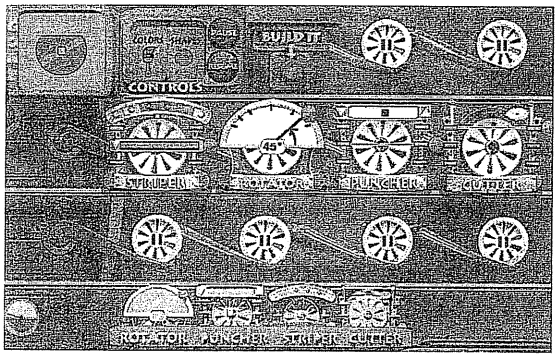
Another problem-solving program, *The Factory Deluxe,* challenges learners to "manufacture" products according to specifications provided by the computer. There are hundreds of different patterns to be duplicated at nine levels of difficulty. The sequence in which the four types of machines, rotator, puncher, striper, and cutter, are used is another critical factor. Of course, there are numerous ways to solve each challenging problem presented by the program (see "Media File").

During problem-solving activities students not only learn about the content under study but also develop higher-level thinking skills. These higher-level cognitive processes include reasoning skills and logical and critical thinking. The primary reason for teaching elementary computer languages, such as LOGO, is not for students to learn programming itself but to enable them to use the computer for problem solving.

MEDIA FILE

The Factory Deluxe

Problem-Solving Program



Source: Sunburst (www.Sunburst.com).

The Factory Deluxe focuses on several strategies used in problem solving: working backward, analyzing a process, determining a sequence, and applying creativity. Learners are given a square on the computer and four types of machines. The "rotator" machine can be programmed to rotate the square 30, 45, 60, 90, 120, 135, 150, or 180 degrees. The "puncher" machine can punch square or triangular holes in the product as it passes through the machine. The "striper" machine paints thin, medium, or thick stripes of various colors. And the "cutter" cuts off and discards part of the product.

The program has five types of activities. In "Try It" students experiment with one to ten machines as they put together assembly lines to create geometric products. "Build It" allows learners to actually construct the products. During "Research It" they refine existing assembly lines to find more efficient ways to create given products. "Ship It" requires students to build their knowledge of geometric attributes as they pack boxes to fill orders. Finally, in "Deliver It", students compete against each other or one of two computer components in a mathematical race to deliver their products.

Table 9.1 presents an organized overview of the computer-assisted instruction methods discussed in this section.

Information Tools

As students begin to work with information, they find the computer tools available to them help make the process easier and fun. Using a word processing program for writing makes it easy for students to edit their work. Once they have gathered their ideas into concept maps, they then begin to work those ideas into connected text. The word processor makes it possible for students to work with their ideas and to quickly make changes as they explore various ways to present them. Spelling and grammar checking are available to students. A thesaurus makes it easier for them to find the right word for a specific situation. And editing, a process children are not prone to enjoy, suddenly becomes easier. Students are more willing to make changes when the editing is simplified.

Students enjoy putting their ideas onto the page. They especially enjoy seeing their work in finished copy. Desktop publishing allows students to not only print a nice copy of their work but also to design layouts that are creative and a pleasure to see (Figure 9.12). Using a desktop publishing program, students can add graphics to their pages. They can see how their pages will look before they print them. Students of all ages like to produce their writings in formal documents, like small books and newsletters. Class newsletters are very popular, with students working together to produce a document that they are proud to share with family and friends.

As students work with large amounts of information, it is essential that they learn how to cluster it. A database allows students to store information in ways that make it easy for them to retrieve it. By learning how to develop databases, students begin to organize their knowledge and understand ways they can group their information.

A database allows students to quickly get the specific information they are seeking. Computer catalogs and on-site/online databases allow students to search for information. The amount of information available today is constantly growing. When students understand how information is organized and what the process is for retrieving it, they can gather vast amounts quickly and easily.

Graphics Tools

Drawing and creating graphics is a fun activity for students. Computer software such as *KidsPix* can make drawing even more pleasurable. This software allows children to use, for example, a "rubber stamp" that makes noise as it marks on the screen, to erase a picture to find a hidden one behind it, and to use a "drippy" paintbrush. Computer technology thus changes the dynamics of art for children.

As students gain skill in using drawing software, they can learn to use more complex drawing and drafting programs. High school students can use computer-aided design (CAD) and graphics programs to prepare complex visuals. Many of the skills associated with these types of software are easy for students to learn. For example, an art program such as *Photo Deluxe* allows students to develop complex projects using an array of tools, ranging from basic drawing tools for lines and shapes to advanced drawing tools for editing and redesigning. They may create their own pictures, or may begin by using commercially designed clip art, available from many suppliers (Figure 9.13). A simple picture can be developed into a very artistic piece with only a few keystrokes.

TABLE 9.1
Utilization of CAI methods

METHODS	DESCRIPTION	ROLE OF TEACHER	ROLE OF COMPUTER	ROLE OF STUDENT	APPLICATIONS/ EXAMPLES
Drill-and-Practice	Content already taught Reviews basic facts and terminology Variety of questions in varied formats Question-answer drills repeated as necessary	Arranges for prior instruction Selects material Matches drill to student Checks progress	Asks questions "Evaluates" student response Provides immediate feedback Records student progress	Provides feedback Practices content already taught Responds to questions Receives confirmation or correction Chooses content and difficulty level	Parts of a microscope Completing balance sheets Vocabulary building Math facts Product knowledge
Tutorial	Presentation of new information Teaches concepts and principles Provides remedial instruction	Selects material Adapts instruction Monitors	Presents information Asks questions Monitors responses Provides remedial feedback Summarizes key points Keeps records	Interacts with computer Sees results Answers questions Asks questions	Clerical training Bank teller training Science Medical procedures Bible study
Gaming	Competitive Drill-and-practice in a motivational format Individual or small group	Sets limits Directs process Monitors results	Acts as competitor, judge, and scorekeeper	Learns facts, strategies, skills Evaluates choices Competes with computer	Fraction games Counting games Spelling games Typing (arcade-type) games
Simulation	Approximates real-life situations Based on realistic models Individual or small group	Introduces subject Presents background Guides "debriefing"	Plays role(s) Delivers results of decisions Maintains the model and its database	Practices decision making Makes choices Receives results of decisions Evaluates decisions	Troubleshooting History Medical diagnosis Simulators (pilot, driver) Business management Laboratory experiments
Discovery	Inquiry into database Inductive approach Trial and error Tests hypotheses	Presents basic problem Monitors student progress	Presents student with source of information Stores data Permits search procedures	Makes hypotheses Tests guesses Develops principles or rules	Social science Science Food-intake analysis Career choices
Problem Solving	Defines problem States hypothesis Examines data Generates solution	Assigns problems Assists students Checks results	Presents problem Manipulates data Maintains database	Defines the problem Sets up the solution Manipulates variables Conducts trial and error	Business Creativity Troubleshooting Mathematics Computer programming

FIGURE 9.12
Desktop publishing software allows students to produce their own written materials with minimal time and little computer expertise.

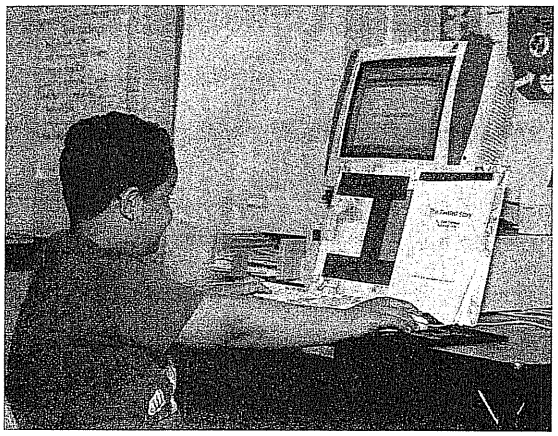
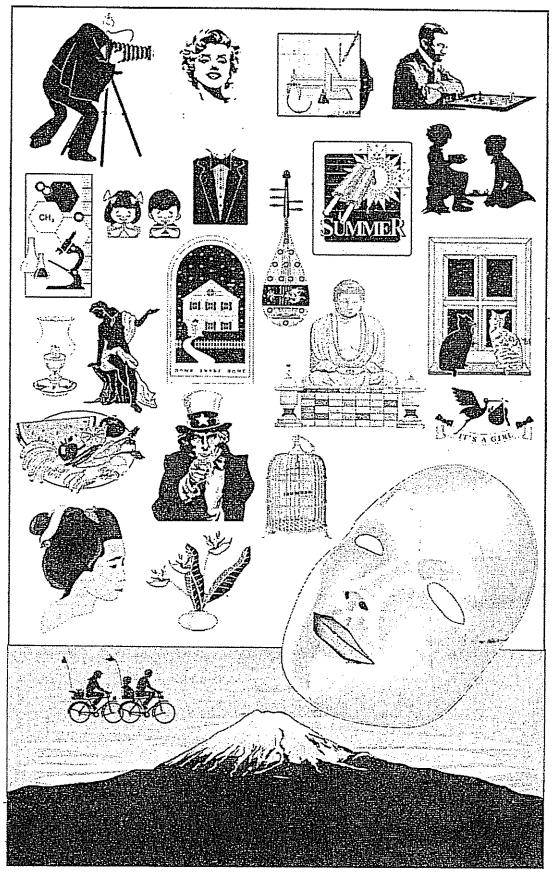


FIGURE 9.13
Examples of computer clip art.



Source: Used by permission of C.A.R., Inc., 7009 Kingsbury, St. Louis, MO 63130. These illustrations taken from the Clipables® EPS Graphics Library. Clipables is a registered trademark of C.A.R., Inc. All rights reserved.

Further, presentation software has become a very popular format for teachers and students alike. With the computer connected to a data projector, it is possible to create colorful and animated overheads. Supervise carefully, though; using a program such as Microsoft's *PowerPoint,* sometimes individuals spend more time deciding the color scheme or the font style than they do actually preparing the content of the presentation. (See Chapter 5 for further discussion of this topic.)

INTEGRATED LEARNING SYSTEMS

In many schools a viable form of computer use is the **integrated learning system (ILS),** referring to a networked set of computer workstations equipped with software that provides a particular set of sequential lessons. Students work through these lessons as prescribed by the built-in management system, which tracks individual student progress. These systems are "integrated" in the sense that each lesson is connected with the next, all lessons are correlated with a set of objectives, and all tests are matched to the lessons and objectives. Further, the software typically is customized to match the content, objectives, and chapter sequence of the textbook used.

An ILS installation might, for example, provide four networked computer workstations in each classroom in a school building. The menu might include hundreds of carefully sequenced lessons throughout several grade levels and subjects. The teacher can decide which students will use the system for which lessons. Students work individually at the workstations for about 45 minutes per day. When they finish one lesson they are tested and directed to the next appropriate lesson. The management software gathers and stores all information about student progress and supplies reports to the teacher and administrators.

Advantages

- *Self-pacing.* Students can move through the material at their own pace, being tested and branched at frequent intervals.
- *Total package.* A major advantage from the administrative standpoint is having a total integrated package of hardware and software; there is no need to try to piece together your own network or to shop for and evaluate courseware.
- *Validated.* The learning programs can be tested and validated before distribution; with a large base of clients, the vendors can afford to invest in curriculum

research and development. Vendors revise and update software on a regular basis. Some vendors even provide "money-back guarantees" of student success.

Limitations

- *Courseware quality.* The quality of the courseware is variable; some of it is low-level, uninspiring drill-and-practice material. The instructional strategies used in computer-assisted programs may be contrary to your own teaching philosophy. A frequent criticism is overemphasis on low-level knowledge and skills. These criticisms are not necessarily inherent in truly integrated learning systems, but they do apply to many of the commercially sold packages.
- *Evidence of effectiveness.* There is little objective research to indicate the effectiveness of these materials; most of the existing studies have been commissioned by one of the vendors and have been conducted with less than acceptable rigor.
- *Loss of flexibility.* One of the trade-offs made in adopting an integrated computer system is flexibility. Teachers and students are limited to using the same hardware and software in the same way. Some argue that the real potential of computers is achieved when users have control and can take off in their own directions. The standardization imposed by the typical ILS is contrary to the impulses of most teachers to maintain autonomy in terms of content and methods.
- *Reports.* The individual progress reports given to teachers are often hard to interpret.
- *Curricular integration.* Perhaps the most serious risk of the ILS is, ironically, its lack of integration with the curriculum. The components of the computer system are integrated with each other, but the system may not be integrated with the rest of the school curriculum. One of the most frequent criticisms of curricula is that of fractionation—fragments of facts and skills taught in isolation, not coalescing into a whole.

Integration

ILSs are used most commonly for basic mathematics and language arts instruction. Often, low-achieving or special needs students leave their regular classrooms to use the ILS in a cubicle within a computer lab environment. Homebound students can be linked to the network as well. Some systems specialize in software for remediation of basic skills, others offer broad curricula encompassing virtually all the standard school subjects. Some systems use the networking capability to make databases, such as encyclopedias and libraries of video clips, available to all users.

The most attractive applications in the future are likely to be ones like Project CHILD (see "Close-up: Project CHILD—A New Approach to Integrated Learning Systems" in Chapter 2) in which the ILS lessons are one component of an overall school program that combines team teaching, thematic units, student and parent involvement in goal setting, and customization to the prescriptions of the local teaching staff.

SOFTWARE SELECTION

Selection Criteria

There are several factors associated with selecting software (see "Appraisal Checklist: Computer Software"). Foremost is to examine the software within the context of the learning outcomes. Other factors that should be considered include content, format, ease of operation, design, and completeness of the package.

In addition, software programs, also called *applications,* are written to run on specific operating systems. An *operating system,* such as *Mac OS, Windows,* or *Unix,* is software that functions as the computer's interface with the user. It determines precisely how user, computer, and application interact to produce the desired results. The software you select must be designed to run on your available operating system and must function properly with your specific hardware configuration (see the next section).

Accuracy. When looking at software, you need to consider the content in terms of its accuracy. If the software is older, some of the information may be out of date. Also, it is important to consider the sequencing of the information. Information should be presented in a clear and logical manner. Finally, you need to examine the intent of the lesson and its relation to your intended student goals.

Feedback. It is important that software follow sound educational techniques and principles. In a drill-and-practice program it is important that students have frequent informative feedback.

Learner Control. Another important criterion is the amount of learner control given to the student. Students should be able to control the pacing and direction of their learning. Software should provide students with opportunities to select topics within areas of study. Also, students need to be able to control how quickly they progress through material. Finally, the information needs to be presented in a manner designed to maintain student interest and involvement in the tasks.

APPRAISAL CHECKLIST

COMPUTER SOFTWARE

KEY WORDS: _____, _____, _____

Format

- ☐ **Drill and practice**
- ☐ **Tutorial**
- ☐ **Game**
- ☐ **Simulation**
- ☐ **Discovery program**
- ☐ **Problem solving**

Title _____

Series Title (if applicable) _____

Source _____

Date _____ **Cost** _____ **Length** _____ minutes

Subject Area _____

Intended Audience _____

Brief Description

Objectives

Entry Capabilities Required (e.g., prior knowledge, reading ability, vocabulary level, math ability)

Rating	High	Medium	Low	Comments
Match with curriculum	☐	☐	☐	
Accurate and current	☐	☐	☐	
Clear and concise language	☐	☐	☐	
Arouse motivation/maintain interest	☐	☐	☐	
Learner participation	☐	☐	☐	
Technical quality	☐	☐	☐	
Evidence of effectiveness (e.g., field-test results)	☐	☐	☐	
Free from objectionable bias	☐	☐	☐	
User guide/documentation	☐	☐	☐	
Clear directions	☐	☐	☐	
Stimulates creativity	☐	☐	☐	

Strong Points

Weak Points

Recommended Action _____ **Name** _____ **Date** _____

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A computer version of this Checklist is available on the "Classroom Link Portfolio" CD-ROM.

HOW TO . . . Utilize Computer Software

- Try all software yourself before using it with students.
- Give students clear, concise explanations and illustrations of the subject matter.
- Explain purposes or objectives of software to students and make sure they understand these goals.
- Make sure students understand why they are using the software.
- Get students involved with the software as quickly as possible. Avoid lengthy explanations.
- Demonstrate how to use software to students, if necessary.
- Use large monitor, data projection device, or LCD panel to demonstrate software.
- Allow students to struggle somewhat—don't always come to their aid immediately.
- Provide a cooperative environment, encouraging students to help each other.
- Use experienced students as assistants.
- Ask frequent questions to see if students understand what they are doing.
- Interact periodically with each student while they use software, asking, "How is it going?" or "What are you learning?"
- Give students frequent opportunities to practice what they are learning.
- Provide frequent feedback to students as to how well they are doing.
- Provide worksheets or handouts to students if necessary.
- Make students accountable for what they are learning from software through one-on-one (student–teacher interaction), class discussion, paper-and-pencil tests, individual/group projects, papers, and activities.
- Make sure that the assessments match the objectives and instruction.
- Provide remedial and enrichment instruction as necessary.
- Relate software to past and future course content.

Prerequisites. Practical examples that relate to students' own experiences are more valuable within the learning process. Prerequisite skills need to be identified if they are essential for successful use of the software. Information needs to be presented at a level appropriate for students.

Ease of Use. Further, software needs to be easy to use. Software is *user friendly* if it makes the computer transparent in the learning process. When students must focus more on the operation of the software than on developing an understanding of the content, then the computer is interfering with, rather than assisting, learning.

Ease of use is a particularly critical attribute in situations where students are working individually or in small groups on different projects, using different software. If you must continually be interrupted to help students cope with obstacles in using difficult software, then both you and your students become frustrated.

Special Features. Sometimes software has special effects or features that may be essential for effective learning. Often, however, these are only window dressing and add no value to the learning process. In fact, they may interfere with learning. Color, graphics, animation, and sound should be a part of quality software only if they contribute to student learning. As discussed in Chapter 5, text should be presented in a consistent manner, using size, color, and location to reduce the cognitive burden of deciphering meaning. Keystroking and mousing techniques should be intuitive for students. The manner in which students interact with software needs to be transparent, allowing them to focus on the content.

COMPUTER HARDWARE

Basic Components

Regardless of the size of the computer or complexity of the system, computers have a number of standard components. The physical equipment that makes up the computer is referred to as the **hardware.** A computer's specific combination of hardware components is referred to as its *configuration.* The basic hardware components are diagrammed in Figure 9.14.

FIGURE 9.14
Basic elements of a desktop or laptop computer.

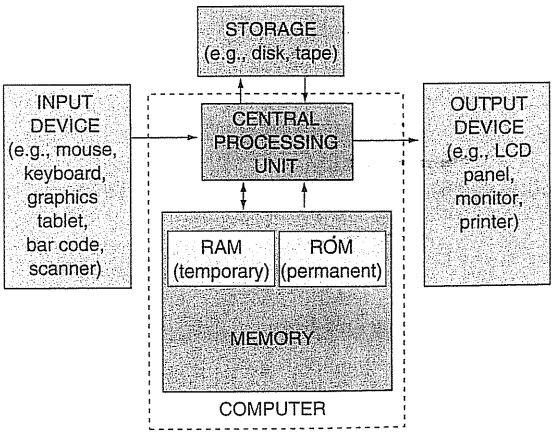


FIGURE 9.15
The tiny microprocessor fostered the microcomputer revolution. Chips like this one are used in home appliances, automobiles, toys, and hundreds of other devices, giving each a "brain" of its own.

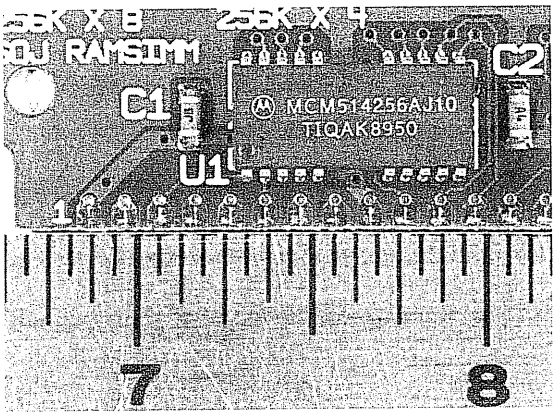
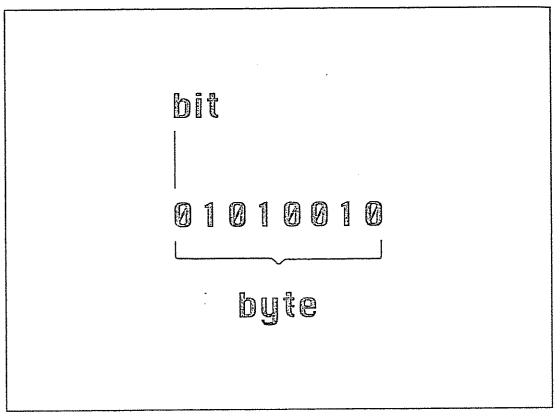


FIGURE 9.16
Representation of the letter A in ASCII (American Standard Code for Information Interchange) code when 8 bits represent 1 byte.



Input Device. Input devices transmit information into the computer. The most commonly used input device is the keyboard. Others include mice, trackballs, joysticks, graphics tablets, and even voice. Both students and teachers can use graphics tablets to incorporate drawings into their programs. Science laboratory monitoring devices can also be connected directly to a personal computer with the proper interface device.

Central Processing Unit. The central processing unit (CPU) is the core element, or "brain," that carries out all the calculations and controls the total system. In a personal computer the CPU is one (or more) of the tiny chips (microprocessors) inside the machine (Figure 9.15).

Memory. Memory stores information for manipulation by the CPU. The memory contains the *control function*—that is, the programs written to tell the CPU what to do in what order. In computers, control instructions and sets of data are stored in two types of memory:

- **Read-only memory (ROM).** This consists of the control instructions that have been "wired" permanently into the memory and which the computer will need constantly, such as programming languages and internal monitoring functions.
- **Random access memory (RAM).** This is the flexible part of the memory. The particular program or set of data being manipulated by the user is temporarily stored in RAM, then erased to make way for the next program.

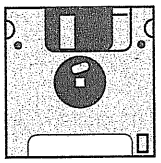
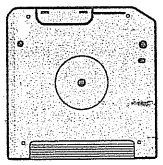
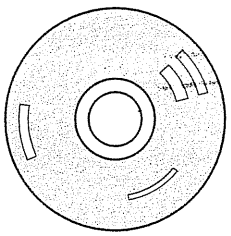
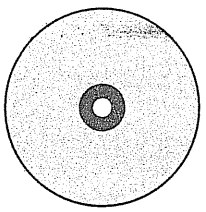
A computer's memory size is usually described in terms of how many bytes it can store at one time. A **byte** is the number of bits required to represent and store one character (letter or number) of text. A **bit** is a single unit of data, coded in binary form as either 0 (off) or 1 (on). A byte is most commonly made up of 8 (sometimes 16 or 32) bits in various combinations of 0s and 1s (Figure 9.16).

A **kilobyte (Kb)** refers to approximately 1,000 bytes (1,024, to be exact), a **megabyte** (**Mb** or "meg") indicates 1,000 Kb or approximately a million bytes, and a **gigabyte** (**Gb** or "gig") is equal to 1,000 Mb or approximately one billion bytes. A megabyte is the unit used to measure the RAM storage capacity of a computer. Thus, if a computer can store 1,024,000 bytes, it is said to have 1 "meg" of memory capacity. We now talk about storage in terms of **terabytes (Tb)** which is a million megabytes or a trillion bytes. The more powerful machines are capable of processing more bytes simultaneously, thus increasing their processing capacity.

A computer's memory is one of its limiting factors. You need to be sure that the computer has enough memory to run the software you will be using. If you plan to use more than one application at a time, it is recommended that you have a minimum of 64 Mb of RAM; 128 Mb is preferable. One megabyte of memory can hold approximately 2,000 single-spaced pages of text, but many graphics and animations may themselves require a megabyte or more to display properly.

Storage. The computer's operating system, application programs, and data files are stored outside its CPU when not in use. The most common storage mechanism is the magnetic disk. Recordable CD-ROMs are becoming common. Storage capacity (measured in Mb or Gb) has expanded to keep pace with the rapidly growing memory demands of today's software and the

TABLE 9.2
Disk types

TYPE	SIZE	PHYSICAL CHARACTERISTICS	STORAGE CAPACITY	MACHINES USING
Floppy disks 	3½ in. diameter	Thin flexible plastic disk in a stiff plastic case	Double-sided, 700 to 800 K Double-sided, high density, 1.4 to 1.6 megabytes	Commonly used with Macs and PCs
Removable storage disk 	Varies—usually 3¾ in. or 5½ in. diameter	Thin flexible plastic disk in a stiff plastic case	High density, 100 megabytes to 4.6 gigabytes	Used with an external drive or special internal drive. Available for both Macintosh and PC
Hard disks 	Varies—usually 5¼ in. or 3½ in. diameter	Metal or metal-coated platters Internal or external to the computer	240 megabytes to one gigabyte most common Up to several gigabytes available for some machines	Available for all computers
Compact discs (CD-ROM, CD-B, CD-RW, DVD, DVD-R, DVD-RW) 	4¾ in. diameter	Metalicized disc coated with clear plastic	650 megabytes or more	Commonly used with Macs and PCsl

ever-increasing size of graphics- and animation-laden multimedia data files.

Magnetic disk devices may be built into the computer or are available as stand-alone ("external") devices. The disk is made of thin plastic, coated with a magnetic recording surface, and encased in a protective shell.

In general, fixed media devices are called *hard disks,* although removable hard disks are also available. This disk is encased in a rigid plastic shell (hence the name "hard" disk). Current hard disk capacities range from several hundred megabytes to four or more gigabytes (Table 9.2).

Low-capacity removable media devices are called *floppy disks* (Figure 9.17). They were originally 5¼ in. diameter plastic disks encased in a stiff yet flexible paper or plastic shell (hence the name "floppy" disk). Current floppy disks are 3½ in. in diameter and are encased in rigid plastic. Their storage capacity ranges from 800 Kb to 1.6 Mb (see Table 9.2).

High-capacity removable media devices, a kind of hybrid of hard and floppy disks, are replacing floppy disks as the portable storage format of choice. Generically termed **removable-storage devices,** they are small, portable, and

FIGURE 9.17
The floppy disk is a convenient way to transfer information from one computer to another.



used primarily for backing up and archiving computer files. Many users refer to both a drive unit and its disks by either the manufacturer or product name (e.g., SyQuest, Zip, Jaz). The trademarked Zip® drive was developed and is sold by Iomega Corporation. SyQuest makes a similar product. Approximately the same size and of the same construction as floppy disks, these devices, some magnetic and some magneto-optical, come in several sizes. The 100 megabyte size actually holds 100,431,872 bytes of data or the equivalent of 70 floppy disks. There are also 250 megabyte and 1 gigabyte drives and disks. Removable-storage devices come with a software utility that lets you copy the entire contents of your hard drive to one or more disks. In general, the larger the capacity, the smaller the cost per megabyte (see Table 9.2).

Applications of removable-storage devices include the following:

- Archiving old e-mail or other files you don't use any more but may want to access someday
- Storing unusually large files, such as graphic images that you need infrequently
- Exchanging large files with someone
- Moving your files from one computer to another, perhaps a laptop computer
- Keeping certain files separate from files on your hard disk (e.g., old test files)

The compact disc (as described in Chapter 6), used for digitally storing and reproducing music and verbal narration, is also used to store and retrieve text and graphics. A **CD-ROM (compact disc–read-only memory)** drive connects to a computer, which can read data from a compact disc in much the same way as from a floppy or hard disk. CD-ROM has the advantage of storing more data—approximately 250,000 pages of text or the equivalent of several hundred floppy disks. An entire encyclopedia can be stored on a single CD-ROM with room to spare. A computer can find and list all page references to any topic in that encyclopedia within seconds.

Almost all computers now have CD-ROM readers built into them. As the CD-ROM becomes a standard format for data storage, recordable CD (CD-R) devices are beginning to appear with more computer systems.

The newer DVD technology provides two additional storage devices, DVD and DVD-R. DVD drives can be connected to computers and function much the way that CD-ROM drives do. DVD players, which read both DVDs and CD-ROMs, are starting to replace CD-ROM drives in laptops and desktop computers. DVD-R (rewriteable) drives for computers can hold 5.2 gigabytes at a cost of less than a penny per megabyte of storage.

Its vast storage capacity and potential to replace CD-ROMs as the standard storage device for computers make DVD an extremely attractive medium for reference materials, multimedia applications, simulation games, virtual reality experiences, and complex problem-solving exercises. You can speculate on the application of this new technology and its associated software. (For example, as of this writing, the recently announced high-end Apple Power Macs come with a built-in DVD-R drive and preloaded software that lets users create DVD discs compatible with commercial players.)

Output Device. Output devices display the results of your program. A television-type monitor, referred to as a CRT (cathode-ray tube), is the usual output device of a personal computer. Liquid-crystal (LCD) and other display types are becoming common. It may be built into the total package, or it may be a separate component.

Computers also commonly provide output in the form of data printed on paper sheets (hardcopy). Printers are available in a range of prices and quality (Figure 9.18). Quality of text and graphics correlates with cost.

COMPUTER FACILITIES

There are a variety of facilities for computer use. They range from the **computer classroom** (one or more computers in a single classroom) to the computer laboratory.

The One-Computer Classroom

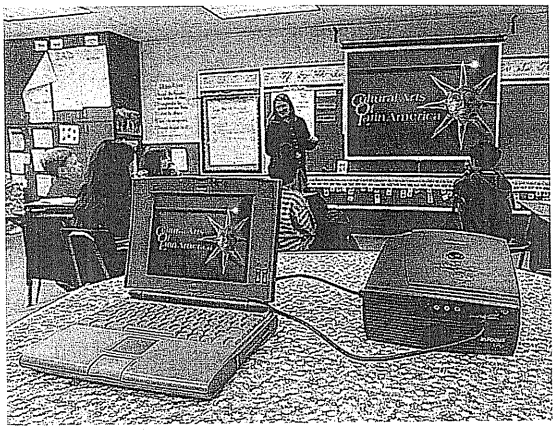
In some schools access to computers is still limited. Often there is a single computer lab where a teacher can take a whole class of students to work on computers as part of a lesson. However, increased interest by many teachers in incorporating the computer into their lessons limits the number of times per week that any one teacher can use the computer lab. One solution has been to have a computer placed in each classroom. This

CLOSE-UP

CLASSROOM USE OF A SINGLE COMPUTER

A high school economics teacher uses a single computer with a class of 24 students. A computer coupled with a video data projector allows all students to see what is on the monitor. The teacher uses prepared computer graphics instead of overhead transparencies for key points and illustrative graphs. She can advance from one visual to the next as needed and can also reveal key words from the presentation with the touch of a key.

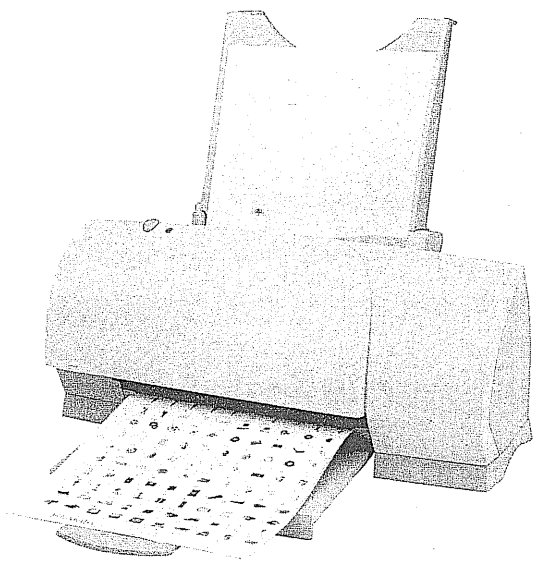
The biggest advantage of the computer in a large-group instructional situation is its usefulness in presenting "what if" results. For example, while presenting the concepts of supply and demand, students can discuss the effect of an increase in availability of a product on its cost. Following the discussion the teacher can project the results. The teacher can also put student-suggested values into the computer, and the class can see the results immediately. Economics comes alive in the classroom when years of data can be manipulated within minutes for all to see.



single computer is therefore available to the teacher and students to use throughout the day.

It is possible for a teacher to use a single computer in creative ways with a whole class of students. Some software lends itself to being used by single students who need to work on specific tasks; other software is designed for group activities. For example, with the series of programs *Decisions, Decisions,* groups of students interact with the computer to get specific information before they can proceed with their group activity (see the "Media File" on p. 224). The students do not need to work on the computer during the entire lesson; they only work with it at certain intervals as needed. While one group interacts with the computer, the remaining groups are working at their desks.

FIGURE 9.18
A typical printer for use with a computer.



The one-computer classroom, then, can be viewed as a place where you may use the computer in many ways:

- *Large group.* With a data projector you can demonstrate to a whole class how to use a particular software program or how to manage a particular set of data.
- *Small group.* A small group of students can work together with the computer. Students can interact with a program in groups, then return to their seats, allowing others to have some time on the computer. Each group has a turn using the software to gather or present data.
- *Learning center.* Individual students or small groups can go to a learning center that has at its core a computer. Integrating a specific software program into the center, you create another type of interactive learning center.
- *Personal secretary.* Every teacher is responsible for maintaining grades, communicating with parents, and preparing instructional materials. The computer can assist you with these types of tasks.

FIGURE 9.19
Computers around the wall in a laboratory allow one teacher to monitor all student activity.

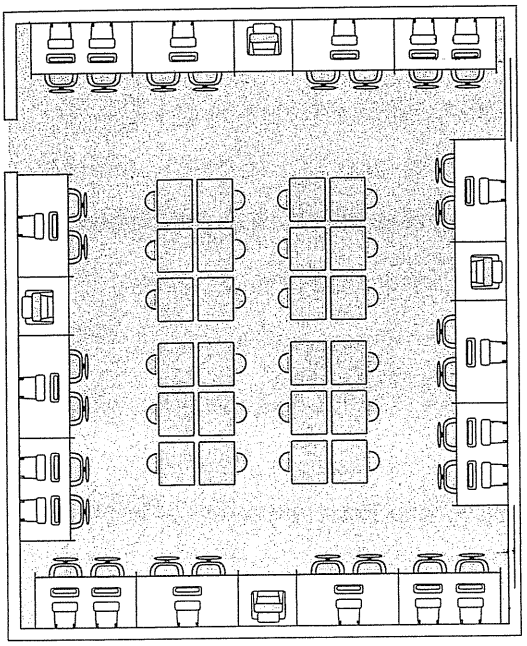
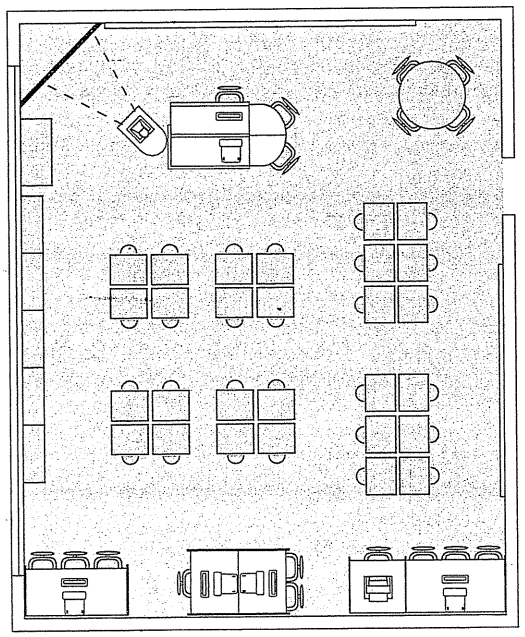


FIGURE 9.20
An elementary classroom with four computers (bottom) used for individual and small-group study. (Plan developed by Interactive Learning Systems, Inc., Cincinnati, OH.)



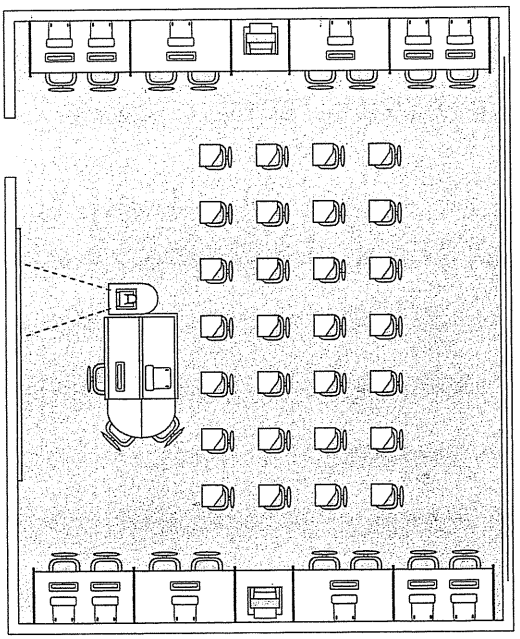
The Multiple-Computer Classroom

A **computer classroom** is useful when the teacher wants to present to all the students simultaneously. The arrangement is helpful when the instructor is teaching students to use the same software simultaneously (Figures 9.19 through 9.22). Networked computers with monitors recessed in the tables for both students and teachers allow eye contact and facilitate communication. Students can work in groups of two or three and share one computer. The teacher should have a projection device to display information for all students on one screen. In some networks the teacher can control and monitor what is shown on each student computer.

The Computer Laboratory

When a teacher wants each student to be working on a computer during a lesson, it is necessary for the whole class to have access to computers simultaneously. Schools often place 15 to 20 computers together in a single room called a **computer laboratory.** The computer laboratory is appropriate if you want students to be working independently or in small groups on different programs and different activities. To monitor student activity, to keep them on task, and to prevent them from viewing inappropriate or irrelevant material, the computers can be

FIGURE 9.21
A high school classroom with 12 computers and 2 printers (along both side walls) used individually. (Plan developed by Interactive Learning Systems, Inc., Cincinnati, OH.)



HOW TO . . . Prevent Pain and Strain When Using Computers

We have all heard of carpal tunnel syndrome but there are other injuries, as well, that can result from improper computer use. The following guidelines can reduce the chance of discomfort and injury when you and your students use computers.

- Position the monitor so there is no glare on the screen.
- Have your monitor at least 25" away to reduce eye strain.
- The top edge of the screen should be at least 15 degrees below your eye level.
- The keyboard should be right under your hands as they are naturally positioned.
- The height of your chair should be equal to the length of your leg from the knee to the bottom of your foot.
- Keep your feet flat on the floor and relax your legs.
- Sit up straight and relax your back and chest.
- Keep your arms and hands relaxed. Let your elbows hang gently by your side.
- Every 10 minutes take a 10-second break to close your eyes and relax your body.
- Every hour take a 5- to 10-minute stretch break. Get up and walk around. Rest your eyes and stretch your body.

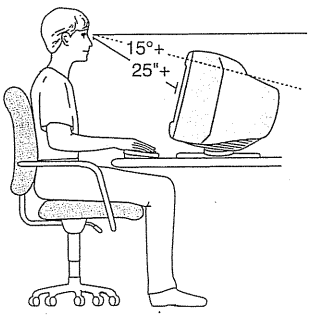
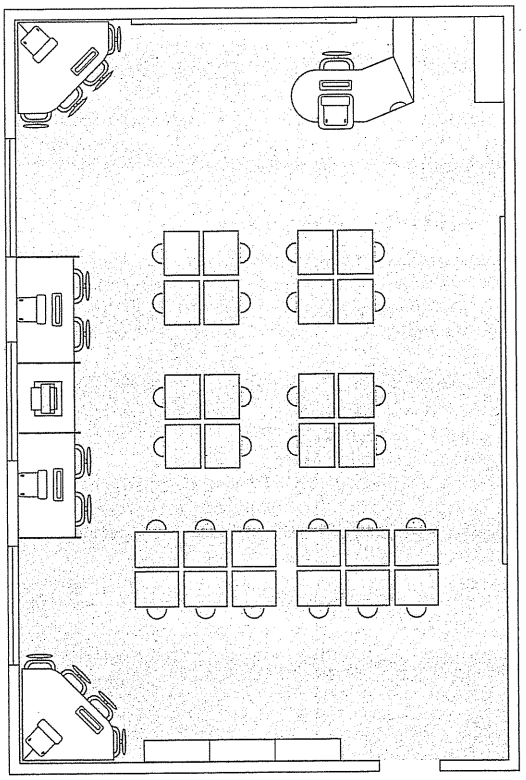


FIGURE 9.22
A middle school classroom with chairs arranged at computers for collaborative learning. (Plan developed by Interactive Learning Systems, Inc., Cincinnati, OH.)



placed around the walls of the laboratory with the monitors facing the center of the room (see Figure 9.19). The teacher can quickly see what each student is doing and respond to student questions individually.

We believe that the trend is toward the multiple-computer classroom. In the early days when schools had a limited number of computers, they assembled them in a laboratory. As more computers became available single computers were assigned to individual classrooms. Teachers soon discovered how they could successfully use multiple computers in their classrooms. Some schools have done away with their computer laboratories, distributing those computers to individual classrooms. Consequently, many classrooms that had just one computer now have several.

There are advantages to using a computer lab. A group of students can be taught the same lesson simultaneously, which might be more efficient for the teacher. Also, software can be located in one place conveniently. Supervision and security are often easier when all the computers are located in a single room.

The foremost limitation with the computer lab is access. If there are no other computers available to students outside the computer lab, then students may have a problem. If a class is scheduled to use the lab, students will have to wait until the lab is not scheduled to use the facilities. Also, because of scheduling problems, some classes may not have access to the lab at all.

Labs are often structured to facilitate ease of use by using networks, which make it easy to use the available software. Another solution would be to place computers throughout the school building. Thus, students can access computers in the computer lab, their classrooms, and the media center.

Mathematics

Dennis Sorge's middle school pre-algebra students enjoy competing with classmates while simulating the operation of a hotdog stand. The students practice their math skills while cooperating with one group of peers and competing against other groups.

Analyze Learners

General Characteristics

Mr. Sorge's class is made up of 20 general math students in grades 9 and 10, representing a range of abilities. Some students have minor physical handicaps and others have learning disabilities. The school is located in a rural area of the Midwest. The majority of the students have attended high school football games and most have purchased hotdogs, soft drinks, and chips while at a game.

Entry Competencies

Approximately 80 percent of the students are able to do the following:

1. Add and subtract five-digit numbers with decimals (money amounts)
2. Multiply amounts up to one hundred dollars by double-digit quantities

Learning Style

Most students, especially those with low verbal skills, prefer visual learning. Most students enjoy both interacting and competing with their peers. The majority is motivated by using a computer. About half of the students enjoy learning and most are motivated by the class and the study of mathematics.

State Objectives

Mr. Sorge wanted his students to practice real-world applications of math skills while having a good time. The specific objectives of the lesson were that, on completion, the general math students would be able to do the following:

1. Solve five-digit addition and subtraction problems at 90 percent accuracy without the use of a calculator.
2. Calculate the income and expenses of a hotdog stand with 100 percent accuracy in a group situation without the use of a calculator.
3. Budget expenses using a budget planning sheet and to be able to justify their decisions during a simulation.
4. Make predictions of sales based on previous sales and the weather forecast. The prediction will be within 20 percent of actual sales.
5. Deal with random events that influence outcomes. Students will be able to justify planning for random events before they happen and to justify their strategy for dealing with them after they happen during a simulation.
6. Plan and predict how they should stock a concession stand given the type of event, the weather forecast, records of past sales, and so on during a simulation.
7. Demonstrate team-building skills in a competition situation.
8. Prepare a report that accurately reflects the team's expenses and income and that is properly written (spelling, punctuation, and sentence structure).

Select Methods, Media, and Materials

Mr. Sorge wanted his students to experience the application of math skills in a lifelike situation. Therefore, he chose to use a simulation. He also wanted to capitalize on his students' love of competition while building team skills such as cooperation. Therefore, he chose to incorporate a game format within the simulation. Because he didn't have time to design such an activity, he decided the only way to carry it out would be through a computer simulation. He searched through the catalogs in the school media center and found a program called *Hotdog Stand: The Works,* distributed by Sunburst Communications.

Utilize Media and Materials

The 20 students in his class were randomly divided into four teams of five. Each team worked in a cooperative manner to achieve the highest possible end of season profit. As an incentive, the team earning the most profit received a picnic with the teacher during an upcoming lunch period. Mr. Sorge demonstrated to students how to use the software and explained the goals of the simulation game. He kept his introduction brief so the students could get into *Hotdog Stand: The Works* quickly. He explained specific details as questions arose. His philosophy was to not give them answers for which they had no questions.

Require Learner Participation

During the lesson the students participated in discussions and had to justify their decisions to their peers. The teacher then divided the class into small groups to make specific decisions for specific events. The activity provided practice and feedback as students discussed and decided the data to enter into the program. Feedback was provided by the computer, peers, and Mr. Sorge. While participating in the simulation game, students began to understand how certain variables, such as weather conditions, crowd size, product quality, and product price, influence sales. How they dealt with these factors ultimately affected their success as a team. Students were motivated by the simulation game to become actively involved in developing a variety of mathematical and practical skills.

Evaluate and Revise

Mr. Sorge gave a written test following the use of the *Hotdog Stand: The Works* to evaluate Objectives 1 and 2; he decided not to evaluate Objectives 3 thru 6. To evaluate Objective 7, Mr. Sorge observed students during the simulation game to see if they demonstrated appropriate interpersonal skills. Students were evaluated on journals (written as "Annual Reports" for their concession stand operation). The students were asked to justify their decisions. They were evaluated on these justifications, *not* on the decisions they made or their outcome.

Reports were collected from each student and evaluated by Mr. Sorge and the school's English teacher to measure Objective 8 and to give students feedback on their writing and mathematical skills.

The effectiveness of implementation was determined by several techniques. Mr. Sorge observed students as they participated in the simulation. Did the students' decisions improve as they participated in the simulation? He also listened for student comments that indicated their strategies and decision-making skills.

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

CLASSROOM-LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 9 of the Companion Website (http://www.prenhall.com/heinich).

1. *Instructional Software Critique.* Select an instructional computer program, load it, and take a brief tour. Record your initial reactions. Critique this program using the "Appraisal Checklist: Computer Software" in this chapter (also found on the "Classroom Link Portfolio" CD-ROM), citing sources. Compare and contrast the findings from your initial tour and the "Appraisal Checklist." What will you do the next time you find a new instructional computer program? (ISTE NETS-T II-B & C; VI-A)
2. *Written Reflection.* Name three ways computers have enhanced your learning. Why were these effective? How might these strategies be used to help students learn in a technology-enhanced environment? (ISTE NETS-T II-E; V-B)

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 9 of the Companion Website (http://www.prenhall.com/heinich).

1. Read and summarize an article from a professional journal on the use of computers in education or training.
2. Interview a student or instructor who has used computers for instruction. Report on how they used the computer, including their perceptions of its strengths and limitations.
3. Create a list of topics you would include if you were to conduct a one-day computer implementation workshop for teachers or trainers in your content area.
4. Describe how you could use a computer as an object of instruction or as a tool during instruction in your field.
5. Create a situation in which you could use computer-based materials. Include a description of the audience, the objectives, the role of the computer, and the expected outcomes of using the computer.
6. Locate at least five computer programs suitable for your content area using the information sources available to you.

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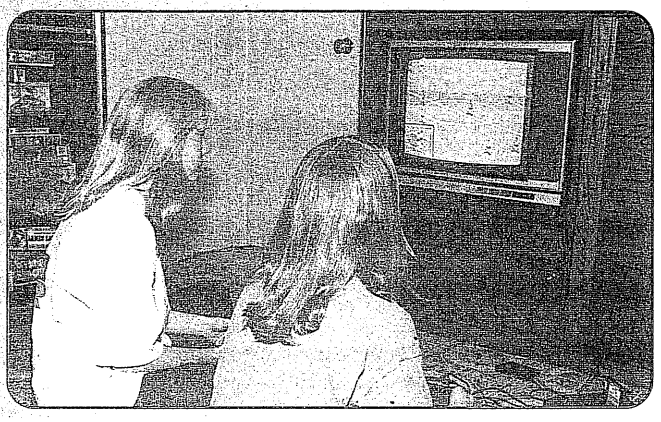
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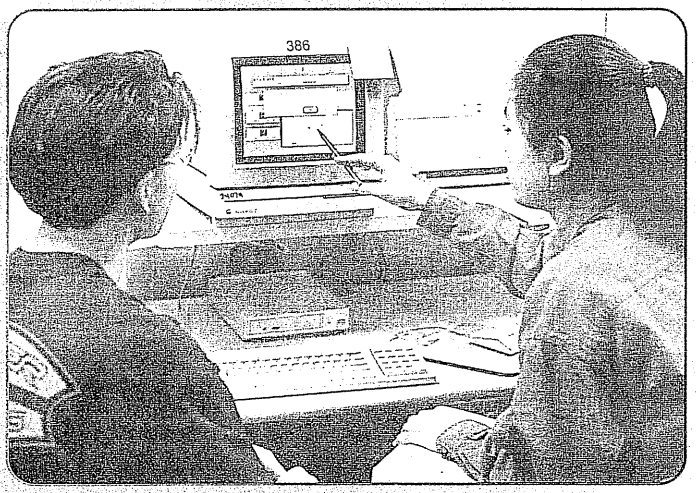
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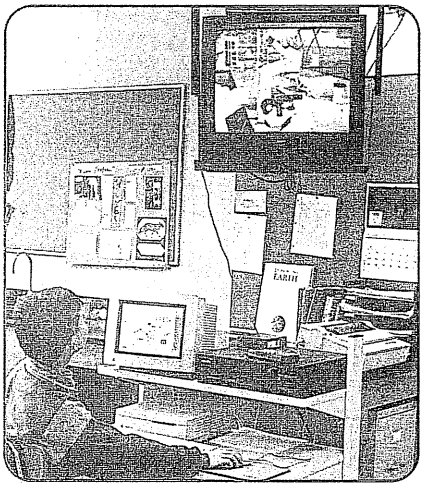
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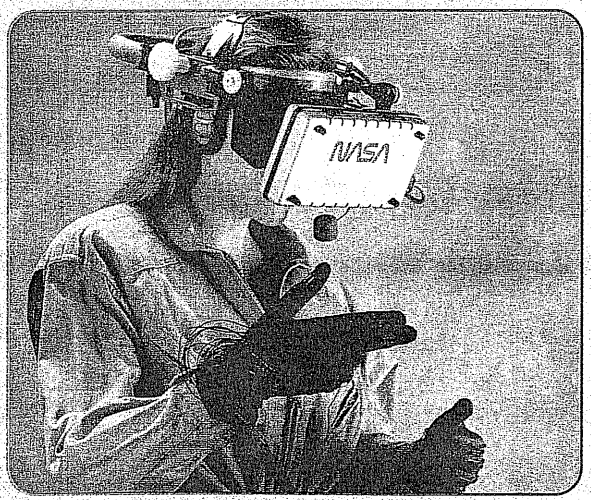
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The advocates of multimedia see these systems as powerful tools for students to explore microworlds and to create their own. Like books, these systems allow users to navigate freely through the material. Unlike books, however, they also allow each person to manipulate the information, to change the text, and thus to adapt the material to one's own learning style.









Computers allow you to easily mix text, images, graphics, and data into dazzling multimedia displays. A few years ago these hardware and software combinations were the province of visual designers and computer specialists—today they are accessible to teachers and students. Different configurations have different names: multimedia kits, hypermedia, interactive media, virtual reality, and expert systems. Each has advantages and limitations in terms of instruction. Understanding these is the key to making the tools part of your own repertoire.

Multimedia

OUTLINE

Multimedia Kits
Hypermedia
Interactive Media
Virtual Reality
Expert Systems

KNOWLEDGE OBJECTIVES

1. Define *multimedia* and describe five examples.
2. Describe instructional applications that are especially appropriate for multimedia kits.
3. Describe the purposes of hypermedia and current instructional applications.
4. Describe an instructional situation in which you could use hypermedia materials. Include the setting, topic, audience, objectives, content of materials, and rationale for using this media format.
5. Diagram and briefly describe the components of an interactive media system.
6. Define *virtual reality* and describe how it might be used in education.
7. Describe instructional applications that are especially appropriate for virtual reality.
8. Describe an instructional situation in which you might use an expert system. Include the setting, topic, audience, objectives, content of the system, and rationale for using this format.

LEXICON

multimedia
multimedia kit
hypertext
hypermedia
browse
link
author
script
button
navigate
interactive media
virtual reality (VR)
expert system

Previous chapters have focused on various audio media, visual media, and computers. This chapter discusses combinations of these media, including combinations managed by computers. The generic term **multimedia** refers to the sequential or simultaneous use of a variety of media formats in a given presentation or self-study program.

Multimedia systems may consist of traditional media in combination or they may incorporate the computer as a display device for text, pictures, graphics, sound, and video. The term *multimedia* goes back to the 1950s and describes early attempts to combine various still and motion media for heightened educational effect. Multimedia involves more than simply presenting information in multiple formats; it involves integrating these formats into a structured program in which each element complements the others so that the whole is greater than the sum of its parts. Today examples of multimedia in education and training include slides with synchronized audiotapes, videotapes, CD-ROMs, DVD, the World Wide Web, and virtual reality.

The goal of multimedia in education and training is to immerse the learner in a multisensory experience to promote learning. One can read about walking on a beach. Someone describing the experience orally along with the recorded sounds of the waves enhances the "experience." The addition of motion video lets one "see" the sights. Running one's hands or feet through a box of sand and handling sea shells lets the "experience" become more real. Multimedia makes one's experience as realistic as possible without actually being there.

In the past the predominant mode of providing instructional experiences was the written and spoken word through textbooks and the lecture. As shown in Dale's Cone of Experience (see Chapter 1), "verbal symbols" are the most abstract. A newer form of media, virtual reality, is near the bottom (more concrete) of Dale's Cone. Virtual reality is very effective and efficient in recreating reality and approaches "direct purposeful experiences"—the most tangible mode of learning.

Instructional designers understand that individual learners respond differently to various information sources and instructional methods, so chances of reaching an individual are increased when a variety of media are used. Multimedia also attempts to simulate more closely the conditions of real-world learning, a world of multisensory, all-at-once experiences.

Multimedia addresses different learning styles (see Chapter 3). Auditory learners, visual learners, and tactile learners all benefit from multimedia's varied presentation forms. The redundancy of print, sound, visuals, and motion media allows learners to choose for themselves the most meaningful sensory mode. When you, the instructor, have a clear sense of the objectives and the necessary student practice, you can decide what media will best facilitate the learning and how best to deliver it.

This chapter will explore the following types of multimedia:

- *Multimedia kits*—a collection of materials involving more than one type of medium and organized around a single topic.
- *Hypermedia*—media that allow the composition and display of nonsequential materials.
- *Interactive media*—media that require learners to practice skills and receive feedback.
- *Virtual reality*—media in which users experience multisensory immersions and interact with phenomena as they would in the physical world.
- *expert systems*—software packages that teach learners how to solve a complex problem by applying the collective wisdom of experts in a given field.

MULTIMEDIA KITS

A **multimedia kit** is a collection of teaching/learning materials involving more than one type of medium and organized around a single topic. Kits may include CD-ROMs, filmstrips, slides, audiotapes, videotapes, still pictures, study prints, overhead transparencies, maps, worksheets, charts, graphs, booklets, real objects, and models (Figure 10.1).

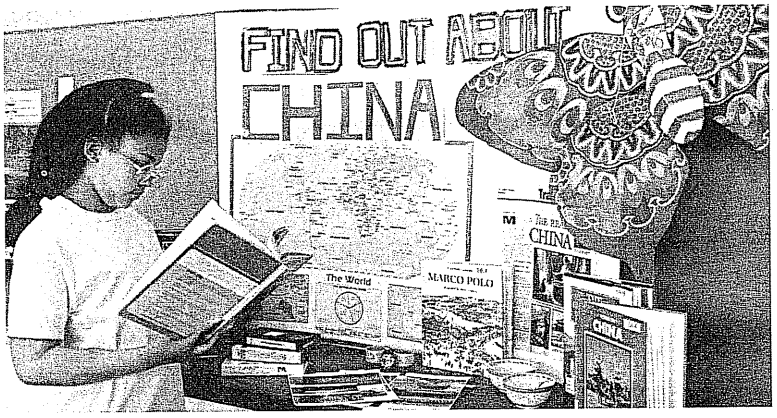
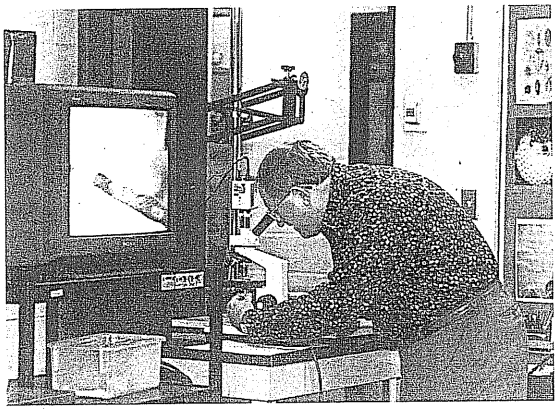


FIGURE 10.1
Multimedia kits provide varied sensory experiences. They give the concrete referents needed to build a strong foundation for more abstract mental abilities.

MEDIA FILE

Environments Module

Commercial Multimedia Kit



Source: Encyclopedia Britannica Educational Corporation.

Barley, bugs, beetles, and brine shrimp are just a few of the living organisms the students work with in this multimedia kit. Relating what they see in the experiments with what they see in the interactive videos, students come to appreciate that living things are dependent on the conditions of their environments.

Among other things, this commercial multimedia kit includes videocassettes and/or videodiscs in both English and Spanish, bilingual computer software, scientific equipment, and coupons to secure live organisms. There is also a teacher guide and teacher preparation video.

Some multimedia kits are designed for the teacher to use in classroom presentations. Others are designed for use by individual students or by small groups.

Commercial multimedia kits are available for a variety of educational subjects. These learning kits may include videotapes, audiocassettes, floor games, board games, posters, full-color photographs, activity cards, murals, wall charts, geometric shapes, flash cards, laboratory materials for science experiments, and even puppets to act out stories. They also normally include student workbooks and a teacher's manual.

Teachers or media specialists can also prepare multimedia kits. The main purpose of a kit is to give learners a chance at firsthand learning—to touch, to observe, to experiment, to wonder, to decide.

Availability and cost of materials are obviously important considerations. Will there be one kit for all students to share, or can the kit be duplicated for all? Are the materials reusable? If not, you will need replacement supplies. Will the kit include audiovisual materials? If so, where will students find the necessary equipment? Can the kit be used in a variety of instructional situations?

Advantages

- *Interest.* Multimedia kits arouse interest because they are multisensory. Everyone likes to touch and manipulate real objects—to inspect unusual specimens up close.
- *Cooperation.* Kits can be an ideal mechanism for stimulating small-group project work. Cooperative learning activities can revolve around experiments,

CLOSE-UP

A TEACHER-MADE MULTIMEDIA KIT

An elementary teacher developed a series of separate multimedia kits on science topics for use with her third-grade class. She incorporated real objects, such as musical instruments, magnets, small motors, rocks, harmless chemicals, and insect specimens in the kits. She also gathered pictures associated with each topic from magazines and old textbooks. A study guide, prepared for each unit, required students to inquire about the topic, make hypotheses, and conduct investigations. References were included for books on the topic and other nonprint sources. Audiotapes were prepared for use at school and at home for students who had access to audiocassette players.

For a unit on sound, the teacher prepared the multimedia kit shown in the photo, which includes several musical instruments, cassette recordings of common noises for listeners to identify, anatomical models of the human ear, books about how humans hear, and educational videos explaining how animals like bats, dogs, and dolphins hear and use sound.



The students enjoyed taking the kits home to work on the experiments. The response from parents was very positive. Several parents reported that they, too, learned by working through the activities with their children. Students often preferred to stay in at recess and work on the multimedia kits in the science corner.

MEDIA FILE

Understanding Taxes

Multimedia Resource Package



Source: Internal Revenue Service.

The *Teacher Resource Package,* available from the IRS, serves as an introduction to taxes for high school students. The content enhances teaching about the history, politics, and economics of the U.S. tax system. Activities include preparation of Forms W-4, 1040EZ, and 1040A. Media included in the large 3-ring, loose-leaf binder include a CD, a videotape, overhead transparencies, handout masters, lesson plans, and a user's guide for the computer software supplement. A website (www.irs.treas.gov/taxi) provides online learning centers developed for high school students and teachers. (TAXI stands for Tax Interactive). The resource package is available free to teachers and is updated with annual mailings.

problem solving, role playing, or other types of hands-on practice.

- *Logistics.* Kits have an obvious logistical advantage. Being packaged, they can be transported and used outside the classroom, such as in the media center or at home.

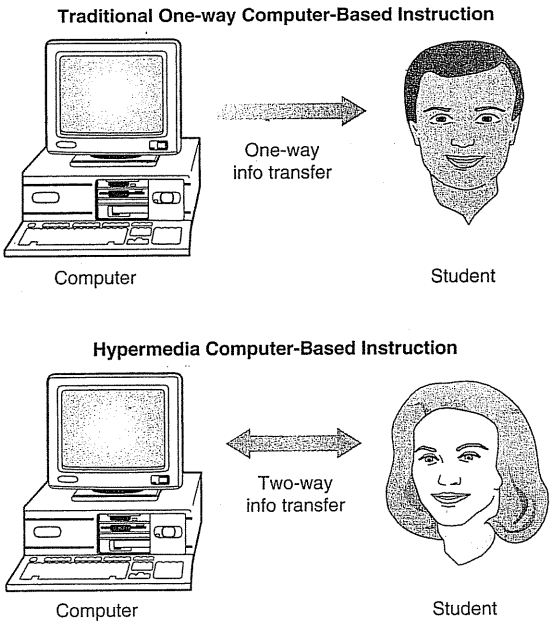
Limitations

- *Expense.* Learning with multimedia kits can be more expensive than with other, more conventional, methods.
- *Time consuming.* It can be time consuming to produce and maintain the materials.
- *Replacement.* Lost components can make the kit frustrating to use.

Integration

Multimedia kits are particularly well suited to content for which discovery learning is preferred. You can pose questions to guide learners' exploration and arrival at conclusions. Science topics are well suited to this approach. For example, a kit on magnetism might include several types of magnets, iron filings, and metal objects that may or may not be attracted to magnets. In mathematics, a kit on measurement might include a folding meter stick and directions for measuring various objects and dimensions around the home or in school.

FIGURE 10.2
Hypermedia versus one-way computer-based instruction.



HYPERMEDIA

The term **hypertext** was coined by Nelson in 1974 to describe "nonsequential documents" composed of text, audio, and visual information stored in a computer, with the computer being used to link and annotate related chunks of information (nodes) into larger networks, or webs (Nelson, 1974a & b). The goal of hypertext is to immerse users in a richly textured information environment, one in which words, sounds, and still and motion images can be connected in diverse ways. Enthusiasts feel that the characteristics of hypertext parallel the associative properties of the mind, thereby making the construction of one's own web a creative educational activity.

Hypermedia refers to computer software that uses elements of text, graphics, video, and audio connected in such a way that users can easily move within the information. Users choose the pathway that is unique to their own style of thinking and processing information. According to its very nature, it provides a learning environment that is interactive and exploratory (Figure 10.2).

Hypermedia is based on cognitive theories of how people structure knowledge and how they learn. It is designed to resemble the way people organize information

FIGURE 10.3
Hypermedia organization.

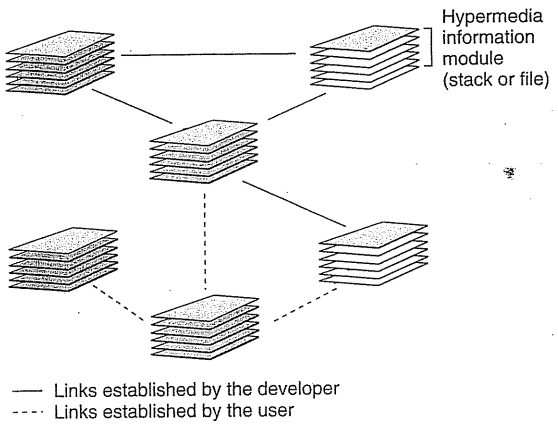
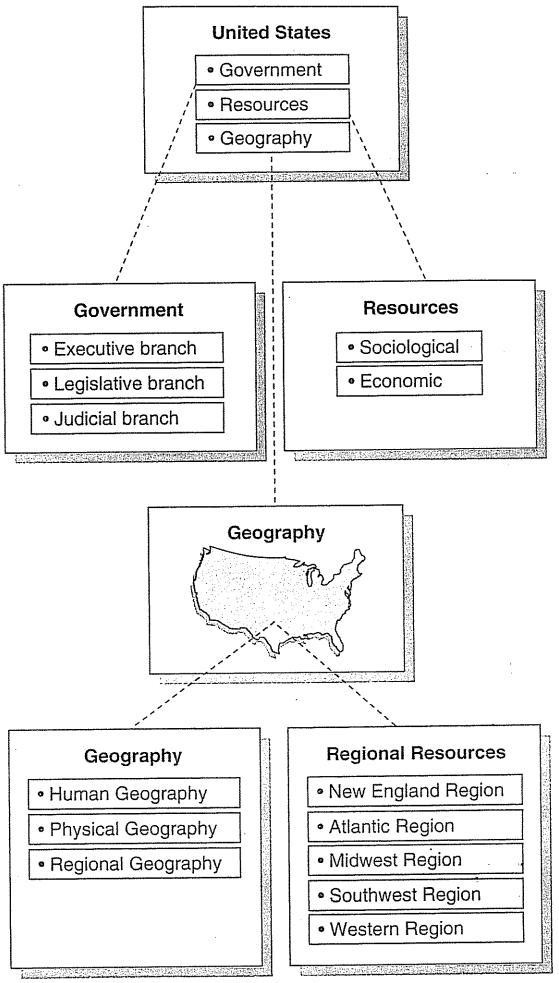


FIGURE 10.4
Sample stack.



with concepts and their relationships. These relationships, or *links,* are associations between ideas—for example, when thinking about bicycles, one creates a link between ideas about transportation and recreation. With hypermedia, one can link asynchronous data sources directly to compose and display nonsequential information that may include text, audio, and visual information. There is no continuous flow of text, as in a textbook or novel. Rather, the information is broken into small units that the author or user associates in a variety of ways. Using the bicycle example, learners can connect the word "bicycle" with a photo of a girl riding a bicycle in a field and a video clip of a Hong Kong boy carrying a duck to market on the back of a bicycle (Figure 10.3).

The intent of hypermedia is to provide users with possibilities to move about within a particular set of information without necessarily using a predetermined structure or sequence. The chunks of information are analogous to notes on a collection of cards. Each card contains a bit of information. Subsequent cards or sets of cards (often referred to as *stacks*) may contain extensions of the information from the initial card or other relevant or related information (Figure 10.4). Hypermedia programs are usually set up so that each computer screen display is equivalent to what is displayed on one of the cards.

Computer hypermedia systems can be used for several different purposes:

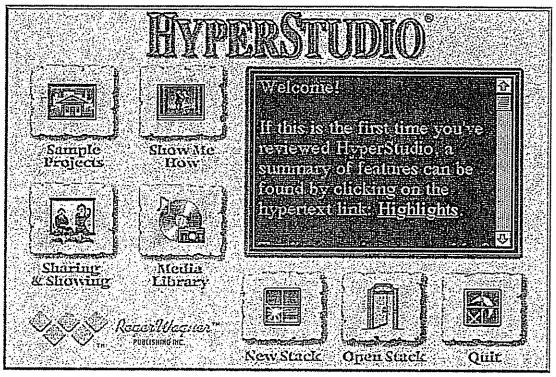
- Browsing. Users **browse,** or navigate through the information, by choosing routes that are of interest. You can explore features in detail as it suits your personal learning style.
- Linking. Users can create their own special connections, or **links,** within the information.
- Authoring. Users can **author,** or create, their own unique collections of information, adding or linking text, graphics, and audio as they wish. They can retain this creation for their own individual use, or share it with others, or use it to prepare a report or presentation.

Hypermedia materials can be created easily (see "How to . . . Create a HyperStudio Stack"). The user can write a **script** using a special scripting language that is more like spoken language than earlier programming codes (such as those used for BASIC and Pascal). Any object can become "hyper" through scripting. For example, a word can become "hot," thus allowing users to connect to a glossary or to other concepts associated with that particular term. Graphics and buttons can also be scripted as links to other information. Users, with the aid of a mouse, point to a word or button and click the mouse. A **button** is an icon that might be a picture or graphic or might look like a button one might press on any electric device.

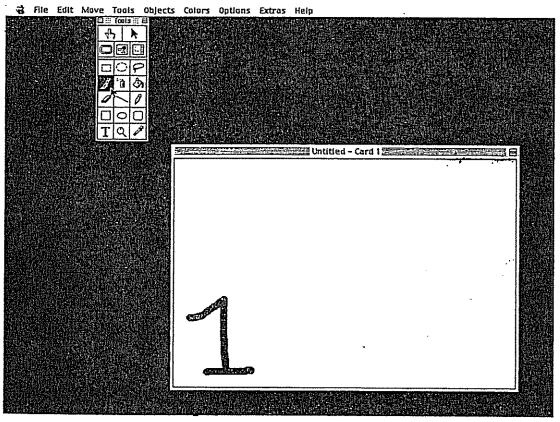
HOW TO . . . Create a HyperStudio Stack

A simple *HyperStudio* stack is the foundation for more complex types of hypermedia materials. By following the steps here, you will be able to create a basic three-card *HyperStudio* stack. You will then be able to create hypermedia materials to use with your students. You can also use these steps to get your students started in creating their own hypermedia materials.

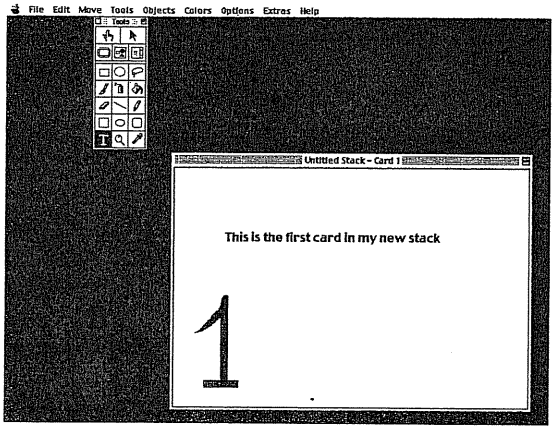
1. Start *HyperStudio* by double-clicking on the icon for *HyperStudio* (do not use the *HyperStudio Player* program).



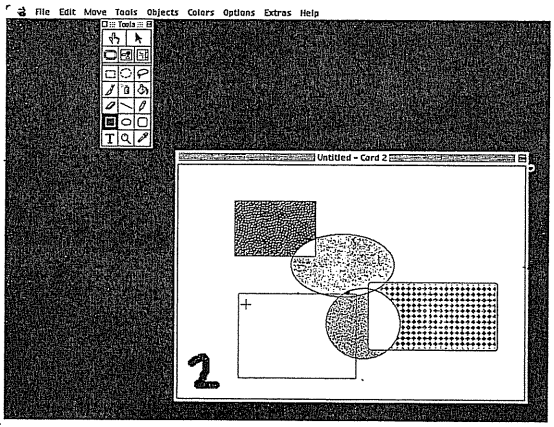
2. Choose the *New Stack* button at the bottom of the screen. This will open the New Stack Dialog boxes on your screen to let you create a new stack. Generally you will want to save your new stack on your floppy disk; therefore, you will need to select the *Save Stack As* . . . option under the File menu. Type in the name of your new stack in the "Please Name This Stack" box and click on the "Save" button. It helps to name your stack with a descriptive name.



3. Your first card will appear. This will be the title card for your new stack. Open the "Tools" menu and select the paintbrush tool by pointing to it and clicking on it as shown. Draw a "1" in the corner of your card (this will help you later when you try to find your way around your stack). Because this is your title card, you will want to type the name of your stack here. Select the "letter tool" from the Tools menu (bottom left corner), click on an area of your card to type, and type the stack's name.

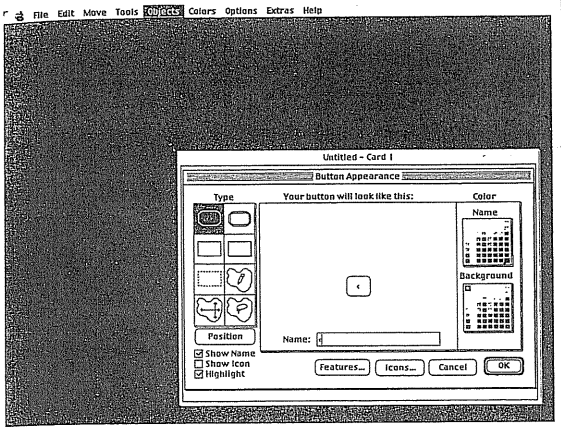


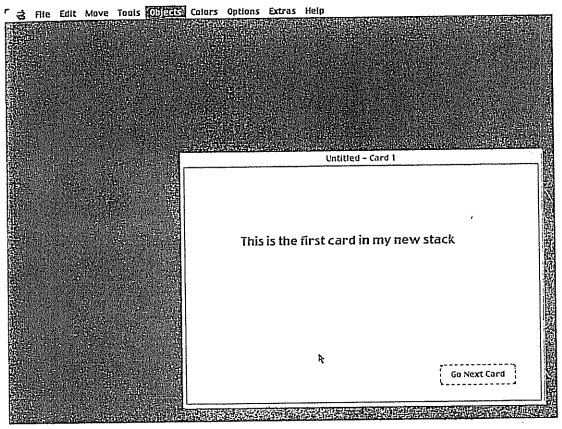
4. You are now ready to add a card to your stack. Select *New Card* from the Edit menu. A new blank card will appear on your screen. This is the second card in your stack. Use the paintbrush tool to paint a small "2" in the corner of this card. Because this is your second card, let's play with some of the other tools in the Tools menu. Select a rectangle or circle tool (those with solid outlines). When you move the cursor into the white area of your card, you will see a small "+." Shapes are built on the diagonal in this program, so select the upper left corner of your shape, holding your mouse button down, drag your mouse in a diagonal away from that corner. A rectangle or circle will appear. Make several; design a picture made of shapes.



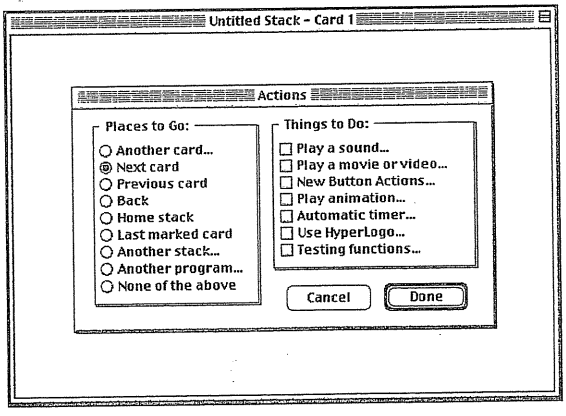
5. Add a third card to your stack by selecting *New Card* from the Edit menu. Another blank card will appear. This is the third card in your stack; mark it with your paintbrush with a "3" in the corner. Let's try using some of the other tools for drawing. Select the spray can or the pencil from the Tools menu and draw a picture on your card. Remember to click and drag with your mouse when you want the image to appear.
6. Now it is time to add buttons to your stack. Select *First Card* from the Move menu at the top. This will take you to the first card in the stack. Notice the "1" in the corner (you can erase this now using the eraser in the Tools menu if you

want). Select *Add a Button* from the Objects menu. A new button dialog box will appear in the middle of your card.

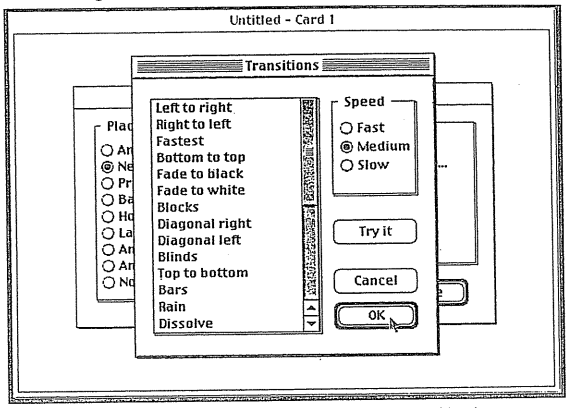




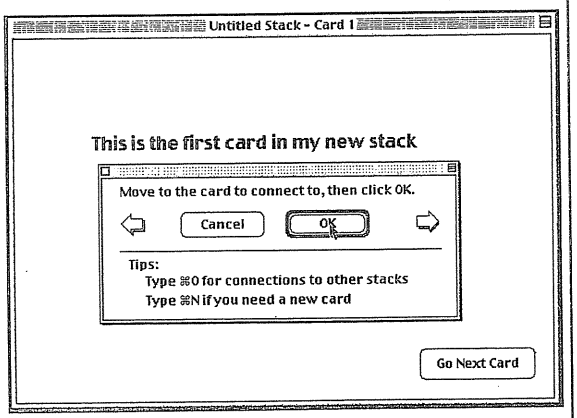
7. You can give your button a name, such as "Go Next Card." Make sure there is a check mark in the box next to "Show Name." Also make sure there is a check mark next to "Highlight," as shown. Select the *Position* button at the left of the dialog box. You can place the button on your card wherever you would like it to appear.



8. Click on the white space of your card. You will be back at the *Button* dialog box. You can click on "OK". You will open the *Actions* dialog box. Select the *Places to Go* radial button that indicates "Next Card." You will open the *Transitions* dialog box as shown. Select a transition and speed. Click on "OK." You will return to the *Actions* dialog box. Click on "Done."



9. Make a button on your second card that will take you to the third one in your stack. Follow the same procedures in steps 6–8.
10. When you are at your third card, you will make a button to link to the first card in your stack. Select *Add a Button* from the Objects menu to get a button on your card. After naming your button (perhaps "Go First Card") and marking "Show Name" and "Highlight," click the "OK" button in the lower right area of the dialog box. Position your button on your card. Click on the white space of your card. The *Actions* dialog box will appear. Select "Another Card" from "Places to Go."



11. Use the left arrow to move to your first card. Your first card will appear behind the window. After clicking on the "OK" button one time, you will be back at your third card with the *Transitions* dialog box. Select your transition and speed and click on "OK." Now click on "Done."
12. Click on the "Go First Card" button and you will go to the first card. Try clicking on each of your buttons. You should now be able to navigate through a simple linear stack that you have scripted and linked. Just imagine all the fun things you and your students can now create!

HyperStudio 3.0, 1999. All rights reserved. Used with permission.

The button is used to move around in the hypermedia environment. In a hypermedia environment, then, you activate the link and make the connection between pieces of information. The linking interface lets you **navigate,** or move about, more quickly and precisely within a hypermedia environment. The interactive nature of hypermedia is the essence of its advantages. Hypermedia engages learners to make choices about moving within the material in meaningful ways, thus fulfilling the requirement of learner participation (the R of the ASSURE model).

Advantages

- *Engrossing.* The opportunity for deep involvement can capture and hold student interest.
- *Multisensory.* The incorporation of sounds and images along with text expands the channels to the mind.
- *Connections.* By using "hot buttons" students can connect ideas from different media sources; for example, connecting the sound of a foghorn with the word "lighthouse."
- *Individualized.* Web structure allows users to navigate through the information according to their interests and to build their own unique mental structures based on their exploration.
- *Teacher and student creation.* Software allows teachers and students to easily create their own hypermedia files; student projects can become opportunities for collaborative work.

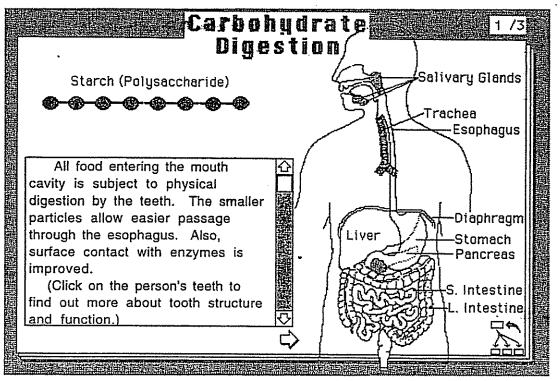
Limitations

- *Getting lost.* Users can get confused, or "lost in cyberspace," when using hypermedia programs because of limited clues as to where they are in the material.
- *Lack of structure.* Students whose learning style requires more structured guidance may become frustrated. Students may also make poor decisions about how much information they need to explore.
- *Noninteractive.* Programs can be simply one-way presentations of information with no specific opportunities for interactive practice with feedback.
- *Complex.* More advanced programs may be difficult to use, especially for student production, because they require the ability to use a scripting language.
- *Time consuming.* Because they are nonlinear and invite exploration, hypermedia programs tend to require more time for students to reach prespecified objectives. Because they are more complex than conventional instructional materials, hypermedia systems require time for both teachers and students to learn to use.

MEDIA FILE

Digestion

Multimedia Program



Source: HISC.

A hypermedia stack designed for high school science students, *Digestion* contains carefully drawn diagrams. The graphics are designed with the complexity necessary to convey the information without being too difficult for the students. In addition, the text is easy to read and the material is presented in a comprehensive manner.

Integration

Hypermedia can be developed and used on the computers that are commonly found in schools. They are applied in all areas of the curriculum, for any learning goals that are suited to individual or small-group exploration of a body of information. Hypermedia programs are available as off-the-shelf courseware; teachers can create them to fit unique local needs; or students can create them as a way of organizing and synthesizing their research on a topic of interest.

Ready-made hypermedia instructional courseware is becoming available for teachers to use in their classrooms. Many titles have been developed for use in all areas of study. For example, *Digestion* (see "Media File") is designed to be used by secondary science students; with complex and accurate diagrams, students can learn about the process of digestion. This program is available as a complete package; you do not have to do anything to the software. However, you will need to consider how to best introduce the application into the curriculum and what types of followup are appropriate.

Connie Courbat, a third-grade teacher, developed *HyperStudio* stacks to use with her students for their study of the Oregon Trail and the westward movement. Her academically challenged students used an instructional

© COPYRIGHT CONCERNS: MULTIMEDIA MATERIALS

The advent of new technologies, such as the Internet, the World Wide Web, CD-ROM, and videodisc, have made it necessary to re-examine the copyright laws in view of multimedia capabilities. In September 1996, a U.S. House of Representatives Subcommittee on Courts and Intellectual Property adopted a set of fair use guidelines for the production and use of multimedia in educational settings. These guidelines include the following allowances:

- When creating multimedia programs, students and teachers may legally use the following copyrighted materials:

  Text: up to 10% or 1,000 words, whichever is less
  Audio: up to 10%, but not more than 30 seconds
  Images: not more than five images by the same artist or photographer
  Video: up to 10% or three minutes, whichever is less
  Numerical data: up to 10% or 2500 fields or cell entries, whichever is less

- Educators may use their multimedia projects and materials for educational purposes for a period of up to two years after the first instructional use in class. Beyond that period they must acquire permission of the holders of each copyrighted portion.
- Students and educators may retain multimedia projects for personal portfolios to be used later for assessment of learning or for tenure review and job interviews.
- Educators and students are advised to include at the opening of their multimedia project and in any accompanying print material a notice that certain materials are included under the fair use exemption of the U.S. copyright law. It is always best to give credit for the sources of any materials used. For information concerning usage guidelines for online information and data, see the following Internet sites:

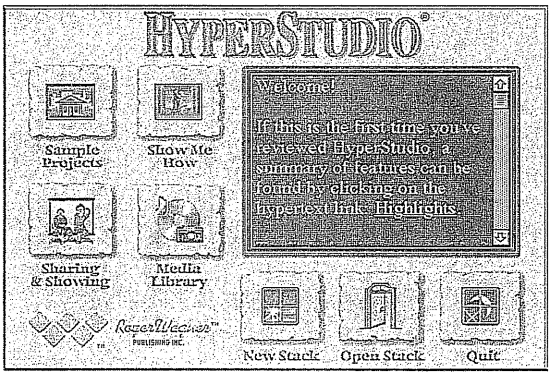
  Copyright and fair use: http://fairuse.stanford.edu/
  Cyberspace law for nonlawyers:
  http://www.counsel.com/cyberspace/
  U.S. Copyright Office: http://lcweb.loc.gov/copyright/
  U.S. House of Representatives Internet Law Library—intellectual property; copyright:
  http://law.house.gov/325.htm

For additional information on this topic and to visit these websites, go to the Web Links module in Chapter 10 of the Companion Website (http://www.prenhall.com/heinich). For general information on copyright, see the Copyright Concerns on page 87 in Chapter 4. Suggested readings on copyright appear at the end of Chapter 4.

MEDIA FILE

HyperStudio

Multimedia Program



Source: HyperStudio & SiteCentral.

HyperStudio is a multimedia authoring system that offers teachers and students the ability to bring together text, sound, graphics, and video in a single presentation. Teachers can prepare materials in exciting ways and address student learning through multiple modalities. Students of all ages can create their own colorful multimedia projects.

stack and reported on the information they learned. With her more advanced students, she developed a shell for stacks that her students could use to create their own stacks. These stacks were created to help the rest of the class learn more about the Westward movement. All the students had an opportunity to utilize hypermedia in a manner appropriate to their learning levels, and everyone enjoyed their learning experiences.

Teachers can either adapt existing materials or create new materials to fill a need of their own students. When you and your students are creating any multimedia materials, be certain to follow copyright guidelines (see "Copyright Concerns"). Because hypermedia software—for example, *HyperStudio* (see "Media File")—provides an easy-to-use authoring language, many teachers have learned to successfully develop their own hypermedia materials. See "How To . . . Create a *HyperStudio* Stack" for directions on using one popular authoring system. One caution: Don't think that ability to use the authoring tool automatically bestows expertise either in instructional design or visual design. These skills are usually developed through special study and lots of practice. Some advice on screen design is provided in Chapter 5, "How To . . . Design Computer Screens."

Hypermedia can shift the roles of teacher and learners in the classroom. Because hypermedia materials are so easy to develop, it is feasible for students to create their own

programs and thus gain the benefits of creative learning. Given instruction, students can create hypermedia materials that revolve around a particular topic of study. Your role becomes that of resource person for the students.

Digital video can be added to hypermedia files with little effort. Most computer systems have the capabilities of adding digitized "video clips" without any additional software or hardware. For example, *QuickTime* color "movies" can be imported into *HyperStudio* stacks with ease. In addition, *QuickTime* movies can be added to other types of files, such as word processing documents.

It is beyond the scope of this chapter to describe in detail the various techniques for developing hypermedia. Resources on hypermedia development are listed in the Suggested Readings at the end of the chapter.

INTERACTIVE MEDIA

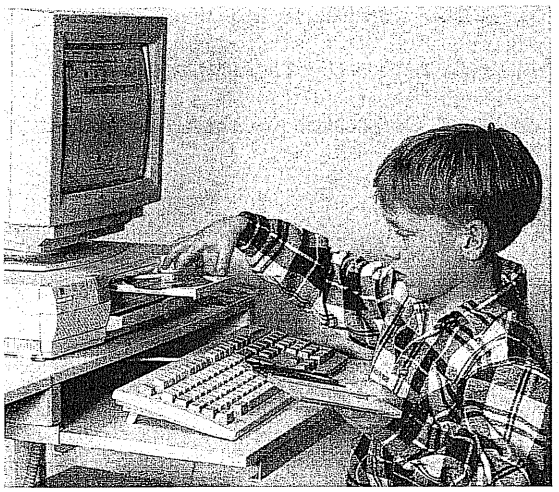
Computer-based **interactive media** creates a multimedia learning environment that capitalizes on the features of both video and computer-assisted instruction. It is an instructional delivery system in which recorded visuals, sound, and video materials are presented under computer control to viewers who not only see and hear the pictures and sounds but also make active responses, with those responses affecting the pace and sequence of the presentation.

The video portion of interactive media is provided through a CD-ROM, DVD, or the Web. Because CD-ROM discs can store many types of digital information, including text, graphics, photographs, animation, and audio, they are popular in school settings, library media centers, and classrooms of all sorts. Anything that can be stored on a computer disk can be stored on a CD-ROM (Figure 10.5). Multimedia CD-ROM products are commonly found in school library media centers, primarily in the form of encyclopedias or other reference databases. There is still relatively little application of multimedia and hypermedia to core instruction in schools. In higher education there is large-scale experimentation with locally produced multimedia and hypermedia, but standardized formats or universal acceptance of such technologies for core instruction across institutions remain to be established.

The images can be presented in slow motion, fast motion, or frame by frame (as in a slide show). The audio portion may occupy two separate audio channels, making possible two different narrations for each motion sequence.

The interactive aspect of interactive media is provided through computers, which have powerful decision-making abilities. Combining computers and video allows the strengths of each to compensate for the limitations of the other to provide a rich educational environment for the learner. Interactive media is a powerful, practical method for individualizing and personalizing instruction.

FIGURE 10.5
CD-ROM discs are popular for storing interactive media programs.



With the introduction of hypermedia, it has become easier to prepare teacher-developed and student-developed interactive multimedia. Students are discovering an innovative way to activate their learning through simple-to-prepare hypermedia stacks.

The heart of an interactive media system is the computer, which provides the "intelligence" and interactivity required. The computer can command the system to present audio or video information, wait for the learner's response, and branch to the appropriate point in the instructional program from that response.

The learner communicates with the instructional program by responding to audio, visual, or verbal stimuli displayed on the monitor. Input devices provide the means for these responses. These devices include such items as a keyboard, keypad, light pen, barcode reader, touch-sensitive screen, and mouse.

A monitor displays the picture and emits the sound from the video source. It can also display the output from the computer software, which may include text, graphics, or sound effects. In most systems the computer output can be superimposed over the video image.

The interface device provides the link between the computer and the video player, allowing them to communicate. Through this device the computer can control the portions of the video learners will see.

Advantages

- *Multiple media.* Text, audio, graphics, still pictures, and video can all be combined in one easy-to-use system.

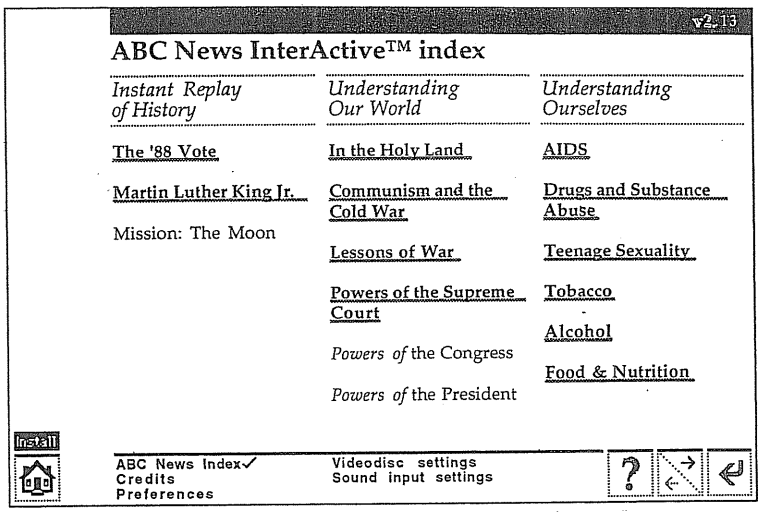


FIGURE 10.6
ABC News InterActive® is a series of interactive video materials that can be used by the teacher to supplement a unit of study or by students to explore a topic in depth.

- *Learner participation.* The R of the ASSURE model is achieved with interactive video materials because they require that learners engage in activities. These materials help to maintain students' attention, and they allow greater participation than does video viewing alone.
- *Individualization.* Individualization is provided for because branching allows instruction on remedial as well as enrichment levels.
- *Flexibility.* The learner may choose what to study from the menu, such as in the ABC News InterActive™ series (Figure 10.6).
- *Simulations.* Interactive video may be used to provide simulation experiences in such areas as medicine, machine operations, and especially interpersonal skills. The development of skills in working with children in a classroom, which otherwise would require role playing or live interactions, can be provided as an individual, self-paced simulation exercise.

Limitations

- *Cost.* The most significant limitation to interactive video is the cost, although the prices of ready-made discs and machines are decreasing.
- *Production expense.* It is expensive to produce CD-ROM and DVD discs, making it necessary to rely on commercially prepared discs, which may not meet local needs.
- *Rigidity.* The discs cannot be changed once they have been made; therefore, material may become outdated.

Integration

Interactive media is a valuable learning system for tasks that must be shown rather than simply told. Some instruction cannot be adequately presented by printed materials. If learners need to interact with the instruction, interactive media is an appropriate choice.

Interactive media systems are currently being used in a variety of instructional applications, from teaching scientific phenomena to teaching special education students to tell time. The programs can challenge a small group of gifted students or provide remedial instruction for students who might be having difficulty with particular concepts.

Interactive media programs can be used by individuals as well as small groups. There is a growing trend, particularly in elementary education, toward small-group applications, providing opportunities for students to engage in cooperative and collaborative problem-solving activities.

Interactive media may also be used for large-group instruction. The teacher alone may use the instructional program, with large-screen projection or an LCD panel for presentation to the whole class. The teacher can then move through the material in a sequence that will promote learning—stopping where appropriate for discussion, jumping ahead to new material, or reviewing when necessary. The pause-and-discuss method might work well when reviewing a topic.

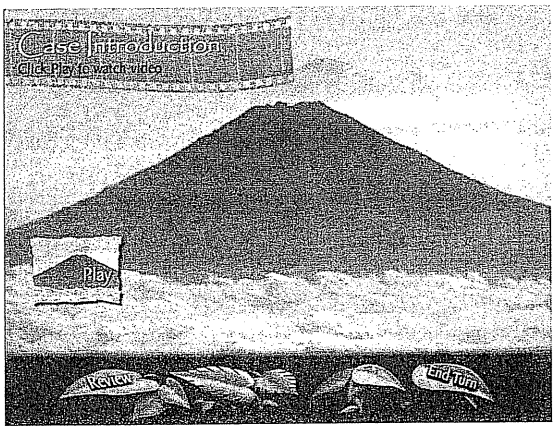
For example, you might use the ABC News InterActive™ feature, *In the Holy Land,* in a social studies unit. Here students have the opportunity to explore the Middle East from the perspectives of the children who live there.

Although interactive media is becoming readily available in the schools, it has actually been used in training since the early 1980s by many corporations and the military. The use of packaged programs was more than twice as common as the use of custom-designed programs. Such areas as medicine, auto mechanics, electronic ignition systems, and communication skills have been taught using interactive media materials.

MEDIA FILE

Rainforest Researchers

CD-ROM and Videotape



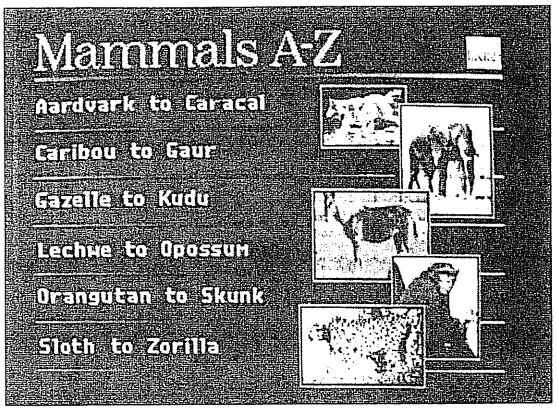
Source: Tom Snyder Productions.

This combination of CD-ROM, videotape, and printed materials virtually puts your students in the middle of the Indonesian rainforest. They work as teams of scientists and through collaborative problem solving explore the diverse and mysterious web of life in this rich ecosystem. Students work in cooperative teams of four, each taking on the role of a chemist, ethnobotanist, taxonomist, or ecologist. Teams watch a videotape and use onscreen displays to guide them in analyzing information, collaborating, and making decisions. This innovate package was selected as Best Curriculum Software for Middle Schools by the Software Publishers Association.

MEDIA FILE

Mammals

Multimedia Encyclopedia



Source: National Geographic Educational Services.

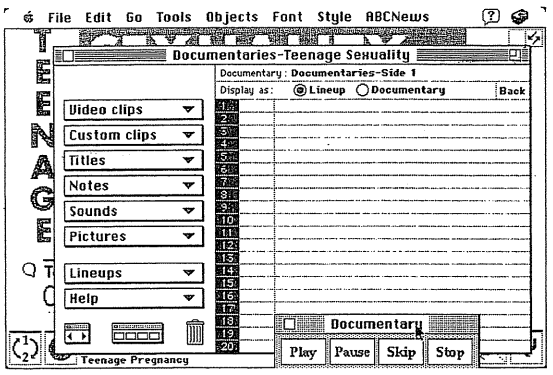
Mammals is a CD-ROM that serves as a multimedia encyclopedia of this branch of the animal kingdom. It contains entries on more than 200 different animals, 700 full-screen color photographs, 155 animal vocalizations, 150 range maps, essays on every animal, and 45 full-motion film clips from National Geographic specials. *Mammals* has been praised by *Media and Methods* magazine and received an Award of Excellence from *Technology and Learning* magazine.

CLOSE-UP

SEX, TEENS, AND VIDEOTAPE

Nadine Davidson, a consumer science and family living teacher, has her students prepare formal reports to present in class using the ABC News InterActive™ series, *Understanding Ourselves.* The students are organized to work in groups, each choosing a particular topic of study. They use the "Teenage Sexuality," "All About AIDS," and "Drugs and Substance Abuse" sets. The students prepare videotapes (although they could use the computer and videodisc player setup) to use within the context of their group presentation to the class.

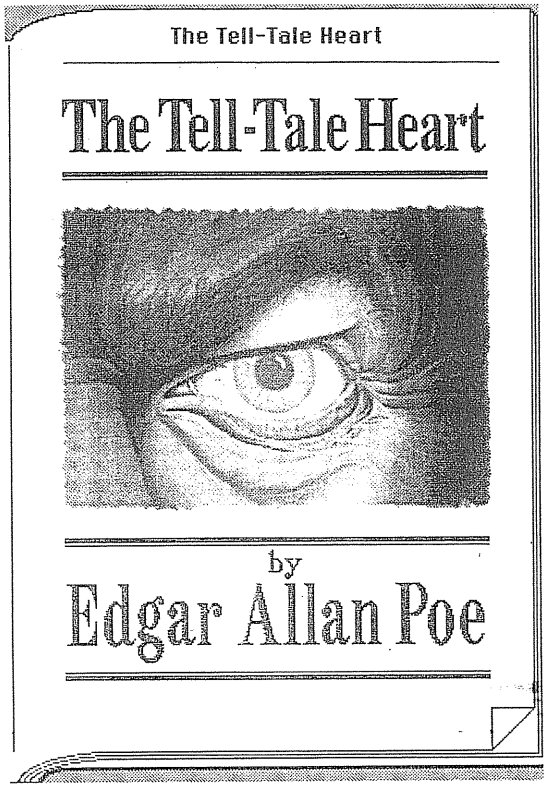
Nadine has found that not only are her students more excited about doing the group reports, they are more engaged in the learning tasks. They not only use the ABC News InterActive™ materials, they also rely on information gathered through the school media center and online database sources. The students have stated that they find this experience interesting and educational.



MEDIA FILE

The Tell-Tale Heart

CD-ROM



Source: Discis Books.

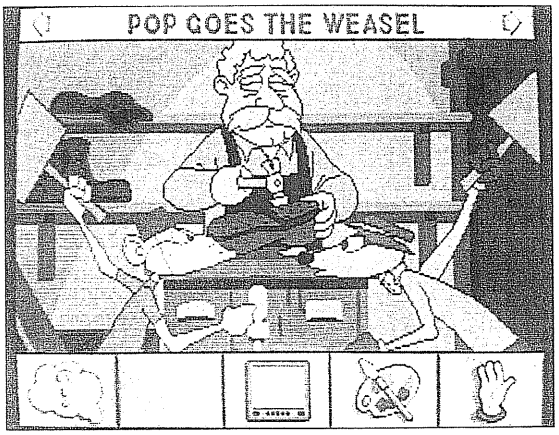
This Edgar Allan Poe classic is a first-person account of a younger man's obsession with an old man's eye. This Discis Book brings this classic to life. Teachers can easily customize the Discis Book experience with a range of built-in educational options. Two different oral interpretations of the short story are available, as well as vocabulary help, sound effects, and a Spanish translation. Online questions are available for further exploration of the text. These questions can be used to stimulate student curiosity and critical thinking and to promote group discussions.

Interactive multimedia formats are beginning to gain a foothold in corporate training, primarily to deliver basic courses across multiple sites. Lack of hardware and software compatibility has restricted the availability of off-the-shelf courseware. Organizations are beginning to incorporate more multimedia courseware into their training programs as compatibility improves; thus, the supply of less expensive off-the-shelf materials is increasing as the demand rises.

MEDIA FILE

Cartoon Jukebox

Interactive Songbook



Source: Philips Corporation.

Young children can enjoy hours of interactive play with their favorite tunes, such as "Pop Goes the Weasel," "Row, Row, Row Your Boat," and the "Alphabet Song." Children can make the songs come alive when they select the colors and the language in which they want to sing. Each song is illustrated with original animation, and with the controller the figures and characters in each cartoon can be painted with interesting colors. Children can sit back and sing along with their personalized animated renditions of the songs.

VIRTUAL REALITY

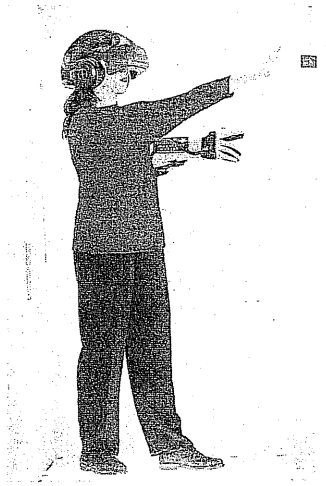
Virtual reality (VR) is one of the newest multimedia applications of computer-based technologies. Virtual reality is a computer-generated three-dimensional environment where the user can operate as an active participant. The user wears a special headpiece that contains a three-dimensional liquid crystal video display and headphones. The user participates within the three-dimensional world by manipulating a joystick or a special glove worn on one hand. The data glove may be used to point, handle, and move objects and to direct the user's movements within the virtual world (Figure 10.7).

The essence of virtual reality is the expansion of experiences for the user. Because VR places the user into the virtual environment, it provides an opportunity to interact with that environment in a unique way, giving the user the "ultimate" chance to grasp new ideas.

Advantages

- *Safety.* Virtual reality creates a realistic world without subjecting viewers to actual or imagined danger or hazards.

FIGURE 10.7
Virtual reality puts the user "into" a multisensory experience.



- *Expansive.* It provides students with opportunities to explore places not feasible in the real world (e.g., outer space or inside an active volcano).
- *Opportunities to explore.* Virtual reality allows students to experiment with simulated environments.

Limitations

- *Cost.* The equipment is extremely expensive.
- *Complexity.* The technology is complex and does not lend itself to most classroom uses.
- *Limited titles.* There are limited software "realities" available at this time.

Integration

Computer-controlled environments allow users to experience multisensory immersion and to interact with certain phenomena as they would in the physical world. Several applications of virtual reality have been demonstrated to be highly effective. One such application is in the area of space exploration. Because virtual reality can simulate the outer space environment, the user can practice exploring space safely and efficiently. Without this type of technology, such an experience would be impossible for all of us.

The most visible applications of VR have been high-fidelity simulators for airplane and Space Shuttle flight training and tank warfare training. VR also allows people to experience things not possible in the physical world. They can take a virtual ride through the human circulatory system or can tour an ancient Mayan civilization. VR has also found successful applications in healthcare, architecture, interior design, city planning, product design, and all sorts of activities involving visualization (McLellan, 1996). One application found at the school level is the "virtual field trip." Adaptive technologies for special education are also being developed and tested.

Virtual reality is still largely experimental in formal education. Still in its infancy because it is expensive and time consuming to develop, VR requires specialized equipment and accessories, and cannot run on a typical desktop computer with its limited memory. It is beginning to be used in professional training in fields such as architecture, the sciences, and healthcare. In the future, as its development and implementation costs decrease, virtual reality will be used widely in education and training.

Virtual reality has shown great promise in the area of medicine. The virtual hospital provides training and updating for medical professionals throughout the country. Given that most hospital staff cannot leave their assigned duties for any length of time, a training climate that simulates the hospital environment while helping staff to upgrade their skills is ideal. The virtual hospital also provides information on new techniques and resources that might prove valuable in particular settings.

Some VR applications are appropriate for schools. One example is a math program that lets students explore solutions to problems by actually manipulating the variables. Students experience algebraic concepts by moving numbered cubes in space, thus developing a unique understanding of the concepts.

Beyond simply manipulating the numbers to solve the problems, this math program lets the teacher decide if it should correct students when they make an error. The teacher may decide to let the computer program ignore only certain types of errors to let students discover the mathematical relationships for themselves.

A new direction in VR has come in the form of three-dimensional rooms, or *caves*, where the user actually stands within the virtual environment, experiencing it from a total three-dimensional perspective. Such applications as neurobiology and pharmacology have capitalized on this technology. Now scientists can enter a cell and manipulate or insert molecules and then observe the results of these actions.

The potential for this type of technology in the area of special education is exciting. Providing safe yet detailed lifelike learning experiences for students with learning problems has promise.

Another variation on virtual reality is the application *QuickTime VR*. *QuickTime VR* utilizes several tools that allow students to create unique realities using simple tools. A *QuickTake* camera on a special tripod attachment lets the student take photographs of an environment in a 360-degree perspective. Computer software "stitches" the digital pictures together and creates a special movie. When viewing the movie, the user can, with a simple movement of the mouse, move the picture in any direction. This gives the user the feeling of standing in a spot and turning around, looking in any direction.

As virtual reality tools improve and their costs decrease, students and teachers will be able to explore ways of using this type of technology in learning. It will become possible for them to create their own unique environments. These types of experiences will add to the dimensions of the classroom (literally and figuratively!) in exciting ways.

EXPERT SYSTEMS

Almost immediately after computers became a reality, scientists were intrigued by what they saw as parallels between how the human brain works and how the computer processes information. They wondered whether the computer could "learn" as well as retrieve and collate information. Their experiments led to computers playing games such as checkers and chess with human experts—and winning. Then they explored whether the computer could enable an amateur to play on an equal footing with an expert. It certainly could. But, they reasoned, why limit this capability to playing games? Why not see if this "artificial intelligence" could be applied to more useful problems?

This line of experimentation led to the development of the so-called **expert system.** This is a software package that allows the collective wisdom of experts in a given field to be brought to bear on a problem. One of the first such systems to be developed is called MYCIN, a program that helps train doctors to make accurate diagnoses of infectious diseases on the basis of tests and patient information fed into the computer. Expert systems are slowly making their way into education.

Scholastic Publications has developed a unique program that learns the rules of any game as it plays with its human partner. The student may play the game with self-chosen rules but must identify for the computer the criteria for winning the game. The computer absorbs the rules and eventually wins. Another expert system, the *Intelligent Catalog*, helps a student learn to use reference tools. Any learning task that requires problem solving (e.g., qualitative analysis in chemistry) lends itself to an expert system. *SCHOLAR* is an expert system on the geography of South America. It is an example of a "mixed-initiative" system. The student and the system can ask questions of each other, and *SCHOLAR* can adjust its instructional strategy according to the context of the student's inquiry.

One example that involves individualized learning is an expert system called *CLASS LD.* Developed at Utah State University, the program classifies learning disabilities by using an elaborate set of rules contributed by experts. In tests, the program has proven to be at least as accurate as informed special education practitioners. The next step is to develop a software package that will design an individualized education program (IEP) for children diagnosed by *CLASS LD.* Because many children with learning disabilities are in mainstreamed classes, the expert system would make more manageable the classroom teacher's job of providing appropriate instruction. The school benefits from more effective and more efficient decision making.

Further down the road is an expert system that could truly individualize learning. We can imagine a system that learns all the important aptitudes and personality traits of an individual. When presented with a large body of material to master, the learner would use the expert system as a guide to learning the content in the most effective manner. The program would adjust the content, instructional method, and medium to the learning styles of the student. The learner, not the experts, would be in charge of the program. When this becomes possible, we will really have individualized learning.

A new professional specialty has emerged from the development of expert systems. The term *knowledge engineers* has been coined to describe the people who work with experts in a field to assemble and organize a body of knowledge and then design the software package that makes it possible to train someone to become skilled in the area or to enable anyone to call on the skills of experts to solve a problem. The work of knowledge engineering is similar to that done by instructional designers in task analysis and module design.



CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 10 of the Companion Website (http://www.prenhall.com/heinich).

1. *Using Multimedia Technology in Learning.* Select a topic or standard. Describe three ways to use multimedia technology as described in this chapter to address the diverse learning needs of students and three to develop students' higher-order skills and creativity. (ISTE NETS-T III-A, B, & C; VI-B & E)
2. *Written Reflection.* Identify at least three techniques that develop students' higher-order skills and creativity using multimedia technology. Now compare these techniques with another kind of media (of your choice). Which do you determine works best? Why? (ISTE NETS-T III-C)

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 10 of the Companion Website (http://www.prenhall.com/heinich).

1. Plan a lesson in which you use commercial interactive video materials. Use the "ASSURE Blueprint" template format provided in Chapter 3 or on the "Classroom Link Portfolio" CD-ROM.

APPRAISAL CHECKLIST

MULTIMEDIA

KEY WORDS: _____, _____, _____

Format

- ❑ **Hypermedia**
- ❑ **CD-ROM**
- ❑ **DVD**
- ❑ **Virtual reality**

Title _____

Series Title (if applicable) _____

Source _____

Date _____ **Cost** _____ **Length** _____ minutes

Subject Area _____

Intended Audience _____

Brief Description

Objectives

Entry Capabilities Required (e.g., prior knowledge, reading ability, vocabulary level, math ability)

Rating	**High**	**Medium**	**Low**	**Comments**
Match with curriculum	❑	❑	❑	
Accurate and current	❑	❑	❑	
Clear and concise language	❑	❑	❑	
Arouse motivation/maintain interest	❑	❑	❑	
Learner participation	❑	❑	❑	
Technical quality	❑	❑	❑	
Evidence of effectiveness (e.g., field-test results)	❑	❑	❑	
Free from objectionable bias or advertising	❑	❑	❑	
User guide/documentation	❑	❑	❑	
Clear directions	❑	❑	❑	
Stimulates creativity	❑	❑	❑	

Strong Points

Weak Points

Recommended Action _____ **Name** _____ **Date** _____

Prentice Hall grants the reader permission to reproduce this checklist for personal use only. Heinich, Molenda, Russell, and Smaldino, *Instructional Media and Technologies for Learning* (2002).

A computer version of this Checklist is available on the "Classroom Link Portfolio" CD-ROM.

World History: The Magna Carta

The eleventh-grade world history class has been studying England in the Middle Ages. Their study has focused on the events leading up to the reign of King John and the signing of the Magna Carta. Now they are studying the Magna Carta itself.

Analyze Learners

General Characteristics

These eleventh graders are 16 to 17 years old. They represent a mixed socioeconomic community, as this is the only high school in their midsize city. Their intellectual aptitude is generally average, with some special-needs students mainstreamed into this section. They have demonstrated that they are more engaged in learning when they are more actively involved.

Entry Competencies

The students are near the middle of the course on world history. They have begun to understand how different socioeconomic and political interests compete for power within nations. Unit test scores up to now indicate a range of achievement from below the expected criterion to slightly above it. About a quarter of the students are substantially below their grade level in reading skills.

Learning Styles

The majority of the students' learning styles are high on the verbal and interpersonal scales. Their perceptual preferences and strengths tend to be auditory. The "mind styles" of these students are predominantly concrete sequential and abstract sequential. They, in general, prefer a high degree of structure and are motivated to achieve because most desire to go on to postsecondary education. Other than the special-needs students, there appear to be no significant physiological factors the teacher needs to consider when he designs the lesson.

State Objectives

On completion of the lesson, the students will be able to do the following:

1. Describe the governance of England in the years just prior to 1215.
2. Identify the groups that were vying for political power in England at this period.
3. Paraphrase the main ideas contained in the Magna Carta.
4. Relate the main ideas of the Magna Carta to the interests of the contending groups.
5. Find ideas in today's world parallel to those of the Magna Carta.

Select Methods, Media, and Materials

The teacher, Rod Winters, felt that his students did not have a high level of interest in this topic and saw little relevance to their own lives. However, he also knew that they enjoyed working in small groups, especially if they could choose their own teammates and topics. So he decided to approach this topic through the discovery method by forming the students into project groups, each selecting a different question to pursue.

Mr. Winters knew that some students were learning to create *HyperStudio* stacks in their computer skills class. He felt that they would be excited about using this tool to prepare their reports, so he engaged the computer science teacher, Linda Hibbard, to be a consultant to the students as they developed *HyperStudio* reports.

Because a wealth of materials was available he worked with other teachers to make these materials accessible to his students. Mr. Winters worked with the school library media specialist to place some books on reserve in the library, along with some videos, maps, and other materials. He also arranged for one member of each team to have a special account number for the local university's online database service. The media specialist helped him plan a field trip to the museum that included a visit with a historian from the university.

Utilize Media and Materials

The groups were scheduled to meet with Mr. Winters during the first and second weeks of the project. These meetings were to provide Mr. Winters with information about students' progress on their topic. In addition, he was able to help each group with further ideas about sources of information. The meetings helped to ensure a coordinated effort on the part of each group.

The computer science teacher worked with the students to develop a *HyperStudio* stack shell that would be used by all the groups. The students extended their knowledge of *HyperStudio* and how to design stacks. They also learned how to help their group members when working with *HyperStudio*.

During the third week of study, Mr. Winters and Ms. Hibbard worked together during class time and during other nonscheduled computer lab times to help the groups prepare their stacks.

Require Learner Participation

Each group met with Mr. Winters several times during the two-week period. They presented information about their activities and the ways they were working together as a group. These meetings assured Mr. Winters that each student in the group was participating in the activities.

The groups worked together in the computer lab during class time. Although this made for crowded conditions, the students did not seem to mind. Ms. Hibbard insisted that each member of the group have equal opportunity to work on the *HyperStudio* stack.

When all the stacks were ready, the group leaders met and developed a stack that would provide the user with access to the whole set of stacks. This stack included cards for the title, names of the group members, and a menu of choices to access the various stacks.

Evaluate and Revise

The students were delighted with the results of their activities and requested that they share their stack with the eighth-grade social studies class. They had learned that these students were learning about English history and thought that their stacks might be of interest to them. They also asked the eighth graders what they liked about the stacks.

Students were given an opportunity to study the information from the class project in preparation for a written test on the objectives. Mr. Winters prepared a short-answer test that focused on each of the topic areas in the *HyperStudio* stacks. For students with reading difficulties, Mr. Winters arranged time to meet with them to discuss each of the topic areas, thus checking their knowledge of the events.

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

2. Plan a simple hypermedia presentation using the storyboarding techniques suggested in Chapter 5.
3. Locate and examine several CD-ROM materials that you might use in a classroom. Prepare either a written or an oral report on the possible applications and relative merits of these materials.
4. Locate and examine an interactive video, CD-ROM, or hypermedia program. Prepare either a written or an oral report on the possible applications and relative merits of these materials.
5. Plan a lesson in which you utilize computer multimedia materials. Describe the audience, the objectives, and the materials to be incorporated. Explain the roles of the students and of the instructor using these materials.
6. Plan a lesson in which you have your students prepare their own hypermedia materials. Describe the audience, the objectives, and the materials to be incorporated. Explain how the students will prepare their hypermedia materials.

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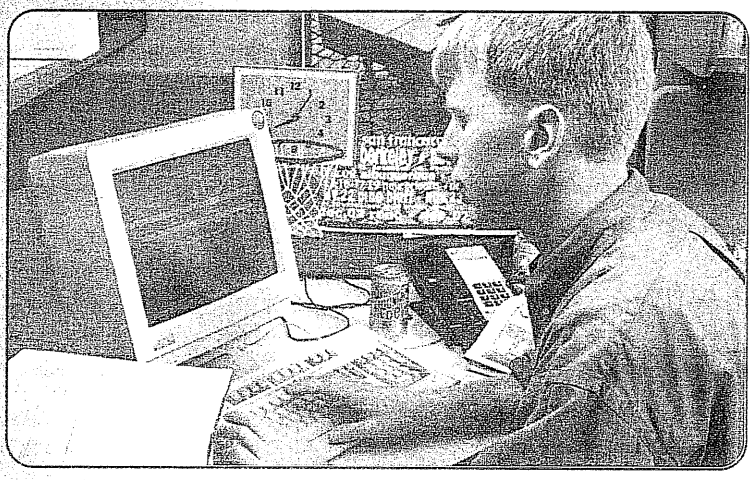
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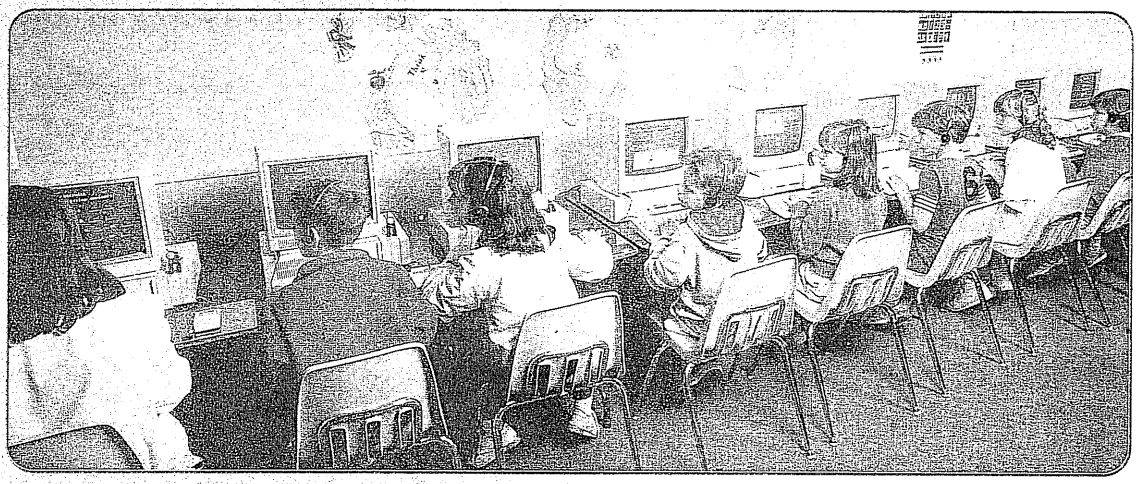
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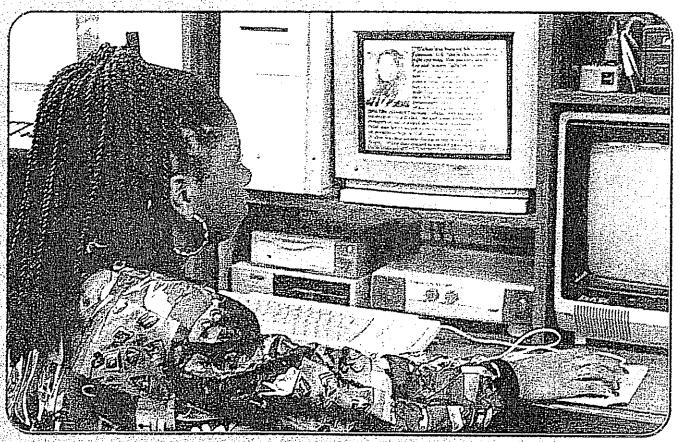
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The Internet provides students access to school software and information from around the world while either at school or at home. Wide area networks (WANs) may connect buildings within a school district and allow students to communicate with other students and teachers within the district.







Local area networks (LANs) enable students to access software programs without using individual diskettes. Teachers can also control what is shown on each computer monitor within a lab. Many corporations and other large organizations have their own intranets, which permit employees to share information and use corporate software without allowing outsiders access to the materials.

Internet and Intranets

OUTLINE

Internet
World Wide Web: Access to the Internet
Intranet
Wide Area Network (WAN)
Local Area Network (LAN)
Issues
Using the ASSURE Model with Network Resources
Future Possibilities

KNOWLEDGE OBJECTIVES

1. Describe the characteristics of the Internet, including its advantages, limitations, and instructional applications.
2. Discuss the advantages and limitations of using the Internet for classroom-based instruction.
3. Select a grade level you are interested in teaching. Discuss the pros and cons of the amount of access and supervision students at this level should have when using the Internet.
4. Explain the advantages and limitations of offering instruction totally on the Internet.
5. Discuss appropriate etiquette when using the Internet. Include 10 guidelines for users.
6. Describe the characteristics of a wide area network (WAN).
7. Describe the characteristics of local area networks (LANs), including their advantages, limitations, and applications.
8. Describe the characteristics of intranets, including their advantages, limitations, and instructional applications.
9. Compare and contrast the characteristics, advantages, and limitations of local area networks, wide area networks, intranets, and the Internet from an educational or training perspective.
10. Select an example from a "Copyright Concerns" or create another example and prepare a presentation for your class that reflects your opinion on the issue.

LEXICON

network
electronic mail (e-mail)
listserv
download
chat room
Internet
wide area network (WAN)
local area network (LAN)
intranet
extranet

LEXICON *(continued)*

Internet service provider (ISP)
information superhighway
cyberspace
modem
newsgroup
distance learning
gateway
portal
World Wide Web (the Web)
hypertext transfer protocol (HTTP)
website
uniform resource locator (URL)
Hypertext Markup Language (HTML)
search engine
WebQuest
computer platform
firewall
bulletin board

As we have seen in previous chapters, computers can be used for a variety of instructional activities. Until recently, educators have perceived the computer as a device that stands alone in the classroom running selected software for students to use. With improvements in technology and telecommunication systems, however, it has become possible and viable to use computers to connect students to people and resources outside of the classroom.

Once you connect computers in ways that enable people to communicate and share information, you have a **network.** Networks connect schools, homes, libraries, educational institutions, organizations, and businesses so that students, families, and professionals can access or share information instantly in the following ways:

- Exchange messages with one or more persons, nearly instantaneously, anywhere in the world that is linked to the network, using **electronic mail (e-mail)**
- Communicate with many people simultaneously (like a meeting), referred to as a **listserv** (note no "e")
- Get, or **download,** information (retrieving files, documents, data, computer programs, or images from other computer systems)
- Communicate one on one in real time in a written conversation, using specially designed text entry windows called **chat rooms**

Computer networks come in many sizes and are used for many types of applications. The most widely known and used network is the **Internet.** Actually, the Internet is an international collection of computer networks, a colossal network of networks! Just as teenagers cruise the streets of their hometowns, people "cruise" the Internet to "surf" its multiple channels of information.

In the hierarchy of networks, a **wide area network (WAN)** is less complex than the Internet. Even though a WAN can connect computers over a wide geographic area (across a city or state or even a country, for example), it often connects the buildings within a school system or on a college campus (Figure 11.1).

The simplest of all networks is a **local area network (LAN).** A LAN could be a network within a computer lab or a single building. These networks connect individual computers to one another to permit exchange of files and other resources.

Not used by the general public but by corporations and large organizations is a special type of network called an intranet. An **intranet** is a proprietary or closed network that connects multiple sites across the country or around the world. Systems connected to an intranet

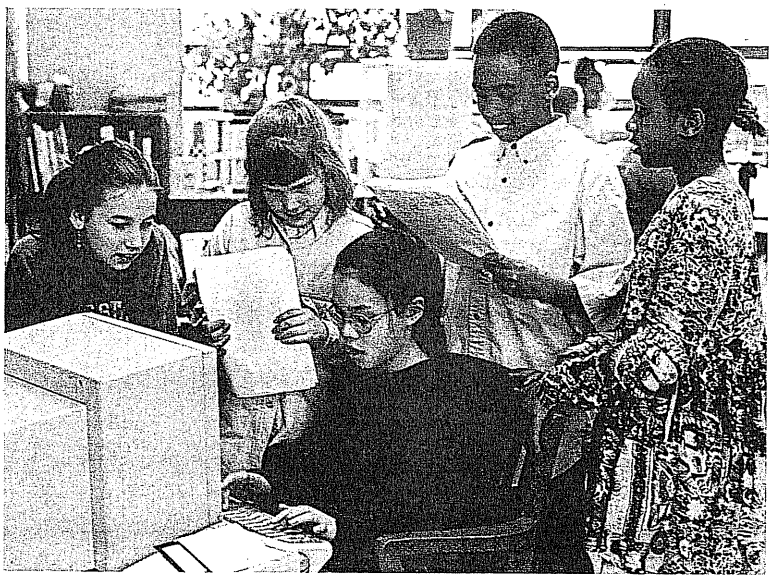


FIGURE 11.1
Students can use a WAN to interact with other students and teachers throughout the district.

are private and accessible only by individuals within a given organization or corporation. A network of intranets is referred to as an **extranet.**

The value of a network is that any individual on it can communicate with anyone else also linked; additionally, all individuals can access information on the network regardless of the type of computer each one has. Reviewing the purpose and capabilities of each kind of network will help us to understand their applications, advantages, and limitations.

INTERNET

The Internet is a frequently changing collection of millions of computer networks serving tens of millions of people around the world (Figure 11.2). Any individual on the Internet can communicate with anyone else on the Internet. Users can access any information, regardless of the type of computer they have, because of standard *protocols* that allow all computers to communicate with each other. Most information is shared without charge except for whatever access fee is required to maintain an account with an **Internet service provider (ISP)** such as America Online (AOL), Prodigy, or any of the many local or community ISPs. Many businesses and most colleges and universities provide Internet accounts to their employees and faculty members at no charge.

The Internet forms the foundation of the **information superhighway.** This expanding network of cable, fibers, and telephone lines forms the physical structure of the electronic "universe" known as **cyberspace,** and delivers vast amounts of information directly to individuals at school, work, and home. Connecting with other computers requires a **modem,** a device that changes computer data into audio signals for transmission across telephone lines. Special communication software connects the computer to a telecommunication service. When you make a connection to the Internet you enlist the help of four communication services: your computer, the ISP, the server (host computer), and the telecommunications network (communication software and a modem and phone or cable modem). Your computer (the *client*) runs communications software. Your modem and communications software provide an open path between your computer and your ISP. The ISP provides you a link to the Internet.

Internet Services

The Internet connects thousands of computer networks worldwide. It provides users with several basic types of connection services:

- Electronic mail (e-mail) for person-to-person communication
- A type of electronic, public bulletin board enabling a person to connect with a group interested in the same topic
- Information search capabilities for accessing libraries and databases of information throughout the world

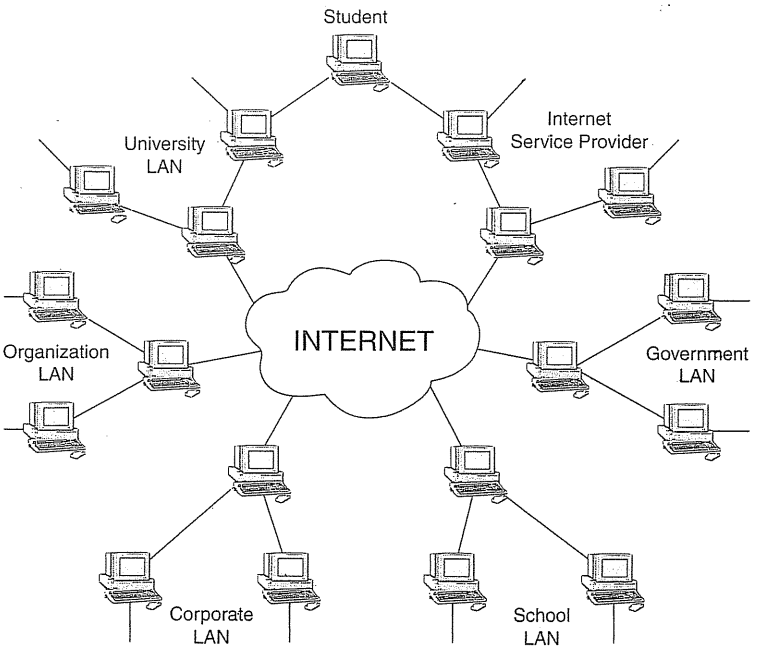


FIGURE 11.2
The Internet is a collection of computer networks. A student, for example, might access the Internet from her home computer either through the University LAN or through an Internet service provider.

- Access to highly specialized computer programs not readily available to individuals
- "Live" communication, allowing individuals on the Internet at the same time to "chat" or "talk" in real time, as quickly as they can type their messages
- Audio communication, allowing individuals with appropriate software to literally talk with each other as they would do over the telephone
- Video-based communication, through software such as *CU-SeeMe* and *NetMeeting,* letting individuals or small groups see and hear each other and show objects in real time

Internet users can communicate with other individuals through e-mail. Along the information superhighway individual users have (at least one) electronic mailbox or a Web page—unique addresses where messages can be stored and then accessed from anywhere else on the highway.

Internet Addresses

Each individual Internet user has a unique address. An Internet address contains three parts: the person's name or *username* (pseudonym), the computer network where they can be reached, and the type of organization they are a part of. For example, the following is the e-mail address for one of this book's authors:

jrussell@purdue.edu

name *computer network* *type of organization*

Organization Abbreviations.

commercial	com
educational	edu
government (U.S.)	gov
military (U.S.)	mil
service networks	net
nonprofit organization	org

Additional designations are being proposed as this book goes to press, in an international effort to accommodate the rapidly growing number of Internet users throughout the world.

International Abbreviations. Each country outside the United States has its own two-letter abbreviation that appears in place of the organization, as in the following examples:

Australia	au
Canada	ca
Italy	it
Mexico	mx
Netherlands	nl

Internet Usage

Internet users can communicate with one another by participating in discussion groups, of which there are two types: **newsgroups** (sometimes called *chat groups* or *conferences*) and *mailing lists* (also called listservs). Both newsgroups and mailing lists are typically dedicated to a single subject, and allow you to read comments, questions, and answers of others on the same subject and to post comments, questions, and answers of your own.

The potential for educational applications of the Internet is growing. Students no longer only have access to textbooks, but to content materials located far beyond the walls of the school building. You and your students can obtain information housed in multiple, distant, and inaccessible libraries around the world! Resources once beyond the dreams of all but the most affluent are potentially available to everyone. Thus, increasing numbers of schools are getting "wired" with networking services such as AOL and EduCom.

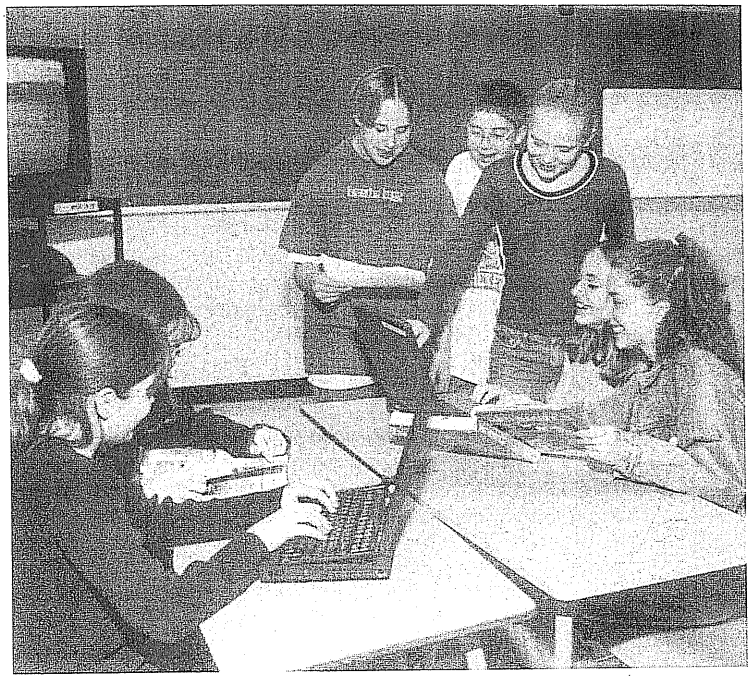
Students and teachers can enhance classroom learning by accessing information from an array of sources (databases, libraries, special interest groups), communicating via computer with other students or with experts in a particular field of study, and exchanging data. Activities such as those conducted by National Geographic make it possible for students and teachers alike to reap the benefits of connecting into a national network of students, teachers, and scientists to investigate a variety of topics (Figure 11.3).

Students can engage in whole-course instruction on the Web. Virtual high schools and colleges are appearing, making programs of study available to students in remote locations. Students can take advance placement classes from other high schools or from colleges and universities anywhere in the world. Undergraduate and graduate collegiate study available on the Web makes it possible for students in any location the chance to seek their preferred field of study without leaving home or employment obligations. There are many software applications (e.g., *WebCT*) that provide both ease of access to the instruction and resources for the instructor and students for successful study online. The opportunities for online study expand daily.

Because computers have the ability to deliver information in any media (including print, video, and recordings of voice and music) the computer has become a boundless library. As students are able to communicate instantly with text, picture, voice, data, and two-way video, the resulting interactions are changing the roles of students and teachers. Teachers can now be separated geographically from their students, and students can learn from other students in classrooms all over the world. These long-distance educational experiences are called **distance learning** (discussed in Chapter 12).

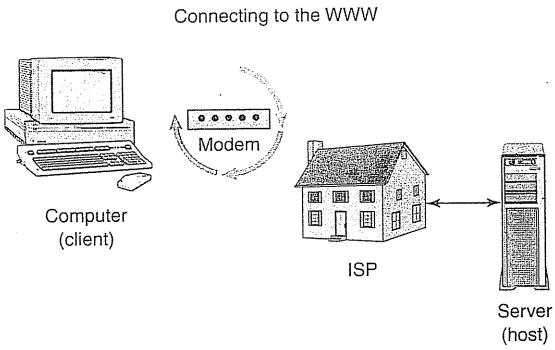
Many educational (and commercial) networks are developing ways to connect to the Internet. These connec-

FIGURE 11.3
Wireless networks allow multiple students to use the same software simultaneously.



tions, referred to as **gateways,** or **portals,** are designed to provide access to many different services; the capabilities of any one service are thus expanded. The attraction is that the maze of connections is largely "transparent" to the user. Users just *log on* (enter the computer system, often with a special password for privacy) to their computer, connect to their networking service or ISP, and begin to exchange information (Figure 11.4).

FIGURE 11.4
You can connect to the World Wide Web from your home or classroom through an Internet service provider (ISP).



Internet Language

The Internet has acquired its own vocabulary of hundreds of terms. Don't attempt to memorize them! You will learn them as you use and discuss them. In addition, they are constantly changing, with new terms added since this text was published! To introduce yourself to some of the terms, see "Close-Up: Network Terms," or look on the Internet at http://www.whatis.com.

For additional information on this topic, go to the Web Links module in Chapter 11 of the Companion Website (http://www.prenhall.com/heinich).

WORLD WIDE WEB: ACCESS TO THE INTERNET

The **World Wide Web (the Web)** is not separate from the Internet. Instead it rides on top of it, in the same way that an application such as *PowerPoint* runs on top of an operating system such as *Windows*. The Web is a series of communications protocols between client and server. These protocols present information in documents that can be linked to other documents and stored on computers throughout the Internet. The Web protocol, called **hypertext transfer protocol (HTTP),** ensures compatibility before transferring information. The Web is comprised of documents called *Web pages*. Each individual collection of pages is called a **website.** Users access a website by entering its address or **uniform resource locator (URL)** into their browser (see list of sample websites at the end

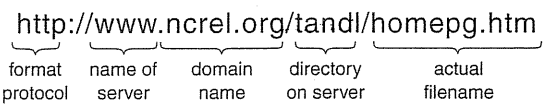
CLOSE-UP

NETWORK TERMS

An array of tools and software is used with the Internet and the World Wide Web. Here are brief descriptions of some of them:

- *E-mail*—a method of electronic communication that enables users to send and receive messages from one user to another.
- *FTP (file transfer protocol)*—a *protocol* (data exchange code standard) that allows users to retrieve files and transfer information from one computer to another over the Internet.
- *HTML (Hypertext Markup Language)*—the programming language that defines the format of a World Wide Web page. This relatively simple code can be purchased as software to streamline the creation of Web pages.
- *HTTP (hypertext transfer protocol)*—the Web protocol that ensures compatibility before transferring information.
- *Hypertext*—a way of organizing information using layered connections that link information through nonlinear, related nodes.
- *Hytelnet*—a collection of sites and services available through Telnet.
- *Internet*—a worldwide system linking computer networks.
- *IRC (Internet relay chat)*—a text-based program that allows users to chat live across the Internet. (Other examples are AOL Instant Messenger and ICQ [I Seek You].)
- *Java*—an object-oriented programming language used to create interactive applications for Web pages.
- *Lynx*—a text-based Web browser.
- *Search engine*—software that provides key word search capability of registered Web sites. Common search engines are Google, Lycos, Alta Vista, Yahoo!, and Web Crawler.
- *Telnet*—a software program that allows users to log onto a remote computer such as a library or database or to log into your "home" server to check your own e-mail.
- *URL (uniform resource locator)*—the address for a Web page containing the protocol type, domain, directory, and name of the page.
- *Usenet newsgroups*—a protocol that allows users to search and read discussion topics on the Internet.
- *Web browser*—software, such as Microsoft *Internet Explorer* and Netscape *Navigator,* used to search the World Wide Web and to access multimedia information (text, graphics, audio, digital video) on the Internet.

FIGURE 11.5
Sample Web address or uniform resource locator (URL).



of this chapter). The URL contains the name of the host computer (server), the name of the domain, the directory on server, and the name of the Web page (actual filename) (Figure 11.5). Navigation within and among Web pages relies on hypertext links that, when selected, move users to another location on the same page, another website on the same host computer, or to a different computer on the Web.

The Web is basically a file formatting standard and a set of programs (browsers and helpers) that can read **Hypertext Markup Language (HTML),** a set of formatting commands, and other similar formatting languages. You can think of the Web as a global system that allows you to access files stored on all the machines connected via the Internet.

The Web represents a major advance in information retrieval by making the process quick, cheap, efficient, and graphical. Its connections to data sources allow you to easily find related information. The Web leads you to information from around the world stored on countless different computers and multiple databases without your being aware that you are moving from one to another. Your browser automatically contacts the appropriate computer to get the information you need.

However, complicating information retrieval is the fact that the Internet does not operate hierarchically. There are no comprehensive directory trees or indexes for Internet resources. There is no Library of Congress cataloging scheme or Dewey Decimal system. You can consider the Internet as a library where every shelf is labeled "Miscellaneous." Finding one interesting service or item of information is no guarantee that you're on the right track to others. In fact, most of the Internet's resources are in little cul-de-sacs on the network, not linked in any predictable way to other, similar resources. You find information on the Internet using **search engines,** programs that identify websites containing user-entered keywords or phrases (see "How to . . . Search the Internet" on page 278.

When searching the Internet it is important to respect copyright laws and the intellectual property of others, the same as when doing research using traditional methods. Materials on the Internet and items downloaded from commercial services are generally under copyright. Unless a document indicates that you have the right to reproduce it (many Internet postings do just that), you must obtain permission to make more than a single copy for personal use (see "Copyright Concerns" in this chapter and in Chapter 4).

© COPYRIGHT CONCERNS: ONLINE MATERIALS

On October 28, 1998, President Clinton signed the Digital Millennium Copyright Act, a bill providing new guidelines for dealing with online copyrighted materials. Basically, it says that existing guidelines for printed material apply to the Internet. One cannot reproduce or distribute or transmit electronically other people's materials without their permission. In addition, you cannot link your website to something within someone else's site without permission. You can link to their homepage. The user must be aware that they are being transferred from your site to another site. You should request permission even to link to someone else's home page.

You and your students may legally look at materials on the Internet or a website, just as you may read a book in the library. However, you may *not* legally upload or download copyrighted works without the copyright holder's permission because doing so involves copying that work. Exceptions are those that fall within fair use—just as with any published materials. Remember, publishing materials on a website is no different than publishing them in a book.

Frequently, unauthorized copies of copyrighted works are posted on a website without the knowledge of the copyright owner. Recently a student of one of the authors found the ASSURE Model on a website without attribution as to its source. The casual observer would assume it was developed by the university on whose website it was found. Not the case, and a serious violation of copyright law!

Example 1. You find useful instructional materials on another teacher's website. There is no copyright notice anywhere on the materials. Can you legally distribute the materials to your student for educational purposes? Contrary to popular opinion, *all* material on the Internet is copyrighted unless stated otherwise. It is copyrighted even if it does *not* display the copyright symbol.

Example 2. You download an article from a large city newspaper's website and then make copies to distribute to your students prior to a class discussion on the topic. Can you do this without violating copyright? Yes, this would be permissible for most of the newspaper following the current photocopying guidelines, which establish precedent for making multiple copies for classroom use. The exception would be individually bylined, copyrighted articles, such as Jack Anderson's column. Such articles *cannot* be copied legally for class distribution (adapted from Becker, 1997).

Example 3. Students in your class write poems and some are very creative. You decide to post the better ones on the school website. Can you legally do this? No, unless you have permission of the students and their parent or guardian.

Example 4. You receive a personal e-mail message from a fellow teacher. Because the content is so helpful, you forward the message on to other teachers. Have you violated any copyright laws? Probably, because many people regard e-mail messages as copyrighted items. It is definitely a "gray area" with a strong possibility that a claim of copyright violation may be possible. As far as we know this type of case has not been tried in a court of law. However, in this case you have violated the Privacy Act. It is recommended that you not forward any e-mail, without permission, in consideration of both copyright and the Privacy Act. You may quote excerpts and report the gist of the message. If the teacher had sent you an original poem, which is automatically copyrighted, then you have definitely violated *both* copyright law and the Privacy Act (adapted from Becker, 1997).

Educators should use copyrighted materials from and over the Internet the same way they use them in print formats. The following guidelines are based on what the authors have read in the literature and online. These guidelines do *not* reflect a legal opinion.

1. Assume all materials are copyrighted unless otherwise stated. Almost everything created privately after April 1989 is copyrighted and protected whether or not it has a copyright notice.
2. You *cannot* even give away copyrighted material for educational purposes except under fair use guidelines.
3. Follow fair use precedents and guidelines set in current copyright law. Fair use should be a short excerpt and must be attributed to the original author and copyright holder.
4. All materials posted on the Internet are copyrighted. They can legally be read, but *not* legally forwarded or copied for instructional purposes, except under fair use. You can make one copy for your personal use.
5. A few words and ideas cannot be copyrighted. However, individual words and brand names, such as "Apple" applied to computers, can be trademarked.

Because the copyright law is still muddled, the best guideline is to always obtain permission. It is usually not that difficult. When in doubt, ask!

For general information on copyright, see the Copyright Concerns on page 87 in Chapter 4. Suggested readings on copyright appear at the end of Chapter 4.

The Web for Delivery of Instruction

To use the Web to deliver instruction, Web pages have to be designed and written, and a host computer must be identified to house them. Universities and large companies are usually directly connected to the Internet and run the necessary Web hosting (server) software.

Most colleges and universities, as well as major corporations, government agencies, and school systems, have established websites. Websites act as information centers and include information about programs of study, products, services, events, facilities, and materials available. Classroom Connect (www.classroom.net) is a good source of information about Web applications in K–12

settings. The Center for Networked Information Discovery and Retrieval site (http://k12.cnidr.org) is devoted to issues having to do with the use of information technology for school reform. Included on this site are resources for teachers and ideas for using technology in learning. Visit these websites through the Web Links module in Chapter 11 of the Companion Website (http://www.prenhall.com/heinich).

Although students can access a rich array of information on the Web, their searches often use random or low-level thinking skills. Teachers can use a technique termed "**WebQuest**" to help their students use the Web effectively in gathering information in student-centered learning activities (Dodge, 1999). Developed by Bernie Dodge at San Diego State University, WebQuests infuse the Internet into the school's curriculum. A WebQuest is an inquiry-oriented activity in which some or all of the information that students interact with comes from resources on the Internet. Students follow a series of steps to gather information meaningful to the task. Teachers design a WebQuest with specific learning outcomes in mind. There are specific steps for the students in a quest:

- *Introduction*—A scenario points to key issues or concepts to prepare the students to ask questions.
- *Task*—Students identify issues or problems and form questions for the quest.
- *Process*—In groups, students assume roles and begin to identify the procedures they will follow to gather information to answer their questions.
- *Sources*—Resources are identified by the teacher and students to investigate in their quest. This is one area where the teacher helps to provide the links to websites and to provide access to print-based materials in the classroom or school library.
- *Conclusion*—This is the end of the quest, but invites students to continue to investigate issues or problems. Quests often end with an evaluation of the process students used along with benchmarks for achievement.

The Web can function as a global online publishing system. Students can create Web documents as class projects and post them on the school's website (see "How to . . . Create a Website"). Some schools are involved in large-scale collaborative projects with other schools. Many museums are creating online exhibits or tours of their collections. An increasing number of online journals and magazines are being published, either as supplements to existing print versions or as entirely new efforts. Most major publishers have put their catalogs on the Web, making it easy to locate and order books, software, and other products. Many publishers are willing to make their actual products available on line. They provide a trial package, one that "dissolves" within a certain period of time—usually 30 days. However, there is still the issue of illegal copying and distribution of materials, which makes some publishers wary of complete and unlimited access to software and files.

Whole courses and programs of study are available on the Web. Students can access courses that might not be available to them at their school. It is possible to obtain a high school or college diploma without ever having set foot in a classroom. There are issues that need to be addressed by anyone wishing to venture into this area of academic study. First is the credentials of the institution offering the degree. Another is the issue of the quality and rigor of the courses. And finally, there are issues related to costs associated with online courses, such as the equipment requirements, online charges, and tuition.

Electronic communities provide their citizens with access to information. A number of cities have created websites that involve a broad cross-section of their community including schools, businesses, local government, and social agencies. The Web dissolves the artificial wall between the classroom and the world beyond, making it possible for students and teachers to access information and people from every imaginable source. Everything is accessible to anyone with an Internet connection anywhere in the world!

Advantages

- *Variety of media.* The Internet is a versatile means of delivering information to learners around the world. Internet sites may contain a variety of media, including text, audio, graphics, animation, video, and downloadable software.
- *Up-to-date information access.* Until recently, educators were limited to the resources in their classrooms or school buildings. Now, with the ability to connect to resources in the community and throughout the world, new vistas on teaching and learning have opened up. Students can access libraries and databases well beyond local limits, this expands the horizons for smaller and rural schools as well as for individuals participating in home schooling.

HOW TO . . . Create a Website

There are three approaches to building a Web page or a website (multiple Web pages connected together). The first is to hire someone to build your site for you. The second is to buy a software package that will assist you in building your website. The third is to build the website yourself.

The first option is often expensive. Custom Web page design can cost $150 per hour or more. Additionally, contracting a Web page designer means you lose a measure of control over the content and design of the site. For these reasons, this option should be a last resort. As you will see, basic website design can be easy and inexpensive.

The second option is to buy a software package to assist you in designing your website. Popular packages include Microsoft *FrontPage*™ Adobe *PageMill*™ and Claris *Home Page*™. However, as with most other computer technologies, this software is evolving rapidly. Consult a knowledgeable friend or computer store associate to find the latest software available. The packages are improving in quality and lowering in price, but a good package will still cost you from $50 to $500. This is much less than paying someone to build your site, but is still an expensive option. Carefully research the pros and cons of individual software packages before you spend money on them.

The last option is building the website yourself. What do you need to build your own website? We'll assume you want the rest of the world to see your site, so you will need an Internet account capable of supporting a website, FTP software to transfer your website from your computer to your Internet account, and a text editor. You also should have a Web browser installed, so you may view your creation.

Both Netscape (http://home.netscape.com) and Microsoft (http://www.microsoft.com) offer free downloads of their browsers (*Navigator* and *Internet Explorer,* respectively) to students. You can use a web search engine (used to locate information on the Internet) such as Google (http://www.google.com) or Yahoo! (http://www.yahoo.com) to locate free FTP software. Almost all computers come with a simple text editor already installed so you need not spend money on the editor (although you will probably want to purchase a quality word processing program in any case). Finally, most Internet service providers (ISPs) offer a Web page account at a price similar to maintaining an e-mail account. Also, many organizations with their own websites offer to host personal individual Web pages for free or for a nominal charge. For just a few dollars a month you can have your own website!

Building the site involves learning the basics of Hypertext Markup Language (HTML) programming. Actually, HTML is not a true programming language. A markup language is simply a collection of tags used to format text and images in different ways. It is similar to using underline or **boldface** in a word processing document.

In the following example we guide you through the steps for building a simple Web page. We will focus on the steps for creating the actual file for your website and viewing it locally right off your computer's hard drive. We will not cover how to transfer the file to your Internet account, as that can be done in a variety of ways. This example assumes that you are using *Windows.*

Step 1: Content

Decide on the content of your website. It sounds obvious, but quite a few people run out and try to build a website before thinking about what should be on it. Ask yourself a few questions first: What information do I want on this site? Who do I want to look at it? How professional does it need to be? If you just want a site on the Web for your friends to look at then you probably don't need to think too deeply about content. But if you want your site to be worth visiting and revisiting, you must carefully choose the contents of your site. If you want sports fans to view your page, then think about what content they would find useful or interesting. If you want gardeners to visit your site, you might provide a list of green thumb tips. Remember, once you build your website and upload it to the Internet server, anyone on the Internet anywhere in the world can view it simply by entering its unique Web address, or URL.

If you are using these instructions to design your first website, lay this book down and think about your content for the rest of the day. Brainstorm with friends and write down ideas. Pick this book up tomorrow when you are at a computer with the required software and we will begin.

Step 2: Open Your Text Editor

Double-click on your text editor and if it does not have a new file open already then choose File | New from the menu bar.

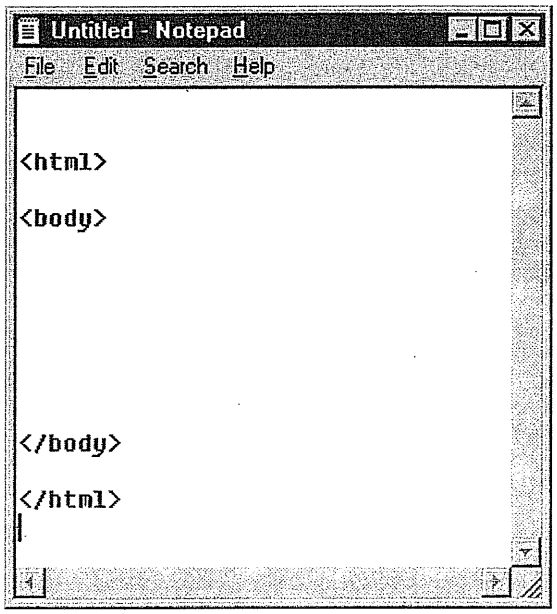
Step 3: The Basics

All HTML files need to have the following two tags: html and body. (A *tag* indicates the specifications applied to the following text, similar to style sheet tags in word processing and page layout programs.) Tags in HTML are bracketed as follows:

(continued)

HOW TO... Create a Website (continued)

<html><body>. Most copy within HTML requires an opening and closing tag. For example, the body tag would be <body> to open and </body> to close. Begin your document as shown in the illustration.



The space between your <body> and </body> tags is where you will do almost all your work. The space between your <html> and <body> tags is reserved for formatting the background, selecting the colors, and adding a title.

Chose File | Save and name your document "howto.html" (do not type the quotation marks). Make sure you know where you saved it. Your file is now ready to be viewed on the Web! Of course at this point, nothing will show up, so we will add more HTML to test your page. (Note: You do not need to space out the HTML tags. However it is a good idea to insert spaces so that as your HTML document grows it will remain easily readable.)

Step 4: Title and Basic Text

Add the following lines to your text:

1. Add this between your <html> and <body> tags:

   <head><title> This is my first webpage</title></head>

   This demonstrates an important point: tags within HTML can be *nested,* one inside the other. Make sure you order the tags properly. For example, <head><title></head></title> is not valid HTML; you must close the title before you close the head. The <head> tag is used to place information in the heading of your browser and <title> is used to place a title in the heading of the browser.
2. Add this between your <body> and </body> tabs:

   <h1>Hello</h1><h2>welcome</h2><h3> to my first website</h3>How doyou likeit?

   <hx></hx>stands for "heading" and can be between 1 and 6 in size. The tag   is an adjustable font size between 1 and 7.
3. Open your browser and choose File | Open File in *Navigator* or File | Open in *Internet Explorer* and choose "howto.html." You should have something that looks like this illustration.



Do you notice any differences between headings and font sizes? You should see the following: Headings get smaller as you increase towards 6 and font sizes get larger as you increase towards 7. The heading tag (<hx>) automatically sends the cursor to the next line when you close the tag (</hx>). To keep your document readable, space out the heading and font size statements in your document now.

Step 5: Break Lines and Images

Let's add a simple break and an image. The tag <hr> does not need a closing tag. The <hr> creates a line on the screen and positions your cursor below the line. The <hr> is typically used to denote a new section or signify some sort of major change.

The code *img* stands for image, and *src* stands for source. These are used in combination to tell your browser where to get your image from. The source can be from other directories or websites (make sure you have permission to link to the image or use it), but in our example the image will be in the same directory as the howto.html file. Note: You must have a GIF or JPEG (specific image format used by HTML browsers) file in the same directory as howto.html in order for the image to appear in this example. If necessary, place such a file now before continuing.

Add the following to your text editor below the heading and font size section:

```
<hr>
<h3>My Picture Gallery</h3>
<img src="plankis.gif">
```

Step 6: Links

Finally, we will add both a link to another website and an e-mail link. Here is the generic formula for links:

```
<a href="location">link description seen on the webpage</a>
```

The tag <a> stands for anchor and tells your browser you are creating a link. href="location" gives the browser the location of the webpage you are creating the link to. The location must be cited as a URL (uniform resource locator—the exact location of an object on the Internet, which in this case is a Web page).

1. Add the following in your text editor below the image section:

```
<hr>
<h3>My Links</h3>
<a href="http://www.northshore.net/homepages
/plankisb/guide /index.html">Effective website development</a>
<hr>
<a href="mailto:plankisb@northshore.net">Send mail to the author</a>
```

2. Save your file again and open your browser again. Select File | Open to reopen howto.html, or if your browser was still on your page, just click the Reload or Refresh button. (Note: in order for the links to work you must be connected to the Internet and have your e-mail set up in your browser for the e-mail link.) Note also that the links provided here should be valid. (However, if they are not, ask your instructor for a link to the school's website.)

This example has illustrated the use of only a few HTML tags and what they can do. We hope that this has been a fun experience. Enjoy!

Developed by Brian J. Plankis © 1997

- *Navigation.* A primary advantage of the Internet is the ability to move easily within and among documents. With the push of a button or the click of a mouse, users can search a variety of documents in multiple locations without moving from their computers.
- *Idea exchange.* Students can engage in "conversation" with experts in specific fields of study. Further, they can participate in activities that allow them to exchange ideas with other students, even those living in other countries.
- *Convenient communication.* The Internet allows people in various locations to share ideas, just as they do now on the telephone, but without playing "telephone tag" so common among busy people. Users can "speak" to each other at different times and respond at their own convenience. Records are kept of their exchanges.
- *Low cost.* The costs of hardware, software, telephone time, and telecommunication services are nominal and are decreasing.

Limitations

- *Age-inappropriate material.* One concern is that some of the topics discussed on computer networks, especially on the Internet, are not appropriate for younger students. Tobacco and alcohol ads are on the Internet along with games and music kids enjoy. Students can find their way, innocently enough, into topics that might be too advanced for their understanding or too adult for their viewing. Close supervision is essential. There is no organization or agency controlling activity on some computer networks. Control is in the hands of individuals; consequently, students may access questionable materials. Software is available to prohibit access to topics specified by the teacher or parent.
- *Copyright.* Because information is so easily accessible, it is also very simple for an individual to quickly download a file and, with a few changes, illegally appropriate it. Thus, students may turn in a paper or project that is not their own work.
- *Unprecedented growth.* It is estimated that several thousand new websites are added to the Internet every day. This growth makes finding information extremely difficult. To assist in information retrieval, several commercial companies and universities provide search engines that follow Web links and return results matching your query.
- *Support.* Good technical support needs to be readily available. Without such support and thoughtful management, a computer network may die quickly. Problems on a network can disable a lab or even shut down an entire school or corporation. Technical supervisors are needed to set up and maintain networks.
- *Access.* Whether by means of a hardwired system or a modem, all users must have a way of connecting to the network.
- *Access speed.* Another limitation is the speed at which users can access information. Lengthy wait times can be prevented through prudent Web page design. Web pages designed for modem users should contain text and no individual graphic larger than 50K. Another way to reduce wait time is to install Integrated Services Digital Network (ISDN) digital communication lines capable of transmitting information at speeds of 128 kilobytes per second (kbps) or more.
- *Lack of quality control.* Users need to be critical thinkers and readers who know how to evaluate information. Everything posted on the Internet is not "gospel." Anybody can post anything on the Web, including unsubstantiated, erroneous, or untruthful information.

Integration

Computer networks, especially the Internet, can serve a number of functions. Students and teachers can access services and information such as documents, government information, databases, online bibliographies, articles, publications, and computer software.

Teachers and their students can use the Internet to access electronic documents to enrich their courses. Students can actively participate in the process. The Internet facilitates an interactive learning environment. Students can link Internet information to their papers and projects, making them "living" documents wired with hypertext buttons. (See page 244 for a discussion of hypermedia.)

One growing use of computer networks at the K–12 level promotes writing skills by connecting students with "electronic pen pals" or "key pals". For example, one teacher recently connected her elementary students with students in a language arts methods class at a university across the state (see "Close-Up: Key Pals").

The students exchange mail, with the university students helping the younger ones with their writing. Both groups benefit from this experience. The younger students learn ways to improve their writing, and the college students learn about working with children. Systems have also been set up that allow students from different countries, even those speaking different languages, to learn about each other's cultures through computer-mediated communications.

The Web is a very useful tool. Teachers and students alike can use it to access many kinds of information, both in and out of the classroom (Figure 11.6). Other applications include the following:

- Science experiments that involve sharing data among many locations (e.g., National Geographic at magma.nationalgeographic.com or NOAA at www.NOAA.gov)
- Research conducted using databases and other online resources
- Mentors linking with students to help them learn about a variety of topics
- Projects conducted with other classes in other locations, allowing students to plan and produce projects collaboratively.
- Activities that link students with experts in a variety of areas
- Monitoring current events for social studies
- Science activities like tracking weather and studying space probes on other planets (e.g., NASA at www.nasa.gov)
- Sharing instructional ideas and techniques with other teachers (e.g., Kathy Schrock's Guide at school.discovery.com/schrockguide)
- Databases of teaching methods, instructional strategies, and lesson plans

CLOSE-UP

KEY PALS

Rick Traw, professor at the University of Northern Iowa, wanted to expand the methods experiences of his elementary education students in the area of language arts. Because of scheduling difficulties, it was impossible for him to have his students go to a nearby school to work on writing skills with a group of elementary children. With the aid of the university's expanded computer network system, it was possible for the students at the local elementary school to be connected to the university students. The elementary students met their university pen pals (or "key pals"), and began to exchange letters. The children had a new and exciting audience for their writing, and the university students had an opportunity to learn about children's writing firsthand. Traw and the classroom teacher provided guidance to the college students in techniques for assisting children with their writing.

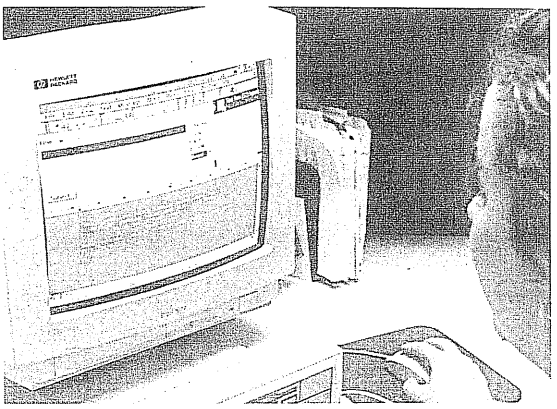
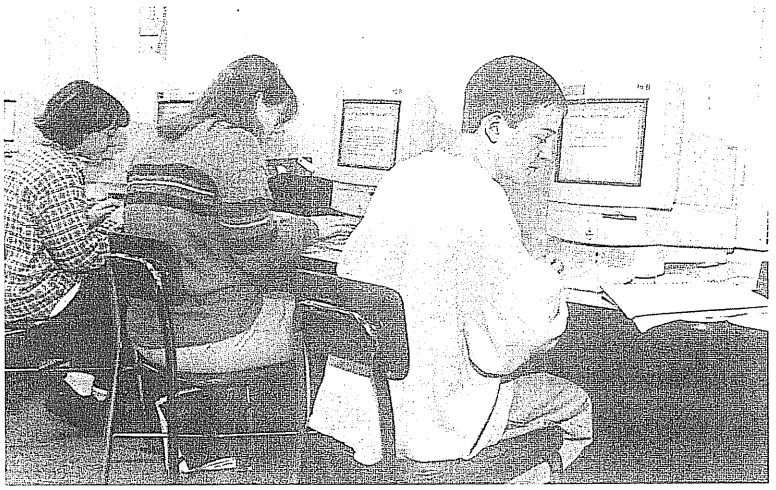


FIGURE 11.6
The Web is a very effective tool for accessing material and information outside the classroom.



- Teacher training workshops, tutorials, and courses available online
- Teacher discussion groups with online exchange of advice and information
- Teacher information on curriculum topics (e.g., T.H.E. Journal's Education Resource for Teachers at www.eduhound.com)
- Job banks and resume services

For additional information on this topic, or to visit these websites, go to the Web Links module in Chapter 11 of the Companion Website (http://www.prenhall.com/heinich).

INTRANET

Intranets are internal networks for companies or schools. Intranets are a way of increasing communication, collaboration, and information dissemination within companies or schools where divisions, departments, and workgroups each use a different **computer platform** (hardware and/or operating system), or where users work in geographically distant locations. Users access the intranet either directly or by dialing into the network. Even though an intranet may be connected to a larger network (the Internet, for example) a software package called a **firewall** prevents external users from accessing

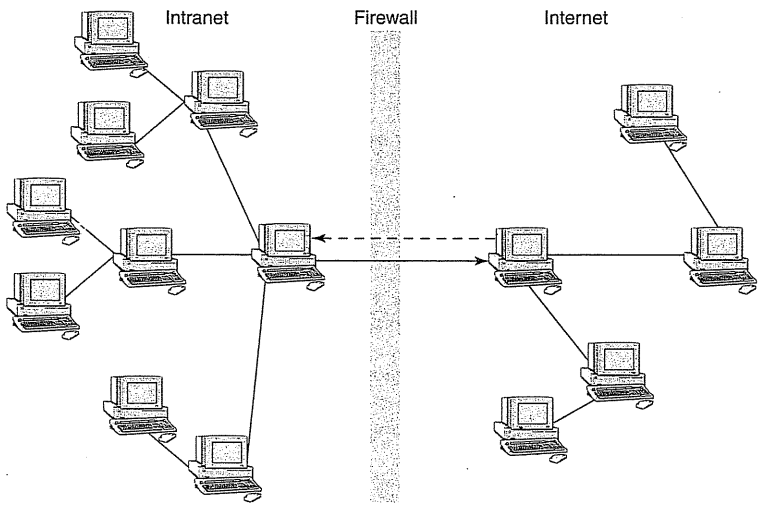


FIGURE 11.7
A firewall protects an internal network (intranet) from external users, but allows internal users to access external networks (Internet).

the internal network, while allowing internal users to access external networks (Figure 11.7).

As with any delivery system, it is important to consider good instructional design and media selection principles—evaluating your audience, objectives, interactivity needs, cost, and technological feasibility, among other factors—before building an intranet.

When using an intranet, it is important that it tie in with the structure, high-level business needs, and information technology of the organization. Using good instructional design principles is important. Developing an intranet is not a one-person project. An instructional designer will likely work in conjunction with managers, subject matter experts, and computer systems specialists, among others. Establishing guidelines for designing, implementing, and modifying materials on the intranet should be a team effort.

Advantages

- *Centralization.* Information resides in a central database accessible by all employees or students at any time. Self-training can be completed at the learner's pace, at work or at home.
- *Consistency.* Because of the central location of information, all interested parties view the same copy of educational materials.
- *Currency.* An intranet allows for easy, low-cost, timely updates of materials, removing the need for constantly replacing multiple copies of obsolete materials. Everyone has access to the most current version of the material.
- *Pull versus push approach.* Rather than have learners feel forced to read a lot of information, such as a large textbook or training manual—being "pushed" to read the material, the learner can choose what information to read—they can "pull" out information as necessary (Stevens, 1996).

Limitations

- *Unreliable remote connections.* An employee or learner dialing in from home may occasionally encounter line problems or a broken connection. This can be particularly frustrating if the person is downloading information from the intranet.
- *Speed of response.* Currently, response time can be very slow for sending or downloading graphics, photos, animation, audio, or video. Video and audio streaming technologies show promise in eliminating some of the problems associated with speed for downloading visual and audio information. The problem with this technology is that the information does not reside on the user's computer in the end.

Integration

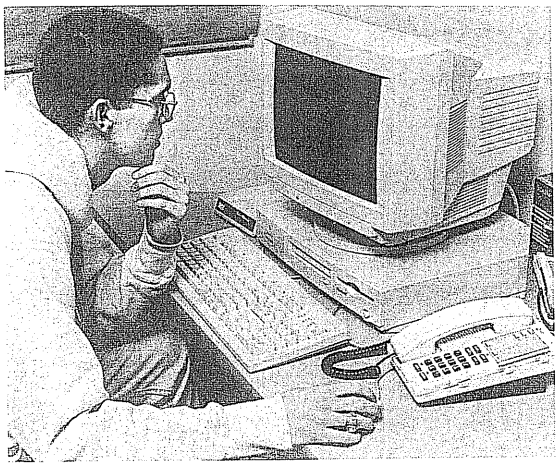
Currently many *Fortune* 500 companies are using intranet-based networks for training applications. Providing training modules (whether or not computer based) over a corporate intranet helps to reduce costs and to decrease the time required to provide employees with the latest version of materials. Updating intranet training materials to reflect changes in the company's policies or products is relatively easy. In the past, revisions often required shipping printed materials and/or computer disks to all training sites. An intranet provides flexibility to employees as well because they may study materials at any time and at any location. Trainees can submit answers to "tests" through the intranet. Once

CLOSE-UP

DEERE & COMPANY DELIVERS TRAINING OVER ITS INTRANET

Deere & Company, manufacturer of a range of equipment under the John Deere name, uses its intranet to deliver self-study training courses to technicians. Its training consists of computer hardware–related courses for its field technicians located around the world. The courses are designed as updates to provide trainees with supplemental information on new equipment. Trainees register for the three- to- four-hour courses, receive a password, log on to the firewall-protected intranet, choose the module they wish to take, and work on the course as time permits—often at home. On completion, trainees take an online test, which is sent to the training department for grading. Results are e-mailed to the trainee, the trainee's manager, and the human resources department. Consequently trainees receive feedback on their performance much faster than in mailed correspondence courses in the past. Other advantages include savings in postage, printing, travel, and employee time away from the job.

Source: Deere & Company.



the answers are in the database, they are scored and the results made available immediately to trainees and the course administrator, even if they are thousands of miles apart. Most intranets are set up so trainees can take the course on any computer platform.

Intranets are very useful for training when the audience is large and geographically dispersed and when the instruction is updated frequently (see "Close-Up: Deere & Company Delivers Training Over Its Intranet").

School applications of intranets include setting up a different intranet for each grade level. Intranets allow access to parents, and parents only. They can join discussions, review their child's work, and correspond with teachers. If parents don't have a computer at home, they can log on from the school, the public library, or a community center.

WIDE AREA NETWORK (WAN)

Computer *conferencing* (connecting two or more computers together for textual and graphical information exchange), is not a new technique. In the past, this type of technology was very expensive, so educators were not able to afford it. Now the classroom computer can be connected with people and resources well beyond the limits of the school building.

Computer networks that extend beyond the walls of a room or building are called *wide area networks* (WANs). A WAN connects a number of computers within a single institution and beyond with one another. Some WANs use a "hardwired" configuration; a campuswide network connecting all buildings via a cable or fiber system is one such example. In this arrangement, the buildings are linked to a centralized computer that serves as the host for all the software used in common.

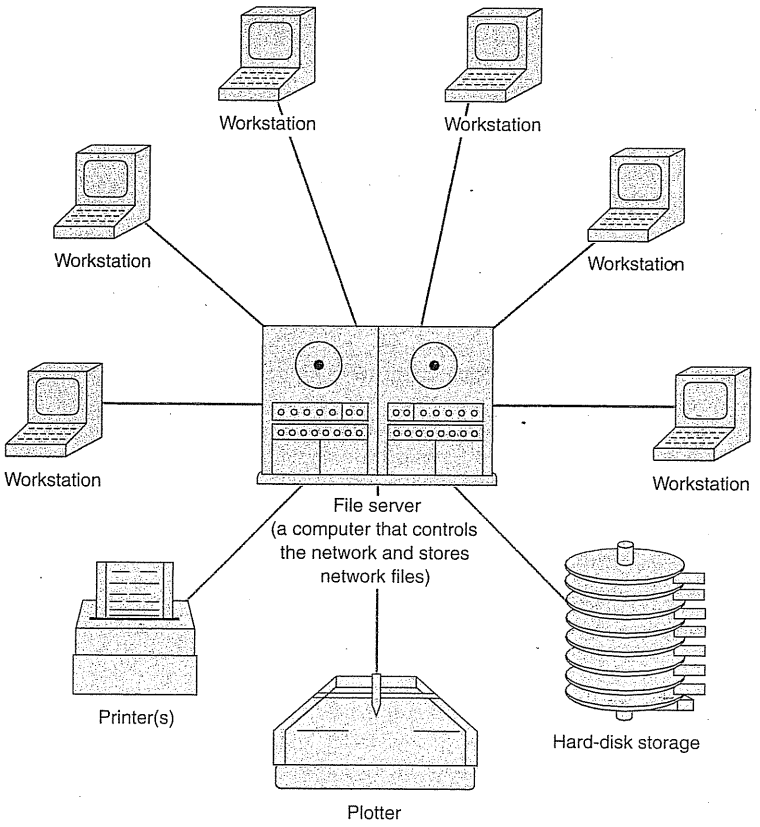
Wide area networking via a computer and modem is done from locations throughout the world. People accessing networks use an array of tools, including e-mail, bulletin board systems, and information resources, such as databases and libraries. A **bulletin board** posts a common pool of information and messages for a particular interest group. Users dial in to review messages and to leave messages for others. The location of the computer is not an issue because telephone lines can link any computer to the central computer system that houses the teleconferencing service. Barring technical malfunctions, the service is available 24 hours a day, every day of the year, at home or at work, thus making it possible for users to access information at their convenience.

LOCAL AREA NETWORK (LAN)

A local area network (LAN) connects computers within a limited area, normally a building, office, or laboratory (Figure 11.8).

A LAN relies on a centralized computer called a *file server* that "serves" all other computers connected to it via special wiring. A computer lab is often a LAN because all the computers in the lab are connected to a single file server, which is usually tucked away in a closet or

FIGURE 11.8
A local area network (LAN) for a computer lab.



other out-of-the-way space. Whole buildings can also be connected to a local area network. A single computer, generally located in the office or media center, can serve as an entire school's file server. Through a LAN, all of the classrooms in a school can have access to the school's collection of software.

Advantages

The advantages of local area networks include ease of communication. A LAN allows people to communicate with each other by leaving messages on the network system. Also, more people have access to software and information. For example, the media center can store its catalog of materials on the file server. Teachers and students then have easy access to information about what is available on a certain topic. LANs also permit sharing hardware. Many users, for example, may access a single printer.

Some older computers lend themselves to being easily connected to a LAN. Since the file server houses the software and information, the computer connected to the network does not have to be the most up to date.

LANs can also reduce a technology coordinator's workload, which might otherwise include installing software, inventorying software, and other such tasks. Coordinators can then spend more time working with teachers rather than with machines and software.

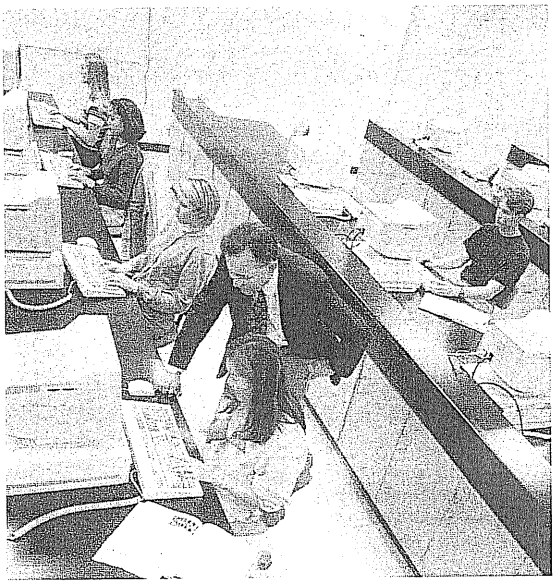
Limitations

One limitation is cost. It is expensive to establish a buildingwide network. The file server must be a large-capacity computer and the entire building must be wired to connect the computers. If the system is to be effective, each room or office must have computers to allow everyone access.

A computer lab may limit access. If no other computers are available to students outside the lab, then students may have a problem. If one class is scheduled to use the lab, others must wait to use the facilities. Because of scheduling limitations, some classes may not have access to the lab at all. One solution is to place computers throughout the school building so that students can access computers in the computer lab, their classrooms, and the media center.

Another limitation is the requirement that schools or offices purchase special network-compatible software. This software generally is costly, although not as expensive as purchasing individual software for individual computers. Finally, a network can be accessed by only a limited

FIGURE 11.9
With a LAN a teacher can provide common instruction for all students in a lab.



number of users at one time. Without extra equipment, users may have to wait their turn to gain access.

Integration

One primary educational application of a LAN is in a computer lab, with 15 to 20 computers connected together. When a teacher wants each student to be working on a computer during a lesson, the lab makes it possible for the whole class to have access to computers simultaneously.

Software and data files for a LAN can be located in one convenient place. Supervision and security are easier when all computers are located in a single room.

Another application when teaching in a computer lab is that teachers can freeze students' screens and/or their keyboards to capture students' attention (Figure 11.9).

ISSUES

The Center for Education and Research in Information Assurance and Security (CERIAS) focuses on multidisciplinary research and education in the areas of information security. The organization is concerned with supporting educators in issues of privacy, ethics, and management of information. Issues such as confidentiality of student records, privacy of information, and protection of students while they work online are important considerations. This organization provides guidelines for educators to establish policies within their schools to protect students, teachers, and the school community. (Contact them at www.cerias.org.)

Monitoring Student Use

Teachers and parents must monitor students when using the Internet to ensure that their behavior is appropriate and to discourage them from exploring inappropriate material either deliberately or accidentally. The amount and level of monitoring is often based on the age of the students—younger students *may* need more monitoring than older students. Your final decisions about monitoring should be made in conjunction with parents and school administrators. And, if a student encounters information or visuals that are inappropriate, that student should feel comfortable in letting the teacher know about that source. There are software packages available to allow the teacher to prevent students from going to sites that are "off limits." They allow the teacher to "wack" the site and save it on the local computer hard drive. In this case students simulate visiting the Web while they are not actually connected.

Acceptable Use Policies

Many schools have developed acceptable use policies. Check to see if your school has such a policy. If not, check with other schools or your state department of public education.

Acceptable use policies (AUPs) are agreements among students, parents/guardians, and the school administration outlining what is considered proper use of the Internet by all parties involved. The policies usually include that the school will do what it can to control access to inappropriate information, that students will accept responsibility for not accessing such information, and that parents understand that there are possibilities that their children may access such information despite the school's efforts. All parties sign the document agreeing that they have read and will abide by the policy. The Virginia Department of Education has generated a handbook of resources to assist educators in developing an AUP to use in their schools. For additional information on this topic, go to the Web Links module in Chapter 11 of the Companion Website (http://www.prenhall.com/heinich).

Security

Students should be instructed not to give out personal information such as their phone numbers, addresses, and other personal information over the Internet. Students have been contacted and even harmed by unscrupulous individuals. It may be wise for students to give their school's phone number and address for correspondence. Also, as an educator, you should be concerned that you have parental permission to post children's photos on the Web.

Etiquette

There are informal rules for appropriate behavior on the Internet. Using the analogy of the Internet as the

HOW TO . . . Search the Internet

The Internet requires searching skills that are different from those used with printed materials. A good place to start, according to Pappas and Tepe,[1] is with a presearch activity, brainstorming to identify the various concepts that might be included within the initial topic. This leads to identifying appropriate search terms prior to using the information resources.

During the actual search, students may use browse, hierarchical, and/or analytical search functions. *Browse* is a basic function and is available in most electronic resources. The searcher enters a search word or phase and the computer locates materials containing that word or phrase.

The *hierarchical* search function is a more complex process and requires higher-level thinking to develop a search strategy. The process starts with a broad concept and then narrows the topic to a specific piece or pieces of information. The searcher makes a series of decisions, selecting subsets of the concept likely to contain information related to the search topic. The concept becomes more narrowly focused with each subset.

An *analytical* search enables students to make connections and relate concepts with the Boolean operators "and," "or," and "not." This search function is very powerful and provides access to information that would be difficult to acquire with printed resources.

Students also need to be taught the skills to interpret the information they receive through an electronic search. Summarizing and paraphrasing, for example, are important interpretation skills. With both word processing and information resources in digital format, plagiarism is easier than ever. Teachers and library media specialists need to work with students so they understand what is and is not plagiarism. Teachers can discourage students from lifting major sections of papers from electronic articles by working with them and seeing student work in progress rather than just accepting the final product. The teacher should see the topic and approve it, then see the outline and various drafts. The focus becomes the process, not the product.

[1]M. L. Pappas and A. E. Tepe, "Information Skills Model." *In Teaching Electronic Information Skills*, ed. M. L. Pappas and A. E. Tepe, McHenry, IL: Follett Software, 1994, p. 1.

information superhighway, these are the "rules of the road." Referred to as *netiquette,* they apply to e-mail and to other interactions on the Web:

- Keep your message short and simple. Try to limit your message to *one* screen. Think before you write. Make it brief, descriptive, and to the point.
- Identify yourself as sender somewhere in the communication; include your name, postal address, and phone number. Not all Internet addresses clearly identify the sender.
- Doublecheck the address or URL before sending a message.
- When replying to a message, include the pertinent portions of the original message.
- Don't write anything you would not want somebody other than the receiver to read. E-mail can be intercepted and/or forwarded.
- Check spelling, grammar, and punctuation. Use lowercase letters except for proper names and beginnings of sentences.
- Be sensitive to others. Treat other people with respect and courtesy, especially in reference to social, cultural, and ethnic differences.
- Don't use sarcasm. It falls flat and doesn't come across.
- Be careful with humor. It is a two-edged sword. The reader doesn't have the benefit of your facial expression, body language, or tone of voice. You can use emoticons or "e-mail body language" such as ;) for a wink or :(for a frown, but it doesn't communicate as well as being there.
- Cooperate and share. Consider yourself a guest on the system just as if you were a guest in someone's home. Be willing to share information with others on the Internet. In exchange for help and information you receive, be willing to answer questions and to share your resources.
- Carefully consider copyright. Just because something can be copied electronically doesn't mean it should be distributed without permission. Unless stated otherwise, *all material* on the Internet is copyrighted (see "Copyright Concerns" in this chapter and in Chapter 4).
- Be alert for obscenity. Laws governing obscenity apply to messages on the Internet. However, material that is not deemed legally obscene may still be inappropriate for schoolage children!

USING THE ASSURE MODEL WITH NETWORK RESOURCES

As with other media and technology, the ASSURE model introduced in Chapter 3 is helpful in preparing lessons incorporating the use of computer networks, especially the Internet.

Analyze Learners

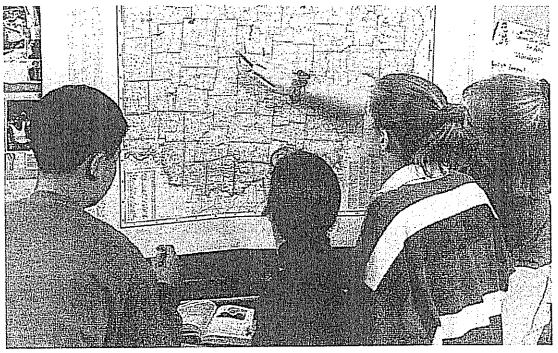
Lesson development begins by identifying the audience. In most cases the audience will be the students in your class(es).

CLOSE-UP

GLOBE—NETWORK TECHNOLOGY IN THE CURRICULUM

The GLOBE program uses technology to promote scientific inquiry and environmentalism. To participate, students use the Internet to send atmospheric data they collect to a GLOBE (Global Learning and Observations to Benefit the Environment) processing facility in Boulder, Colorado. In return, the class receives environmental images vividly depicting their observations along with observations sent in by students from around the world. Professionals from many disciplines participate in and use GLOBE. For example, scientists use the valuable student-collected data to research global change. There are opportunities for students to chat with scientists and astronauts. Students benefit too, learning about data collection, scientific protocols, and databases.

For additional information on this topic, go to the Web Links module in Chapter 11 of the Companion Website (http://www.prenhall.com/heinich).



State Objectives

Before stating specific objectives, you may wish to explore how you want students to use the network (to access information? to communicate with other students, professionals, or content experts?). You will also want to consider the content available on the network your students will be using. Sometimes it is more appropriate to state specific objectives after you have identified potential materials and resources.

Select Methods, Media, and Materials

Selecting materials often begins by "surfing" the Web. You can locate websites on a specific subject matter by using a search engine such as Google, Alta Vista, Web Crawler, or Yahoo! You should use more than one search engine because different engines will locate different information and sources; no one engine looks at everything. You should not base your lesson on data obtained from a single source—even a source as rich as the Internet. Don't forget to explore books, magazine articles, and other media (slides, videotapes, etc.). You can, ironically enough, identify many of these materials through online searches.

Utilize Media and Materials

When you assign students to use computer networks, you may wish to provide them the e-mail addresses of individuals they may want to contact, a list of selected websites, and a brief guide to using their browser (such as the *Quick Reference Guide for Netscape Navigator*). You may want to expand learning opportunities outside formal classroom time. The length of the lesson will depend on the scope of materials available, manner of presentation, and available time. When using the Internet, provide time for students to search for relevant materials. If the computers are not in your classroom, allocate additional time for students to get to the computers housed in the computer lab, media center, or multimedia classroom, and to return to the classroom.

Require Learner Participation

Get the students involved in finding the necessary information and materials and/or making contact with individuals. Don't tell them exactly where to find the resources or individuals. The *process* of searching may be one of their most important outcomes, especially for early lessons using computer networks. Ask students to document (log) their search strategies, progress, and outcomes and either present their results to the class or turn in a report to you.

Evaluate and Revise

If you require students to log their search strategies, progress, and outcomes, you may use this documentation for evaluation along with presentations, reports, and other assessment procedures. As with all media-and technology-based lessons, you may choose to revise your lesson plan after you have used it once. In addition, computer networks and sites change frequently, so you may be forced to change your lesson before offering it again. Be sure to check the most important sites and access procedures just prior to presenting your lesson.

CLOSE-UP

COMPUTERS FOR YOUTH: SPREADING THE NET

Computers for Youth (CFY) is trying to bridge the digital divide by training low-income children, as well as their parents and teachers, to use the Internet. The organization spends an entire school year at each school, showing students and their families how to surf the Web. Students who attend a three-and-a-half-hour course are provided with used computers contributed by local firms and three months of free Internet and e-mail access. Although some nonprofits advocate public technology centers where children can go online in libraries or recreation centers, CFY believes that students need computers in the home to really learn the skills they need. This allows students to spend as much time as they need learning the technology, and also enables students and their parents to communicate more freely with teachers outside of school. Currently, CFY is working with Kipp Academy, a New York City public middle school attended mostly by low-income African American and Hispanic students. Beyond nonprofits, corporations are also working to solve the problem of digital divide—many companies are looking to secure a future workforce with solid technology skills. The government is contributing to computer training efforts as well.

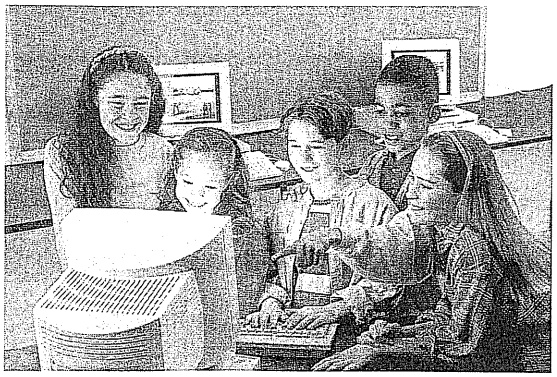
Source: Industry Standard, April 3, 2000.

FUTURE POSSIBILITIES

Computer networks have altered the earlier institutional structures, which were based on transportation. In the past we operated on the assumption that, to learn, learners had to physically be in the "territory" of the teacher. By relying on the school bus and the private car, we consolidated schools and built larger schools and training complexes. However, some parents are growing more and more concerned about the excessively long bus rides their children take, as well as the high cost of transportation. These factors make it attractive to return to smaller and more numerous "attendance centers."

Advances in technology have made it administratively possible and economically feasible to educate smaller groups of students in a larger number and wider variety of instructional settings. Proponents of the decentralization of public education have an unexpected and powerful ally in technological advances such as computer networks for the distribution of instruction (Figure 11.10).

FIGURE 11.10
Satellites make communication a reality among students in different parts of the world.



The opportunity to improve the quality of education is a compelling reason for educators to continue to develop educational applications for computer networks. With high-quality education deliverable over a network, the neighborhood school can hold its own programmatically with larger schools.

However, schools also face social and political problems in reverting to smaller units. Competitive sports and other extracurricular activities thrive in larger schools. We may settle on a compromise—perhaps large high schools will use electronic distribution of instructional materials and information within a larger-than-necessary physical facility, while elementary schools will perhaps become smaller and more numerous.

Increasingly, continuing professional development is being carried out through learning networks rather than on campuses. Computer networks make possible large-scale collaborative efforts between industry and education. The National Technological University (NTU) (see "Close-Up: The University Without a Campus" in Chapter 12) is an example of how such collaboration can create learning opportunities for practicing professionals beyond traditional campuses and degree programs.

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 11 of the Companion Website (http://www.prenhall.com/heinich).

1. *Lesson Planning Using WebQuests.* Develop a lesson incorporating a WebQuest to engage learners. *Written Reflection.* How does the

Secondary Social Studies: Using the World Wide Web to Learn About the Holocaust

The purposes of this lesson were to study the Holocaust and its implications for our lives today and to dispel misinformation students may have had prior to studying the Holocaust. It also raised the question, "Could the Holocaust happen again?"

Analyze Learners

General Characteristics

Mr. Plosnik's students are juniors and seniors in high school. They represent a range of experiences and grade-point averages. The college preparatory curriculum of the school could be considered above average.

Entry Competencies

The students have read about and discussed the historical events surrounding Germany's role in World War II. They have studied printed and televised news reports pertaining to social crises in other countries that may relate to the events of the Holocaust of the 1940s.

Learning Styles

Students in the class exhibit a variety of learning styles. The majority of the students prefer to search for materials on their own and then discuss their findings with their classmates and teacher.

State Objectives

Not all of the project's objectives appear in this Blueprint. Sample cognitive objectives for the lesson include the following:

1. After locating a given World Wide Web site related to the class study of the Holocaust, students will review the information and answer the questions in the workbook. Answers will contain information quoted and referenced from the website and be prepared in a grammatically correct document.
2. Using Internet search engines, students will locate at least three additional sites relating to the Holocaust and select images, sound files, and video clips of personal interest.

Sample affective objectives for the lesson include:

1. During class discussion and in their writings, students will espouse the position that just because the Holocaust happened, it was not inevitable.
2. Students will avoid stereotypical descriptions.

Sample technology-related objectives for the lesson include:

1. During further exploration of topics, the student will use the Internet and its wealth of educational materials as a resource tool.
2. Students will navigate the World Wide Web using Netscape *Navigator* to locate specific websites and to search for sites using one of the Web search engines.

Select Methods, Media, and Materials

Because the students lacked direct experience with the Holocaust, the teacher, Tim Plosnik, and a college professor, Lawrence A. Tomei, sought to provide experiences that could help students better understand the complexity of the subject. They wanted to help students make connections between their own lives and the experiences of those who suffered the Holocaust.

While preparing the lesson, Dr. Tomei conducted the initial exploration of the Internet, locating over 240 websites related to the Holocaust. On these sites students would be able to view photos of the prison camps, listen to prisoners' songs, view video clips of the atrocities, and download these files to classroom computers. Virtual tours of the Anne Frank House in Amsterdam and the Holocaust Memorial Museum in Washington, DC were also located.

Mr. Plosnik synthesized the wealth of material into the session objectives. He decided what material was appropriate for his students and which sites could contribute to the objectives of his class. Together, the teacher and the professor were able to construct a lesson that combined the strengths of technology with the pedagogy of sound classroom objectives.

The teacher and facilitator wanted students to use the computer and its link to the Internet to encounter a range of human experience. They also found materials in the school library and media center. The resources appeared almost unlimited.

Given the amount of materials available, they decided to use a discovery method with a teacher-created student workbook as a guide.

Utilize Media and Materials

Preview the Materials

As noted, Mr. Plosnik and Dr. Tomei previewed many materials as part of their selection process.

Prepare the Materials

They developed a student workbook to guide students' learning with questions, suggested activities, and lists of resources. Dr. Tomei also developed a *PowerPoint* presentation as an overview and introduction to the topic.

Prepare the Environment

The teacher arranged to increase class time in a computer laboratory with Internet connections. The facilities were scheduled and the Internet hookups checked prior to the lesson.

Prepare the Learners

Mr. Plosnik prepared students to participate actively in the lesson. He indicated to students that their ideas and opinions matter and that history has multiple ramifications for them both as individuals and as members of society.

He instructed students to review the information and to seek answers to questions just as historians do. Questions included, "Why did the Holocaust happen?" and "What were the world events that permitted such an atrocity?" Their responses were to

(continued)

ASSURE BLUEPRINT (continued)

contain information quoted and referenced from the Internet and other sources. The results had to be grammatically correct.

Provide the Learning Experience

The teacher took on the role of facilitator in this discovery learning environment.

Require Learner Participation

The students completed the teacher-prepared workbook, which posed the following questions to guide learning:

- What was the Holocaust?
- Who were the Nazis and why did they rise to power?
- Why did the Nazis want to kill large numbers of people?
- How did the Nazis carry out their policy of genocide?
- How did the world respond to the Holocaust?

The questions focused students' attention to basic knowledge and information. Self-exploration of learning materials was followed by cooperative learning sessions and discussion. Many of the Web locations stimulated considerable discussion.

During a virtual tour of the Anne Frank House in Amsterdam, students learned the stories of the other individuals who hid with the Frank family. The virtual tour of the U.S. Holocaust Memorial Museum allowed students to review the museum's educational resources.

Students selected a specific image (or two) and explained how that image represents the Holocaust and why they selected that particular image.

Evaluate and Revise

Evaluation of Learners

Students were guided on their exploration by the student workbook, which contained a description of each website to be visited, along with specific questions to ensure they found the information that the teacher was addressing. Unstructured time was also allowed for student self-exploration.

Assessment of the completed workbook provided one criteria by which Mr. Plosnik evaluated student performance. He used quizzes to evaluate the lesson objectives.

Mr. Plosnik also encouraged students to connect the Holocaust to other historical and contemporary events. Students reflected on what they learned and considered what the Holocaust meant to them personally as citizens of a democracy.

Evaluation of Instruction (Including Media and Materials)

Mr. Plosnik asked students to provide their own evaluation of the learning outcomes of the lesson, based on the information discovered and its value as a source of additional material from the perspective of the lesson objectives. In addition to reviewing these student outcomes, the teacher prepared an evaluation of the lesson and the value of the Internet exploration method of learning.

Students completed a formal evaluation (questionnaire) focusing on the delivery method used for the class sessions. In addition, Mr. Plosnik provided Dr. Tomei with a detailed report concerning the application of technology for this lesson.

Revise

Based on student input, Mr. Plosnik revised the workbook and student guidelines before using the lesson again.

Adapted from a lesson by Dr. Lawrence A. Tomei, Duquesne University

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

WebQuest change the manner in which you accomplish the lesson? What changes did you need to make in the design of the lesson to incorporate the WebQuest? What Internet safety issues have to be addressed? What learner skills and assessment considerations do you need to address when including a WebQuest? (ISTE NETS-T I-A; II-A & C; III-A; VI-D)

2. *Creating Websites.* Create a website to meet a content standard or a topic of interest to you. *Written Reflection.* Describe the process, the frustrations, the successes. How would you teach your students how to create a website? What considerations do you need to address when designing the lesson? What resources might you include to enhance their learning experience? How will you assess their learning? (ISTE NETS-T II-A; II-C; IV-A & C)

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 11 of the Companion Website (http://www.prenhall.com/heinich).

1. Create your own website following the guidelines in "How to . . . Create a Website."
2. Develop an Internet acceptable-use policy for your school (either where you attended or where you teach).
3. Search the Internet for sites relating to a topic of your choice. Document your search strategy and submit the results of your search.
4. Develop a lesson incorporating the Internet following the ASSURE model.
5. Prepare a position paper on the use of the World Wide Web for education and training now and in the future.

SAMPLE WEBSITES FOR TEACHERS AND STUDENTS

The Adventures of Cyberbee™:
http://www.cyberbee.com/
A site filled with helpful ideas and activities for using the Internet in education.

Classroom Connect:
http://www.classroom.net
A valuable site for K–12 teachers and students including classroom links, materials for educators, addresses of other educators online, and products to bring the Internet into the classroom.

CNN Interactive:
http://www.cnn.com
An up-to-the-minute source of news, weather, sports, science and technical information, show business, and health.

Animal Planet:
http://apl.discovery.com/
Features a collection of articles from the Discovery Channel as well as news stories about animals from around the world.

Crayola:
http://www.crayola.com/educators/
A colorful site with activities, stories, and games for young people.

Kathy Schrock's Guide for Educators:
http://school.discovery.com/schrockguide/
Includes a list of Internet sites found to be useful for enhancing curriculum and teacher professional growth.

Maps and References—Odden's Bookmarks:
http://oddens.geo.vv.nl/index.html
A listing of maps, atlases, geographic references, and other resources.

San Diego Zoo and Wild Animal Park:
http://www.sandiegozoo.org/
Provides virtual tour of the San Diego Zoo and includes information about the zoo, its inhabitants, and endangered species.

Visit The Yuckiest Site on the Internet:
http://www.yucky.kids.discovery.com/
This site provides information teacher and students want to know about the world of science—and the focus is on "yucky things" like worms and cockroaches and other gross things!

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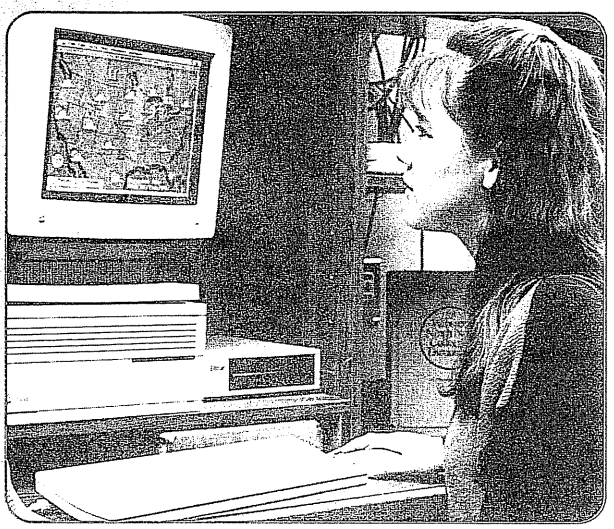
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Advances in telecommunications technology have created new possibilities for learning across the boundaries of time and location. All levels of education, both formal and informal, are expanding their use of distance learning methods. It has long been possible to broadcast lessons over radio and television, and these remain popular media around the world. But computers, satellites, and other emerging technologies have allowed the creation of truly interactive communication systems, enabling high-quality, high-speed communication at a lower cost.







Audio and video teleconferencing are growing in prominence. And the coming of the "information superhighway" has made computer conferencing easier. These new systems demand radically different roles for teachers as well as learners. By understanding these possibilities you have more options for your professional future.

Distance Learning

OUTLINE

Distance Learning
Instructional Communication Functions
Broadcast Radio
Audio Teleconference
Audiographic Teleconference
Television in Distance Learning
Online Technologies
Distance Learning Issues

KNOWLEDGE OBJECTIVES

1. Define *distance education.*
2. State a rationale for the educational use of telecommunications at the elementary, secondary, postsecondary, and informal education levels.
3. Compare and contrast how different telecommunications systems facilitate distance learning.
4. Distinguish among the various telecommunications systems.
5. Compare the advantages and limitations of each type of telecommunications systems.
6. Distinguish between the delivery systems for one-way and two-way television on the basis of their communication capabilities.
7. Create an example of an educational telecommunication application that incorporates two or more delivery systems.
8. Describe an instructional application that would be especially appropriate for teleconferencing in elementary, secondary, postsecondary, or informal education.
9. Describe the functions performed by a classroom teacher using distance education.

LEXICON

distance education
telecommunications
Star Schools
audio teleconference
audiographic teleconference
instructional television fixed service (ITFS)
closed-circuit television (CCTV)
video teleconference
compressed video
origination classroom
distance site

One of the greatest advantages offered by modern electronic technology is the ability to instruct without the teacher's direct presence. That is, we can "time-shift" instruction—experience the instruction at some time after the live lesson—and "place-shift" instruction—experience it at some place away from the live teacher. Of course, the book was the first invention that made it possible to time-shift and place-shift instruction, and it continues in that use today.

For nearly a century people in all parts of the world have been able to participate in guided independent study through correspondence courses via the traditional mail system. Learners receive printed lessons, do written assignments, and get feedback from the remote instructor. The proliferation of newer electronic technologies now makes it possible to experience place-shifted instruction with a stunning array of additional auditory and visual stimuli, far more rapidly, and with a far richer range of interaction, not only with the instructor but also with other learners.

DISTANCE LEARNING

Distance education has become the popular term to describe learning via telecommunications. In this chapter the term **telecommunications** embraces a wide variety of media configurations, including radio, telephone, and television (broadcast, cable, and satellite). What they all have in common is implied in the Greek root word *tele,* which means "at a distance" or "far off"; that is, they are systems for communicating over a distance. You have already examined in Chapter 11 the role of computers in distance education.

More formally defined, *distance learning* is a form of education characterized by the following:

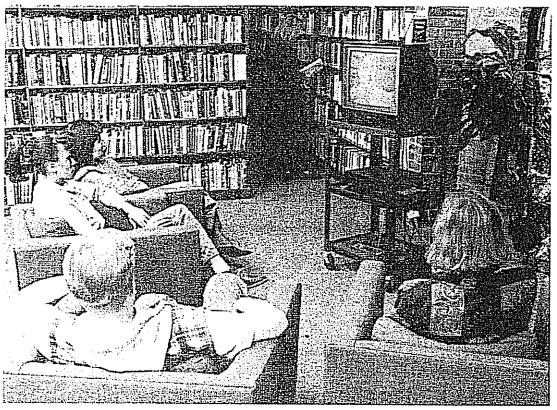
- Physical separation of learners from the teacher
- An organized instructional program
- Technological media
- Two-way communication

As the examples in this chapter will make clear, the converging of electronic technologies has fostered a rich hybridization of media configurations. We seldom see an instructional telecommunication system that is of one pure type. Typically, courses and programs of study are distributed by a combination of broadcast, cable, or satellite-relayed transmissions, and students respond through some combination of mail, fax, telephone, microphone, or computer transmissions (Figure 12.1). Familiarity with these alternative pathways to learning is essential to today's educators.

Elementary Education

At the elementary school level, teachers tend to use prerecorded videocassettes more often than live broadcast television programs. Still, several broadcast series are frequently used: at the early elementary level, *Sesame Street* and *Barney;* at the intermediate levels, *Reading Rainbow, Big Comfy Couch, Arthur,* and *Zoom.* These programs are used mainly as enrichment rather than as the core of instruction (Figure 12.2). Teachers who use educational television programming tend to use more than one program (usually two or three), but not a whole series (Children's Television Workshop, 1990).

FIGURE 12.1
The proliferation of telecommunications makes television accessible at more and more locations, such as libraries.

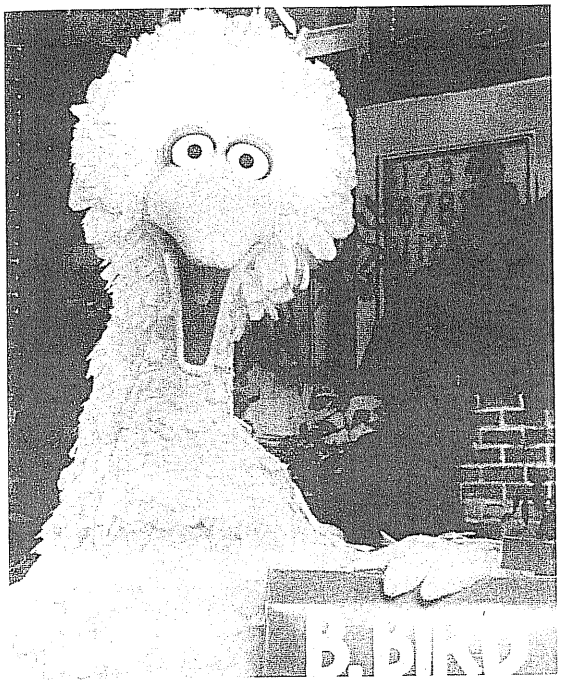


Secondary Education

At the secondary level, television is used mainly to expand the curricular offerings of a specific high school. Rural schools are thus able to offer a full core curriculum. In advanced or specialized subjects for which there are not enough students in one school to justify hiring a teacher, school administrations frequently use television to connect several schools, thus creating a large enough "class" to be affordable. For example, the StarNet network, a satellite network based in Texas, reaches high school students across the United States via satellite. StarNet offers such courses as foreign languages (Spanish, French, German, Latin, and Japanese), calculus, physics, psychology, and art history. These live, interactive classes, which use telephone talkback, are scheduled throughout the school day on two channels. As opposed to the elementary school pattern, these programs tend to be used in their entirety and to provide core instruction.

Distance learning at the K–12 level in the United States gained impetus in the late 1980s from the **Star Schools** program, initiated by the U.S. Department of Education. This program provided multimillion-dollar grants for regional consortia to develop instructional networks that reach elementary and secondary students in rural, disadvantaged, and small schools. StarNet's collaboration with schools throughout the country is an example of the type of network that is providing students with educational op-

FIGURE 12.2
Big Bird is a main character on Sesame Street, which after more than 30 years is still the most recognized educational series for children.



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portunities that would otherwise be difficult or impossible to obtain. Star School projects also included single statewide networks that link schools within a state.

Projects such as the Iowa Distance Education Alliance (IDEA) have trained teachers, provided courses for students, and expanded the nature of distance education at the state level. For example, students who were studying manned space flight via distance education became engaged in dialogues with James VanAllen, of the University of Iowa, and NASA space scientists. The Iowa project uses a statewide fiber optic telecommunication system that connects elementary, secondary, and postsecondary educational facilities in all 99 counties.

The opportunities offered through such projects as IDEA and StarNet continue to expand the educational horizons for many students. Whole courses and special events provide students with the means to expand their educational opportunities, especially in rural areas.

Postsecondary Education

At the postsecondary level, telecommunication systems are used extensively for both on-campus and off-campus education. Hundreds of community colleges, technical schools, colleges, and universities in North America use telecommunications as part of their regular instructional programs. The purpose generally is to expand the number of students who can be reached by one instructor in a given course. For example, closed-circuit television is often used to connect classrooms of students in different buildings, or even in different cities, to a professor speaking from a studio or a camera-equipped classroom.

The fastest growing application, though, is for reaching off-campus audiences with postsecondary courses. An early large-scale distance education program in the United States was begun in the mid 1950s with *TV College,* an extension of the City Colleges of Chicago, using the broadcasting facilities of WTTW-TV, a public television station.

More recently, government-sponsored distance education programs throughout the world have emulated the idea of the British Open University, which began with an enrollment of 40,000 in 1971 and grew to 200,000 by 1997, with over 24,000 students from outside the boundaries of the United Kingdom. In Canada, Thailand, Indonesia, and dozens of other countries, these types of programs provide access to postsecondary education in situations where conventional universities simply cannot handle the demand for further education. In each case, radio, television, the Internet (see Chapter 11), and other telecommunication systems play a significant role in providing part of the instructional program. However, printed materials and various sorts of face-to-face instruction remain a major component of these and most other distance education programs.

Informal Education

As pervasive as telecommunications have become in formal education, there is an equally formidable range of applications outside the confines of degree-granting educational institutions. Hospitals, government agencies, businesses, engineering and architectural firms, and corporations of all sorts use telecommunications to fill part of their need for constant training and upgrading of their personnel. Here the rationale is clearly economic—to provide cost-effective training to large numbers of people who may be distributed across numerous sites. In many cases, such as with multinational corporations, it is often vitally important that the training be standardized. For example, the marketing strategy for a line of garden tractors or a new type of insurance policy demands that all the sales representatives emphasize the same points in their sales presentations. A packaged training course based around television can provide the fast, mass-distributed, simultaneous, standardized training needed.

A telecommunications application that combines formal education and on-site corporate training is a program offered by National Technological University (NTU). This graduate degree–granting program serves on-the-job engineers with televised and online courses leading to masters degrees (see "Close-Up: The University Without a Campus").

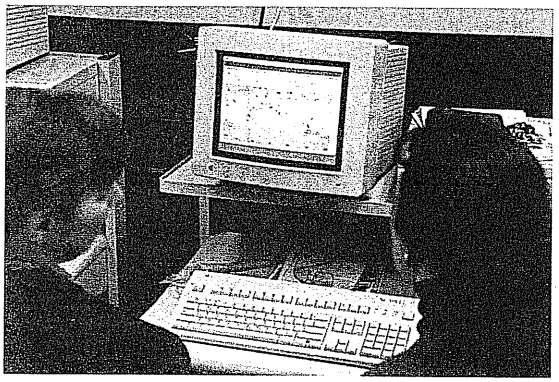
CLOSE-UP

THE UNIVERSITY WITHOUT A CAMPUS

In the fast-paced world of high technology, a corporation's knowledge base can become obsolete overnight. How can a nation keep its engineering talent up to date? In the United States, instructional television lessons delivered by satellite are one answer. The National Technological University (NTU) was formed in 1984 through the collaboration of more than a dozen large corporations, two dozen universities, and the federal government. It now operates as a private nonprofit university offering its own master's degrees in computer engineering, manufacturing systems, and other fields.

The students at NTU are engineers employed at cooperating businesses and government agencies. Each organization maintains classrooms and a satellite downlink. The employee students choose from among dozens of courses, which are broadcast 20 hours a day, six days a week, on two channels. Most of these classes are videotaped and broadcast one way via satellite, but about 30 percent are live and interactive, with two-way audio feedback from the receiving sites.

Through NTU, engineers can stay current in their fields and advance toward a master's degree without leaving their jobs or commuting long distances. Because this school without a campus involves many of the leading engineering universities in the nation, students have access to the top specialists in their fields of study. NTU demonstrates vividly how technology can be harnessed to promote productivity.



Source: National Technological University, P.O. Box 700, Fort Collins, CO 80522.

INSTRUCTIONAL COMMUNICATION FUNCTIONS

Regardless of the technology used, from live teacher to computer conferencing, an instructional telecommunication system must perform certain functions to be effective (Figure 12.3):

- *Information presentation.* A standard element in any lesson is the presentation of some sort of information to the learner. Common examples include the following:
  - Teacher lecture and demonstration
  - Printed text and illustrations (e.g., textbooks, handouts, correspondence study materials)
  - Live or recorded voice, music, and other sounds
  - Full-motion images (video, CD-ROM)
- *Student activity.* We know that most learning takes place when learners are participating actively—mentally processing the material. Teachers attempt

FIGURE 12.3
A hypothetical instructional telecommunications system. You should be able to trace and name at least a half dozen different pathways a radio, TV, or computer message could follow to reach one of the school buildings. This would make a good self-test after reading the chapter.

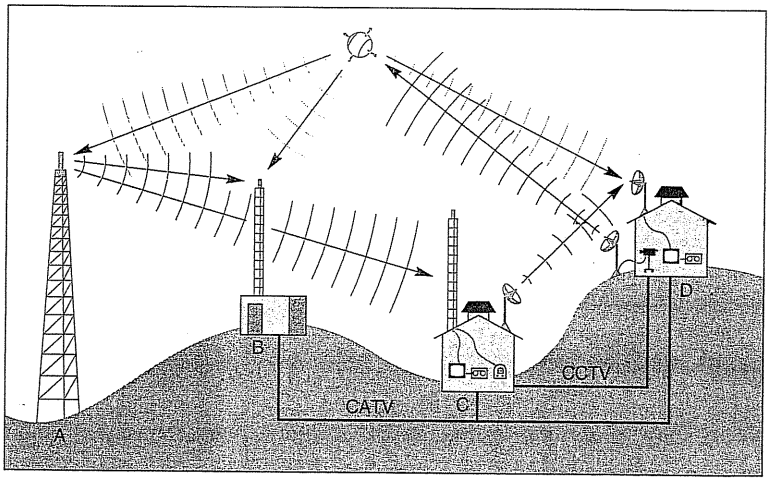


TABLE 12.1
Telecommunication systems

SYSTEM	PRESENTATION	INTERACTION
Radio, broadcast	Voice, music	Homework, tests by mail
Audio teleconference	Voice, music (live)	Question-and-answer with live feedback Homework, tests by mail
Audiographic teleconference	Voice, music (live) Still pictures, graphics	Question-and-answer with live feedback Still pictures, graphics Homework, tests by mail or fax
Computer conference	Electronic text, data, graphs (time-shifted)	Written (typed) exchange with other students Written (typed) exchange with teacher
Television, one-way video, one-way audio	Voice, music Still pictures, graphics Motion images	Homework, tests by mail
Television, one-way video, two-way audio (video teleconference)	Voice, music (live) Still pictures, graphics Motion images	Vocal question-and-answer with teacher Vocal exchange with other students Homework, tests by mail
Television, two-way video, two-way audio (two-way video teleconference)	Voice, music (live) Still pictures, graphics Motion images	Vocal and visual question-and-answer with teacher Vocal and visual exchange with other students Homework, tests by mail

to induce activity in various ways, such as the following:
- Question-and-answer sessions (carried out during or after the lesson)
- Practice with feedback (carried out as drill-and-practice or discussion activities during the class or as homework)
- Testing

- *Student–student and student–teacher interaction.* For many educational objectives, student interaction with other students, in pairs or small groups, can be extremely effective. Some common ways of structuring student interaction are the following:
  - Discussion groups (in or out of class)
  - Structured group activities (e.g., role playing or games)
  - Group projects
  - Peer tutoring
- *Access to learning resources.* Lessons and courses are usually structured with the assumption that learners will spend time outside of class working individually with the material, doing homework, projects, papers, and the like. The external learning resources may take the following forms:
  - Printed materials (e.g., textbooks, supplementary readings, worksheets)
  - Audiovisual materials (e.g., audio- or videocassettes, multimedia, CD-ROM)
  - Computer databases (e.g., for online searches)
  - Kits (e.g., for laboratory experiments or to examine specimens or real objects)
  - Library materials (e.g., original source documents)

Each of the various telecommunication systems has strengths and limitations in these areas. The characteristics of the systems are summarized in Table 12.1 and discussed at greater length in the following sections of this chapter.

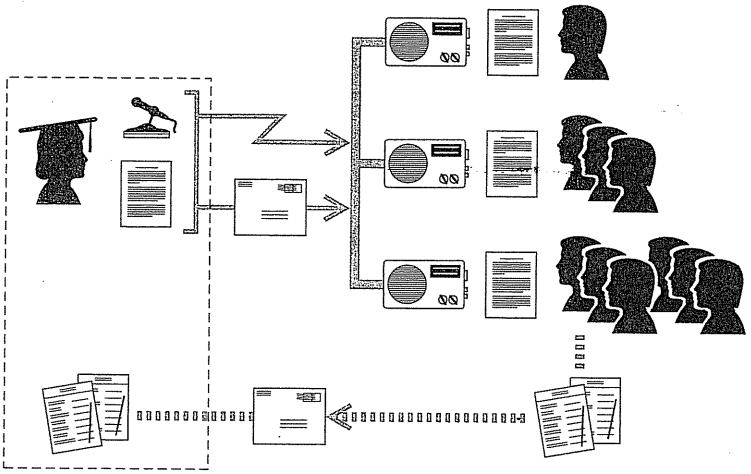
BROADCAST RADIO

When we listen to radio, we hear electronic signals that are *broadcast,* or transmitted through the air, over regular AM or FM radio frequencies. Broadcast radio can be adapted to educational use, as shown in Figure 12.4. Although such radio is basically a format for one-way lectures or dramatic presentations, some degree of interactivity can be added by using printed materials to accompany the programs and requiring listeners to send responses back to the originator. Some programs provide a telephone number for the students to contact the instructor.

Advantages

- *Cost.* Radio is a less expensive broadcast medium than is television. It is still used in developing countries and in other localities where there are

FIGURE 12.4
Broadcast radio. A degree of interaction can be added by sending print materials to students through the mail; they can, in turn, send written work back to the teacher for correction and evaluation.



geographic or economic constraints on the technologies they can employ.

- *Range.* Radio programs can reach a large, geographically dispersed population with a single message.
- *Flexibility.* The audio medium is extremely flexible and can have a powerful, dramatic effect, particularly for conveying music, discussion, and storytelling.
- *Imagination stimulator.* Because radio is an audio-only medium, listeners are free to use their imaginations to create the image.

Limitations

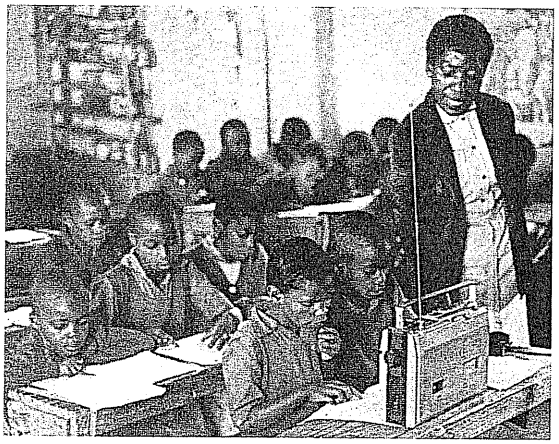
- *Schedule.* Broadcast radio is being displaced by prerecorded material. Instructors and students resist using media that must be used according to a rigid schedule.
- *Operation expense.* It is difficult to justify the expense of operating broadcast facilities when prerecorded materials are readily available.

Integration

Radio was the first telecommunication system adapted to educational purposes in North America. Much of the early technical experimentation with radio broadcasting was carried out at stations operated by colleges and universities.

During that pretelevision period in the United States, many school and college stations linked themselves into networks, usually of statewide scope devoted to providing in-school educational programs at the K–12 level. Ohio started a *School of the Air* in the early 1930s, and others followed in the Midwest, New York, and Texas. Although some of these efforts lasted well into the television era, most languished when television became widely available in their area. In Canada, the Canadian Broadcasting Corporation (CBC) organized educational programming on a national scale.

FIGURE 12.5
In Kenya, "interactive" radio has proved to be a cost-effective method for teaching English.



In developing countries, where large populations still reside in isolated villages, millions of children attend schools where the learning resources begin and end with the teacher and chalkboard. In their search for a low-cost technology that could provide stimulating resources to schools scattered over vast geographic regions, educators have rediscovered broadcast radio (Figure 12.5). An experimental project in Nicaragua demonstrated success in providing mathematics lessons over the radio. Lessons were designed with embedded questions and prerecorded feedback to learners' re-

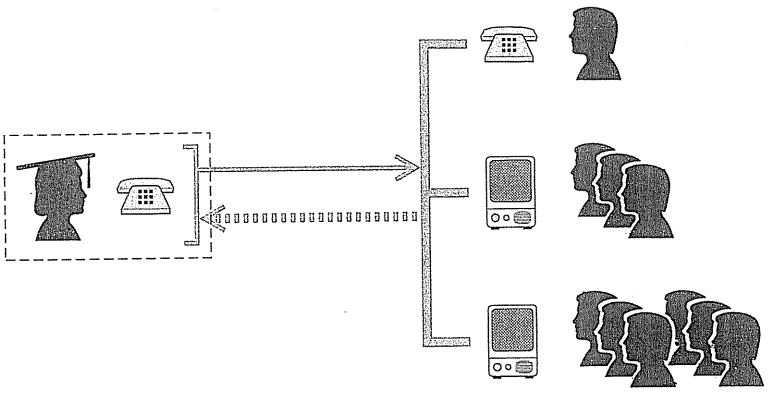


FIGURE 12.6
Audio teleconference. Interaction takes place through the telephone system; groups of listeners use speakerphones.

sponses. The key to success was the novel format requiring fast-paced responses by the students to questions or other cues given in the broadcast program.

Because of its great success in Nicaragua and in other field trials, "interactive" radio has expanded to other countries, including Honduras, Bolivia, and Kenya. English has become a popular subject for educational radio, with lessons in listening, speaking, reading, and writing. Mathematics, health, agriculture, and economics also are taught by radio.

AUDIO TELECONFERENCE

The audio teleconference is an extension of a simple telephone call. Advances in telephone technology now allow individuals or groups of people at two or more locations to hear and be heard clearly and easily (Figure 12.6).

An **audio teleconference**—a live, two-way conversation using the telephone—connects people at different locations. For example, a class can chat with the author of a book they have recently read. They only need to have a speakerphone connection in their classroom. The author needs only a telephone. For connecting two or more groups, as for a class, a special microphone-amplifier device, preferably voice activated, is needed at each location. This device assures that the voices are picked up faithfully and amplified clearly at the listening end. In the middle is a "bridge," an electronic system that joins the calls from all participating locations, equalizes the sound levels, filters out extraneous noises, and takes care of disconnections. The bridge may be either supplied by the telephone company or rented for the occasion from a commercial company.

Advantages

- *Cost effective.* The audio teleconference is often seen as a cost-effective way to hold a meeting or training session without the expense of time and money involved in travel. Schools can invite an expert "into the classroom" to engage in a dialog with students.
- *Easy to use.* It is the most easily accessible form of telecommunications because it uses standard telephone service. Commercial phone companies have made it easy to set up audio teleconferences from any touch-tone phone.
- *Interactive.* All participants get the same message—and interactivity. They can talk to the instructor, a guest speaker, or the other participants.

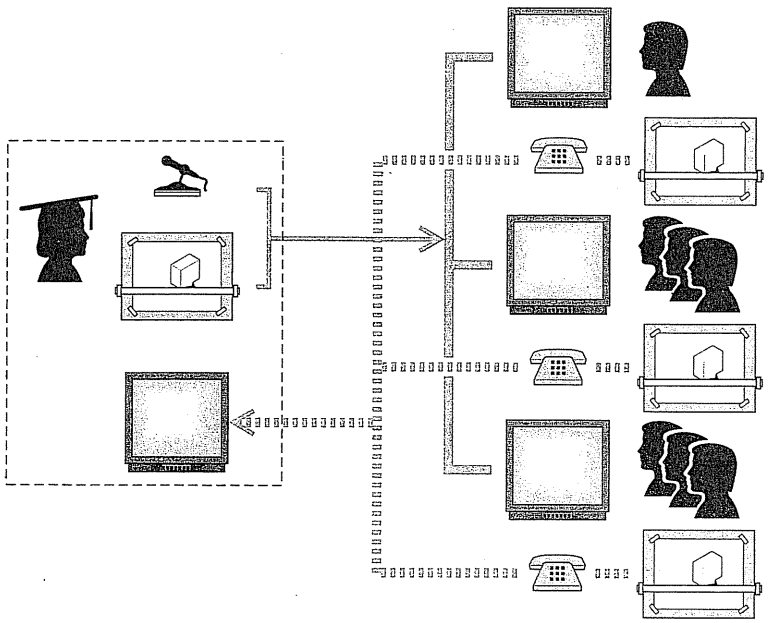
Limitations

- *Lack of visual information.* The lack of a visual dimension poses limitations. This can be offset by arranging to have material at the sites in advance.
- *Poor audio.* To have acceptable audio quality, each receiving site needs to have special microphone-amplifier devices.
- *Intimidating.* Lack of experience with this type of communication technology may make some learners less willing to participate.

Integration

This system is frequently used at the secondary and post-secondary levels to connect students at two or more sites with an author to discuss his or her writing or with a public official to discuss current legislation. It has been used heavily in Alaska to bring inservice training to teachers. Audio teleconferencing is popular in corporate and professional education for training—for example, to discuss the features of a new service, to teach sales representatives the latest selling techniques, to update accountants on changes in the tax laws, and so on. It is not unusual to connect 10, 20, or 30 sites for one audio teleconference.

FIGURE 12.7
Audiographic teleconference. In addition to hearing each other, participants can see visuals sent to a TV set one frame at a time via a graphics tablet or slow-scan video.



AUDIOGRAPHIC TELECONFERENCE

An **audiographic teleconference** adds still-picture transmission to an audio teleconference (Figure 12.7). Several different devices can be used to send pictures and graphics over the same telephone lines as the voice signal: slow-scan (single frame) analog video, facsimile (fax) paper copies, or an electronic graphics tablet. The common denominator in these devices is a method of converting the image to digital form for transmission. (See Chapter 11 for information regarding using computers for audio and image transmission.)

Advantages

- *Visual.* The big advantage of audiographic systems over other audio formats is the addition of the visual element.
- *Cost.* Unless full-motion images are needed, audiographics can provide an audiovisual experience at a fraction of the cost of television.

Limitations

- *Availability.* Audiographic technologies are not readily available.
- *Time factor.* It can take nearly a full minute to transmit a still image via fax or slow-scan technologies.

Integration

Many schools and colleges use audiographic teleconferencing to connect students in a number of isolated locales with a teacher. This is especially the case in rural areas where there may not be enough students in one school to justify hiring a teacher for a particular subject, even if it is a required subject. Through audiographics a teacher at any one location can teach students at all the other sites. At Utah State University, for example, graduate classes are made available to sites scattered throughout Utah plus sites in Idaho and Wyoming even when there is just one student at a particular site. Corporations in the telephone business, such as AT&T, have been especially aggressive in using audiographics as a major tool for employee training.

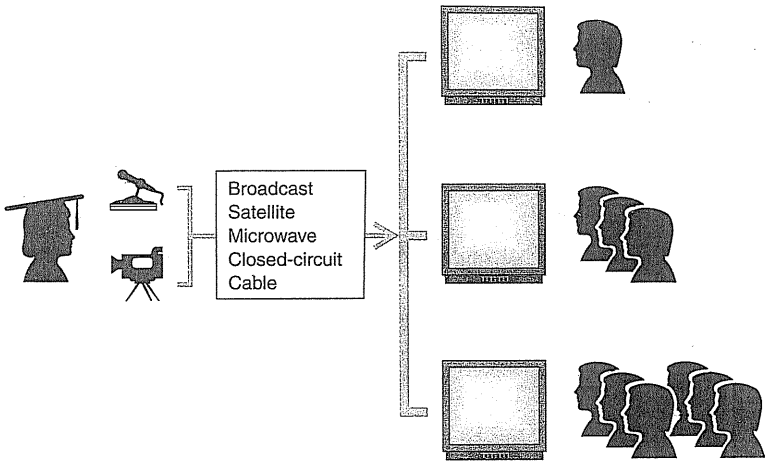
TELEVISION IN DISTANCE LEARNING

One-Way Video, One-Way Audio

Of all the uses of television in education, the viewing of prerecorded videocassettes and videodiscs is the most common (we discussed this application in Chapter 8). Here we will consider the next most common form of television use—live viewing of programs without direct feedback to the presenter.

These programs tend to be about 15 minutes (at the earlier grade levels) to 30 minutes long, and a single program is often repeated at different hours throughout the week to allow for flexibility in classroom scheduling. Contrary to the popular image, broadcast television programs usually do not present core instruction in basic subject areas. One leading researcher (Rockman, 1976) described their role this way:

FIGURE 12.8
Television—one-way video, one-way audio. One-way television, such as broadcast, has no provision for feedback to the source.



- To assist classroom teachers in subjects in which they often have the most difficulty (e.g., art, music, mathematics, science, and health)
- To supplement classroom instruction in subject areas in which limited classroom resources may prevent full examination of historical or international events
- To bring outside stimulation to subject areas, such as literature, where teachers have difficulty exciting and motivating students

We use the term *one-way television* to refer to all the television delivery systems in which programs are transmitted to students without an interactive connection with the teacher (Figure 12.8). This includes five principal types of delivery systems: broadcast, satellite, microwave, closed-circuit, and cable or fiber optics.

Broadcast Transmission. Broadcasting, the transmission of powerful electromagnetic waves through the air, is the delivery system that made television a popular home entertainment medium. Broadcast television signals, using the very-high and ultra-high frequencies (VHF and UHF), radiate outward to the horizon from the transmitting antenna (Figure 12.9). Relay stations carry those signals around obstacles, such as mountains, and to outlying communities beyond the prime coverage area. Any standard TV set can freely receive these signals. Broadcasting is a common format for both commercial and public television programs.

In the United States, most public television stations serve as outlets for the network programming of the Public Broadcasting Service (PBS). Their evening schedules feature PBS offerings and other programs aimed at home viewers in general, while during the daytime hours these stations typically carry instructional programs designed for specific school or college audiences.

FIGURE 12.9
One-way video distribution systems.

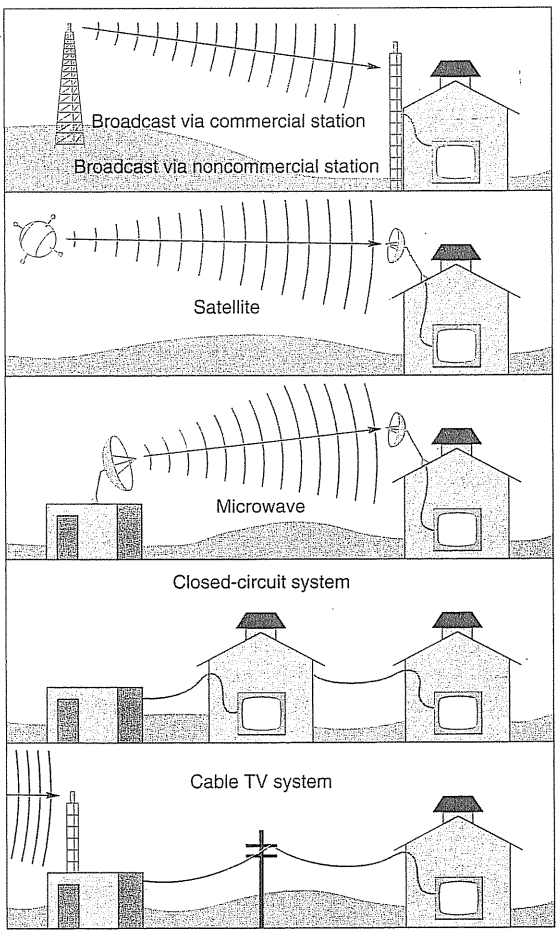


FIGURE 12.10
Although in-classroom playback of videocassettes is the primary delivery system for instructional television, off-air reception from public TV stations is still common.

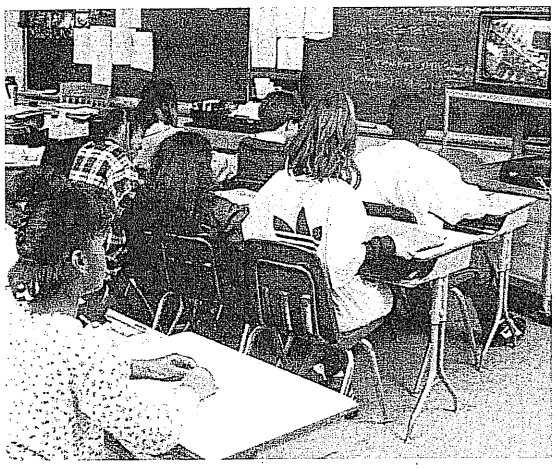
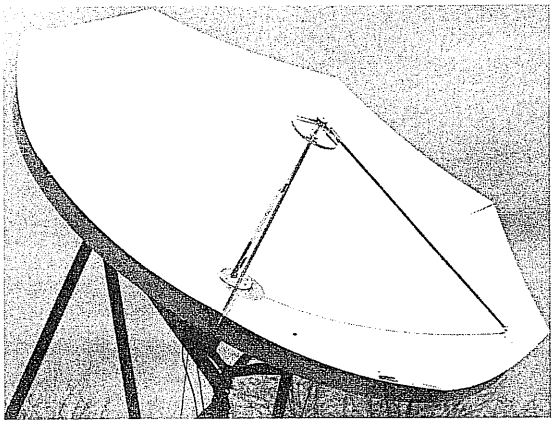


FIGURE 12.11
Satellite dishes bring satellite signals directly to any setting, no matter how remote.



Public television attempts to offer an alternative type of programming for viewers who are not well served by the mass-audience programs of commercial broadcasting. In reaching out to selected subgroups, public television programming does not usually attract viewers on a scale comparable to that of the commercial networks. However, well-produced programs such as *Wall Street Week, Masterpiece Theatre,* and *Nova* have won critical acclaim and loyal audiences that in recent years have grown as large as those for many commercial programs.

The types of programs carried on public television—documentaries, dramas, public affairs features, musical performances, science programs, and the like—are often useful as adjuncts to instruction in schools and colleges. Programs for direct classroom use to reach specific curriculum objectives are a mainstay of most public television stations' daytime schedules (Figure 12.10).

Satellite Transmission. *Satellite communication* refers to an orbiting device in space that receives signals from stations on earth and retransmits them to distant locations (Figure 12.11). Today's satellites are *geosynchronous,* meaning that their orbits are synchronized with the earth's own rotation so that they appear to be positioned over the same spot on earth, serving, in effect, as a transmitting tower 23,000 miles high. At that altitude, a satellite's coverage area could include nearly half of the earth's surface. This, of course, is a far larger area than for any other transmission method. Satellites now carry most network television transmissions.

The trend in recent years has been to build larger and more powerful satellites, allowing the ground reception equipment to become smaller and simpler. We now have satellites that allow home reception with dish receivers no more than 18 inches across. There has been a great proliferation of receiving systems for the home, workplace, and school.

Several programming services broadcast to schools directly via satellite, including Channel One and the Discovery Channel. Channel One programs are broadcast at night via satellite and are picked up and recorded at individual schools on timer-activated video recorders (see "Close-Up: News for Schools").

Microwave Transmission. Television signals broadcast in the microwave spectrum (above 2,000 MHz) are referred to as *microwave* transmission. As with other forms of telecommunications, a license is required to transmit with microwave, and in the United States a specific part of the microwave spectrum has been reserved for educational institutions—the 2500–2690 band, called **instructional television fixed service (ITFS).**

ITFS (and other microwave transmissions) have one major technical limitation: signals broadcast at these high microwave frequencies travel in a line-of-sight pattern. Consequently, the coverage of ITFS is limited to areas in direct sightline of the transmission tower. More than 100 educational licensees operate several hundred channels in the ITFS spectrum. Even though reception is limited to a line-of-sight radius, this is large enough to cover some school districts. Within higher education, ITFS is used primarily for graduate and professional school distance education—for example, connecting engineering or medical schools with professionals in the field who desire a refresher course.

CLOSE-UP

NEWS FOR SCHOOLS

Elementary and secondary school students have daily access to a specially produced 15-minute news program through *CNN Newsroom.* Each program contains current news presented with scripting and graphics that give students a context for understanding the news they hear.

Participating schools can tape the programs off cable or satellite without charge and can receive free teacher's guides to accompany the programs.

There is evidence that even this brief daily exposure to real-world events can have a beneficial effect on students. In the early days of *CNN Newsroom,* one enthusiastic fourth-grade teacher reported that his class scored at the 88th percentile on standardized tests in both science and social studies after a year of watching and discussing *CNN Newsroom.* These scores translate to an equivalent of ninth grade in social studies and seventh grade in science; they were more than 10 points above the average for the rest of the school's fourth graders, who don't have access to the program.[1]

CNN Newsroom originated as a rival to Channel One, a secondary school news service of Whittle Communications. Channel One provides a daily 12-minute news program that includes two minutes of commercials. In exchange for promising that students watch the programs (including the commercials), the schools receive video reception, recording, and playback equipment. The inclusion of commercials has made Channel One controversial in many locations.

[1] *"CNN Newsroom Improves Science and Social Studies Test Scores," Advisory Group Briefing. Turner Educational Services, Inc. (December 1991), pp. 4–5.*

Closed-Circuit Television. The term **closed-circuit television (CCTV)** refers to a private distribution system connected by "wire." This wire may be regular copper wire that carries electrical impulses or thin glass optical fiber that carries impulses in the form of light. CCTV signals cannot be received outside the private network. A major advantage of CCTV is that such systems do not require government licensing and can be set up freely by any institution that desires to do so. Closed circuit is used mainly to connect the buildings on an individual school or college campus and gives a private, multichannel capability within those confines. The cost of distribution rises as the network expands (unlike with broadcast TV), so CCTV is not generally used for reaching a large geographic area. However, several states, such as Indiana, Iowa, and Minnesota, have CCTV networks connecting schools and colleges hundreds of miles apart.

It is difficult to characterize the applications of CCTV because, being unregulated, it has no central information source. Also, CCTV systems can be as simple as a camera connected to a monitor in the same room (e.g., for image magnification of a science demonstration) or as complex as a campuswide wired distributed system (e.g., for distribution of video programs from a central library to any classroom). Because the cost of building a CCTV system increases with larger geographic areas, it is not widely used to interconnect buildings spread out over a school district. However, it is frequently used to connect buildings on a college or university campus.

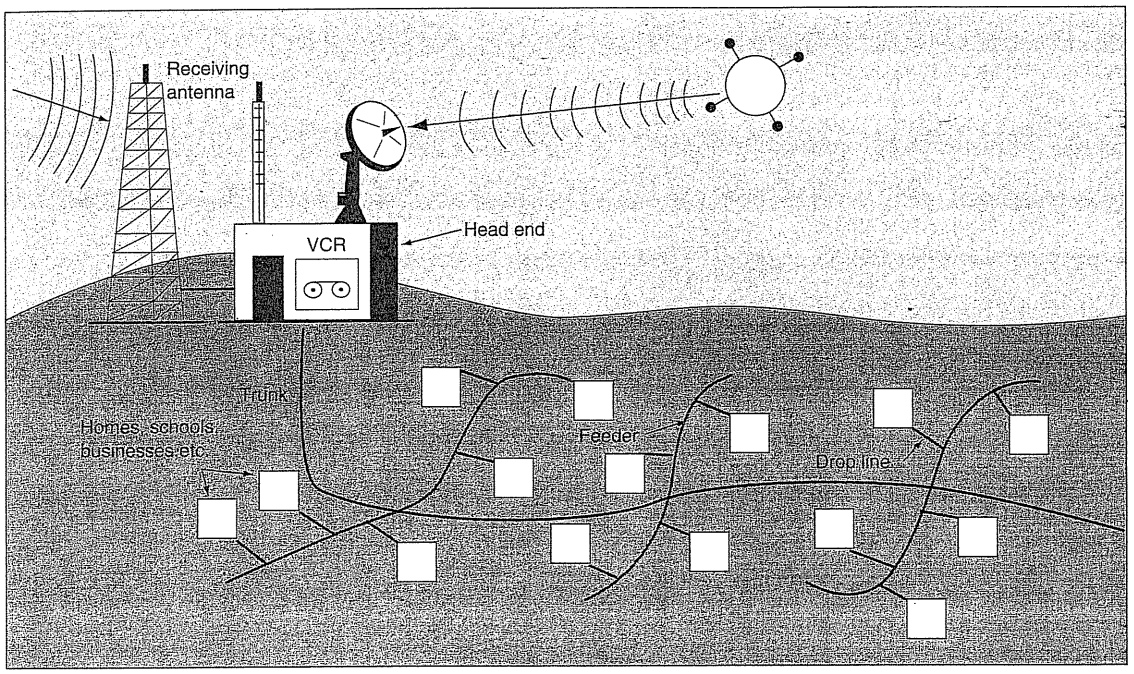
Cable Television. The cable concept of television program delivery was first applied commercially in the 1950s in an isolated town where, due to interference from a mountain overshadowing the town, people were unable to receive a viewable signal from the nearest TV station. Local businesspeople developed the idea of building a master antenna atop the mountain. There the weak signals were amplified and fed into a coaxial cable that ran down the mountain into the town (Figure 12.12). By paying an installation charge and a monthly subscription fee, customers could have their homes connected to the cable. This idea of having a single tall antenna to serve a whole community gave the process the name *community antenna television,* or *CATV,* now more commonly known as cable television. Many schools and most postsecondary institutions are connected to commercial cable systems, often without monthly charges. Educational institutions are often invited to use one of the cable channels for their own purposes.

The availability of multiple channels with cable facilitates a number of special services:

- Transmission of several programs simultaneously and repetition of programs at different hours for more flexibility with classroom schedules
- *Narrowcasting,* or aiming specialized programs at small subgroups (e.g., those speaking foreign languages or having sight or hearing impairments)
- Retrieval of remotely stored libraries of video materials, allowing teachers or individual students access to materials on demand without the logistical struggle often associated with the physical delivery of materials

Furthermore, many cable operators provide schools with special programming, teacher's guides, and even special computer services. Many program sources available via cable are not retransmitted from broadcasts but are sent out only on cable. A number of these offer high-quality programming suitable for school use. The Discovery Channel, the Learning Channel, Cable News

FIGURE 12.12
Cable television distribution system. Multiple program sources are combined at the "head end" and sent out through trunks, feeders, and drop lines to individual homes, schools, and businesses.

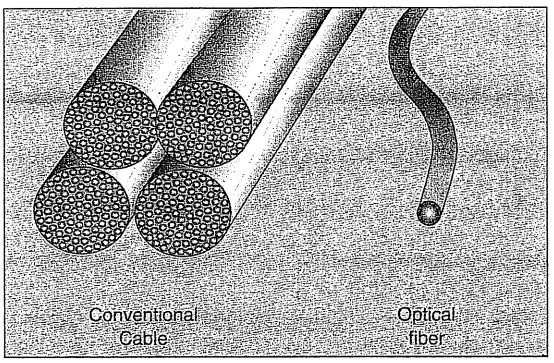


Network, and C-Span are a few examples. All of these offer program guides for teachers. The school library media specialist may already have these available for teachers or can assist in obtaining them.

Fiber Optics. Fiber optics is a fascinating and newer example of links in telecommunications systems. Optical fibers retain the physical link of phone lines but are only a fraction of the diameter of wire (Figure 12.13). All homes, schools, libraries, and offices in a city can be interconnected and tied into state, national, and international networks. An optical fiber carries digital—rather than analog—signals as pulses of light generated by a laser device no bigger than a grain of salt. The millions of pulses per second emitted by the laser make it possible to carry many more messages than copper wires or coaxial cables. For example, two optical fibers can handle well over 6,000 telephone conversations at one time, a task that would take 250 copper wires. The use of fiber optics also helps to save scarce resources. Silicon, used to make the optical fibers, is the second most abundant element on the earth, whereas copper reserves are dwindling.

The digital code can transmit print, audio, and images either separately or simultaneously. The digital signal is also devoid of background noise and is much less vulnerable to distortion caused by external sources such as magnetic fields and electrical storms.

FIGURE 12.13
A single optical fiber can transmit as many messages as more than one hundred copper wires.



Education networks have become prime users of the technology of fiber optics. New facilities are using optical fibers in place of cable, and older facilities are replac-

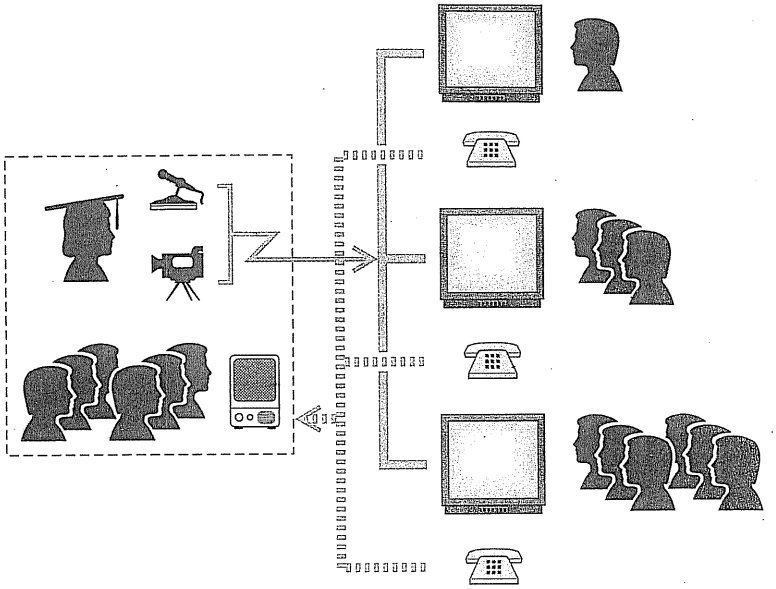


FIGURE 12.14
Television—one-way video, two-way audio. This is probably the most widely used and most economical means of adding interactivity to instructional TV.

ing cables with the space-saving fiber. Hooking up computers with cables or over phone wires limits what can be transferred from one computer to another. Phone lines are too slow and operate on too narrow a *bandwidth* (total available frequency range) to handle multimedia applications, such as video, sound, and animation. Wireless networks promise to provide easier and better transmission of multimedia materials. Schools are finding it practical to build networks combining wireless and fiber optic cable technologies. The emergence of wireless and high-speed networking augments the usefulness of collaborative software packages and makes them less expensive, as well as more accessible to students.

One-Way Video, Two-Way Audio. Virtually all the television modes mentioned so far can be converted into a two-way communication system by using a device for sending audio back to the presenter. In the case of broadcast, satellite, and microwave transmissions, the talkback capability is usually added by means of a telephone for calling the originating studio. In the case of closed-circuit and cable systems, the talkback channel may be incorporated in the CCTV or CATV wiring itself (Figure 12.14).

Two-Way Video, Two-Way Audio

Fully interactive television with two-way communication of both audio and video, or two-way television, is achieved by equipping both the sending and receiving sites with camera and microphone and interconnecting them by some means capable of two-way transmission. This may be fiber optics, cable, microwave, satellite, or a combination of these. A school or other organization may operate its own **video teleconference** facilities or lease them as needed for specific occasions.

Many two-way video, two-way audio systems rely on full-motion video pictures. Technically, it is much more difficult and expensive to transmit a full-motion video image than a still picture (Figure 12.15). The full-motion image requires a signal channel as broad as that used by broadcast TV stations, whereas a still picture uses a narrow signal and can be sent over a telephone line. **Compressed video** removes redundant information, transmitting only the frames in which there is some motion. In this way the video information can be "squeezed" through a telephone line. This compression is important because it costs only about one-tenth as much to transmit through a phone line as through a broadband channel. There is a perceptible difference in the fluidity of the motion depicted, but participants easily adapt to this. Compressed video is popular wherever two-way television is being used. (See "Close-Up: School–University Cooperation Through Compressed Video," p. 299.) Compressed video is also used for computer desktop video (see Chapter 11).

ONLINE TECHNOLOGIES

Online technologies (those that rely on computer-based systems) have opened up a new array of distance learning opportunities. Where once students had to drive a short distance to attend a class conveyed by a video or audio connection, computer-based systems let them remain in

CLOSE-UP

SATELLITE SERVES RURAL HIGH SCHOOL

Eddyville (Oregon) High School is a small, rural high school serving a logging community located on the Pacific Ocean. It is part of a sparsely populated school district covering 1,800 square miles. The school, like many others in similar situations, has difficulty offering a broad enough curriculum to meet the diverse needs of the students. In this case, the interactive television programs delivered by satellite from StarNet network in San Antonio, Texas, helped to fill the gaps. Eddyville High School was about to eliminate classes in French and Spanish because the teacher of those subjects moved away. By subscribing to StarNet the school enabled its students to take not only those language courses but also psychology, sociology, and art appreciation.

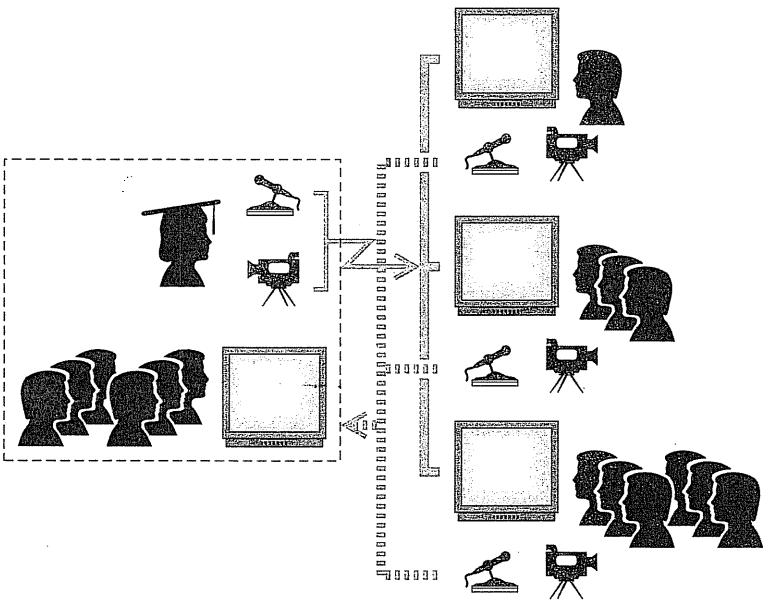
The video lessons are broadcast on a regular schedule, and the students participate along with students at many other sites around the country. At each site there is a telephone to allow question-and-answer (one-way video, two-way audio) sessions. Students, teachers, and parents appreciate the chance to have an enriched curriculum at a cost even a small school can afford.



Source: StarNet Information (StarNet Network, 1999), www.starnet.org

their home or workplace to participate in learning activities. Software programs, cameras, and an array of resources can give students distance learning experiences similar to those that used the older distance education systems. Students can attend class at a designated time, can participate in an audio, video, or text-based chat, can post to bulletin board discussions, and can access information related to coursework right from the computer. It is possible for a mixture of distance learning technologies to take advantage of the contributions of each type of technology. For example, a teacher in an interactive television class might use a Web-based setting for resources and to foster discussions outside of the actual class meet-

FIGURE 12.15
Television—two-way video, two-way audio. Full auditory and visual interactivity requires a camera and microphone at each reception site.



CLOSE-UP

SCHOOL–UNIVERSITY COOPERATION THROUGH COMPRESSED VIDEO

The Wyoming Centers for Teaching and Learning Network (WCTLN) is a cooperative venture among school districts and the School of Education at the University of Wyoming. This network uses compressed video and other technologies to connect schools in nine districts with each other and with the university.

The telecommunication network was set up to deal with the problem of small populations spread over a vast geographic area. Many teachers work in small, isolated schools with limited curriculum offerings. Because of the relatively low cost of building and operating a compressed video system (compared with regular broadband video), it is now possible for students in one locale to participate in live, two-way audio and video exchanges with students and teachers at other schools.

Besides being used to enrich the curricula at K–12 schools, the system is used by teachers and administrators for electronic inservice meetings, saving them from driving hundreds of miles to meet face to face. The School of Education uses the system to enable teacher trainees to observe real classrooms. The system also allows student teachers to be observed by their School of Education supervisors while they are working in the field. Considering that some of these school sites are a seven-hour drive from the university, the video system yields tremendous savings in time and effort.

Source: Landra Rezabek and Barbara Hakes, College of Education, University of Wyoming.

ings. (We discuss more fully this type of learning experience in Chapter 11.)

DISTANCE LEARNING ISSUES

Role of the Student

Students need to know their roles in a distance learning experience. Early attempts at this type of instruction tended to involve a "talking head," with students passively sitting in the distance sites, often not attending to the "head." More recently, with technological advances, interactions among students and between sites is feasible. Students can become more engaged in their learning. It remains the teacher's responsibility, however, to guide students on how to interact appropriately.

Students need to know how to use the technology to communicate with the teacher and with each other. When students want to ask questions or want to add to the discussion, they must be able to use the technology to interact. Students not only need to know how to operate the microphone or how to post to a bulletin board discussion, they also need to understand communication etiquette. A student's "right to interrupt" becomes an important concept when working with multiple video or audio sites in a course. If the teacher does not give equal time to all sites, or if a student has a question that needs to be addressed, it may be necessary for the student to interrupt the teacher's instruction.

Role of the Teacher

When we begin to talk about the teacher in the distance learning classroom, it is necessary to think about the setting in a new light. The classroom is now a *series* of "rooms," connected electronically. The **origination classroom** is the one where the teacher is present. **Distance sites** or *remote classrooms* are the locations connected by the telecommunications system. At the distance sites, there may be only one or two students, or there may be a full class. Additionally, there may be a distance-site facilitator, an adult whose responsibility it is to work with the teacher. The facilitator may be another teacher or a classroom aide. The duties of the facilitator vary depending on the course content and the origination classroom teacher's needs.

Experience has shown that in K–12 education, student success increases when the teacher and the distance-site facilitator work as a team. In one major project, for example, students learned more in cases where the distance-site facilitator did the following:

- Watched and participated actively in all programs with the students
- Encouraged interaction with the teacher and other students
- Answered questions at that site
- Solved immediate problems
- Provided additional quizzes and worksheets
- Took responsibility for operating and troubleshooting the equipment

To play an active, facilitating role requires advance planning and training. Ideally, the distance teacher and facilitator meet before the classes start to discuss goals for the class and instructional strategies. For example, they may agree to allow students in receiving classrooms to discuss and explain points to each other during class with talkback microphones off. Such peer cooperation can greatly enhance the learning atmosphere in what might otherwise be a stilted, restrictive environment.

In an online learning environment, teachers need to assume more responsibility for planning. The materials students will need must be prepared in advance of the actual class offering. Students must also understand

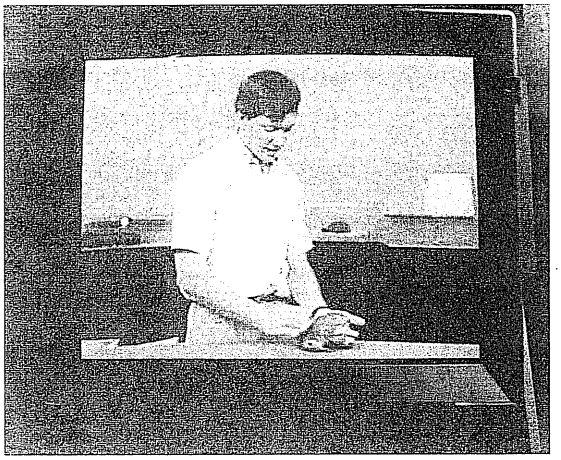
CLOSE-UP

SHARING TEACHERS VIA VIDEOCONFERENCING

How can small rural schools offer advanced courses in mathematics, foreign languages, and science when no single school has a large enough enrollment to justify its own teacher? Four school districts in Carroll County, Illinois, have been experimenting with a simplified two-way videoconferencing system as an answer to this question. Each participating school has set up one classroom as a teleconference room, equipped with cameras, microphones, video recorder, monitors, and a special effects generator/switcher. Classes are taught live at the school in which there is a qualified teacher; students in any of the other three schools may participate.

Students in the receiving schools watch and listen to the class. They can also be heard and seen by activating the camera and microphone in their own classroom. A camera mounted above the teacher's desk gives close-up views of visual materials.

Lessons can be videotaped for review by absent students. They can also be videotaped in advance when the instructor must be absent during usual class times.



Data source: Rhonda S. Robinson, professor, Northern Illinois University, De Kalb, IL.

what is expected of them in terms of their patterns of responses. For example, if students are to post responses to questions on a bulletin board, not only do they need to know where to post, but the expectations of what they will be posting. Further, teachers need to spend time to help students learn the "netiquette" necessary for appropriate interaction with fellow students.

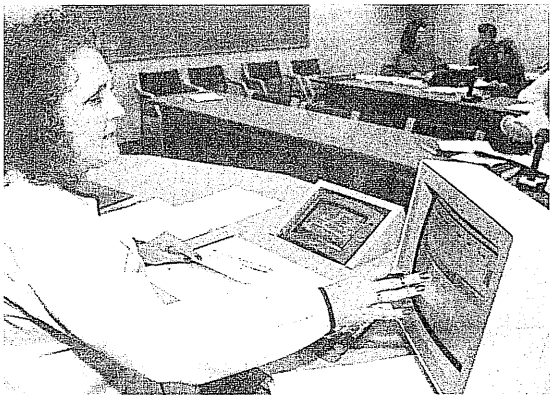
It is essential that teachers receive the types of training they need to successfully implement these technologies in their teaching. Teachers need to know not only how to use these technologies, but also how to teach their students to become successful users. Such basic skills as searching for information take on new meaning when the library card catalog suddenly becomes a range of databases and libraries throughout the world. Here the classroom teacher and school library media specialist need to work closely together to provide students with meaningful and enlightening experiences. Teacher training programs, both preservice and inservice, are engaging their students in various types of activities that require students to use telecommunications. Some offer whole courses, while others provide opportunities for networking among students and faculty. As teachers begin to use these technologies, their interest in sharing them with their students will expand.

Visualizing Instruction

With technologies for distance learning that rely on television, the teacher may need to change existing teaching materials (Figure 12.16). The document camera (see Chapter 6) is a valuable teaching tool for showing students visuals and for demonstrating specific tasks. Although teachers may be able to use classroom materials such as overhead transparencies, these materials tend to be in a format not easily visible on the monitors. Television has a horizontal, or "landscape," orientation, which means that materials prepared in a vertical orientation will not be as easily seen. It may be necessary to redo materials. One suggestion is to have all classroom materials prepared so they can be used in either a regular or a television classroom setting.

Color, size, and design are important considerations. Television is not a very good medium for quality color transmission or for showing fine detail. So, for example,

FIGURE 12.16
Videoconferencing systems can be designed so that the teacher can select the image to be shown by touching the screen.



© COPYRIGHT CONCERNS: DISTANCE LEARNING AND THE COPYRIGHT LAW

The electronic delivery of instruction has created new concerns related to copyright law. For the most part, fair use applies. However, certain specific considerations have been recognized in distance learning:

1. Off-air recordings for nonprofit educational institutions are to be retained no more than 45 days.
2. Off-air recordings may not be altered from their original content. This includes combining or merging, physically or electronically, to constitute teaching anthologies or compilations.
3. Broadcasting of copyrighted materials is allowed if the following terms are met:
   - The broadcast is part of a systematic, ongoing instructional activity.
   - It is directly related and of material assistance to the teaching of content.
   - Transmission is received in classrooms only, or in similar settings normally devoted to instruction.
   - The broadcast is aimed at regularly enrolled students and conducted by a recognized educational institution.

If the class is being recorded, it is a definite copyright infringement if prior approval for material presentation is not obtained.

For general information on copyright, see the Copyright Concerns on page 87 in Chapter 4. Suggested readings on copyright appear at the end of Chapter 4.

a science teacher who is demonstrating a chemical reaction that relies on color change may find that students at the distance sites do not see the desired outcomes. Although it is possible to zoom a document camera in for close-up of a page, definition and quality may be lost. Also, some graphics may be too "busy" for television, creating distractions for students.

Accessing Resources at a Distance

One element often overlooked in a distance learning situation is the access students have to resource materials. The amount of available information resources is expanding at an exponential rate. If a teacher wishes to have students engage in research or certain types of activities, it is critical that they have access to related materials. A teacher may need to change particular types of activities or to make special arrangements for materials to be sent to the distance-site classrooms. Students at a distance site should not be at a learning disadvantage because of limited resources. It is the teacher's responsibility, often working closely with the school library media specialist, to ensure that all students have equal access to the materials essential for learning. While the Internet and the World Wide Web have eased this concern a bit, there are still some courses where the resources for the students are not readily available on the Web, or copyright issues do not allow using the Web to provide those resources. The school library media specialist should be aware of the copyright issues and should be able to help teachers provide easy access to materials.

Advantages

- *Cost efficiency.* All forms of broadcasting share the attribute of reaching geographically dispersed audiences in a cost-efficient way.
- *Audiovisual capacity.* All television systems allow the transmission of motion images and sound over a distance.
- *Two-way possibilities.* When learners can communicate with the instructor and other students via telephone or two-way video, you can approximate a live classroom interaction.
- *Online possibilities.* When available, online technologies can provide access to resources and to instruction that might not be otherwise possible.

Limitations

- *Cost for two-way.* Adding the capacity for two-way communication may require costly hardware installation, including a bridge if multiple sites are connected at once. If using telephones, there may be toll charges for the calls.
- *Facilities for two-way.* The special setups needed for two-way video require that a classroom be dedicated to this use, thus making it difficult to use the room for other purposes (Figure 12.17).
- *Isolation.* Learners who participate in broadcast lessons without talkback capabilities can feel like second-class citizens having little rapport with the rest of the group.
- *Technical problems.* Technical problems may interrupt the instruction and may create confusion and frustration for the instructor and students.
- *Inexperience.* Instructors may not feel comfortable teaching in this type of setting.
- *Reluctance.* Students may be reluctant to assume greater responsibility for their own learning.
- *Connectivity.* Students may have difficulty making certain types of online connections due to their type of access to the Internet.

CLOSE-UP

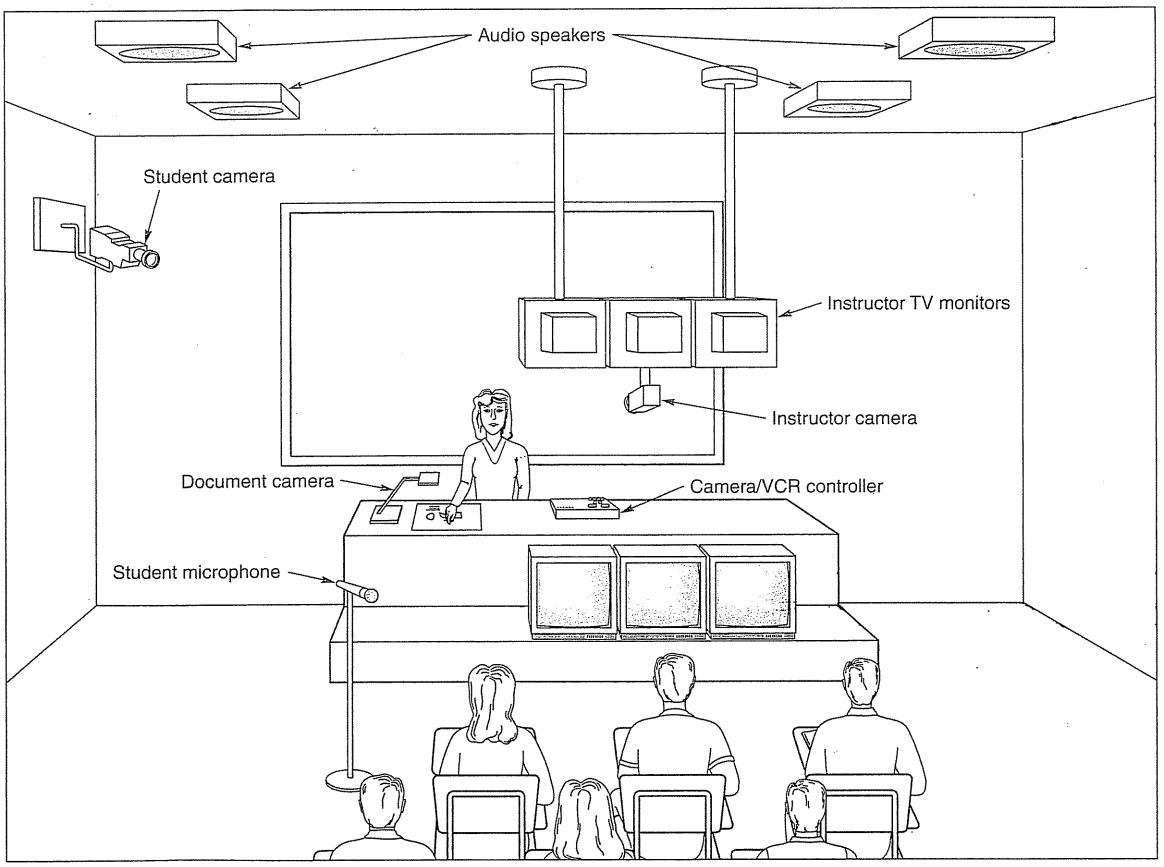
FREE CLEARINGHOUSE ON DISTANCE LEARNING

The National Distance Learning Center (NDLC) is a centralized online database containing detailed program listings for distance-learning courses, including credit and noncredit courses, teleconferences, seminars, and inservice training courses. The listings pertain to all audiences—primary, secondary, and continuing education. NDLC provides program information on courses available in all distance-learning formats, including satellite broadcast, audio- and videocassette, and print.

There is no charge to access the system or to scan the database, and access requires only a computer and modem; communications software for the modem will even be sent without charge if needed.

For more information, contact the National Distance Learning Center, Owensboro Community College, 4800 Hartford Road, Owensboro, KY 42303. The college's Web address is http://www.occ.uky.edu; you can access the NDLC database directly using Telnet at telnet://ndlc.occ.uky.edu. Visit these websites through the Web Links module in Chapter 12 of the Companion Website (http://www.prenhall.com/heinich).

FIGURE 12.17
Classroom setup for interactive TV. At the originating classroom, both teacher and students must have camera(s), microphone(s), and monitor(s) to communicate with students in remote classrooms.



ASSURE BLUEPRINT

Exploring New Worlds

Three science teachers in different communities around the state decided to work together on a unit about space exploration. They wanted to expand the resources available to their students by using the statewide community college interactive instructional television system.

Analyze Learners

General Characteristics

The students in the three classes are all 17 to 18 years old and reside in rural communities that are miles apart. They are a homogeneous group, both in terms of their socioeconomic background, but also in their general learning abilities. Class size ranges from 18 to 22 students.

Entry Competencies

The students have engaged in hands-on science in each of their classes. They have not worked with teachers or students from other schools prior to this experience. They have never used the interactive television system. The students have had little experience talking with experts in the field of science other than their teachers.

Learning Styles

The majority of the students prefer to work in small groups with their peers. They do not like to be at the front of the classroom presenting information. They have not experienced seeing themselves on television before and it is anticipated they will appear shy and unwilling to talk in this class.

State Objectives

The students will be able to do the following:

1. Using the interactive television system, students will engage in a dialog with experts in space exploration, with each student preparing a question in advance of the session.
2. After the interviews and gathering additional data, students will prepare a statement on their views of space exploration.
3. Using the interactive television system, students will discuss their divergent views with the experts by preparing presentations and transmitting them between sites.

Select Methods, Media, and Materials

The teachers, working together, decided to begin the space exploration unit by posing the question, "Is manned space exploration an appropriate way to extend our knowledge of outer space?" Each teacher will conduct a discussion with students prior to connecting them via the statewide television system.

Experts who favor both manned and unmanned space exploration will be invited, via the television system, to present their views on this subject. Students at their schools, using the school media centers and the Internet, will prepare a position paper on their views of manned versus unmanned space exploration.

Students will also present their views using the interactive television system to all three classes. After the presentations, the teachers will group the students to prepare their presentations for the experts. Groups of students will present their views on this topic to the experts at a third interactive television session.

Utilize Media and Materials

The students were taught how to use the interactive television equipment in stages. First they were taught how to use the microphones to ask questions of each expert presenter. Next they were taught how to use the cameras for displaying their documents and showing themselves or others during both their own presentations and the later dialog with the experts.

As students were preparing their position papers they worked with the library media specialist to access resources on the Internet. Many of them used the World Wide Web to locate sites around the world.

Require Learner Participation

The active engagement of students in this project was monitored to ensure that all students had a question for each of the invited experts. Further, each student had to prepare a presentation using the interactive television system. Finally, working in groups, the students had to prepare a presentation to engage in dialog with the experts.

Evaluate and Revise

At the end of the unit, the teachers conducted a debriefing with each of their classes to determine if the students found this to be a valuable experience. By listing the students' responses, the three teachers could decide if they wished to engage in a similar activity in the future. The teachers also contacted the invited experts for their reaction to the experience to see what they might do to improve the exchange of information.

From these data, the teachers learned that the students valued the opportunity to meet with the experts. They liked hearing what the experts had to say. They found writing their position papers to be challenging, especially knowing they had to share them with everyone else. Some expressed concern they were not able to do a good job with this part. Also, students expressed concern with having to work with others in the groups to prepare their presentations for the experts. They found this to be very different from anything they had done before.

The experts stated they enjoyed the experience because not only did they get to work with high school students, but they also had the chance to hear divergent views from young people. They were willing to engage in this type of activity in the future.

After discussing the unit and agreeing on some procedural changes, the teachers and the school media specialists all agreed that they would like to work on this type of activity again.

All of the ASSURE Blueprints in this text and an electronic template for creating your own Blueprint can be found on the enclosed "Classroom Link Portfolio" CD-ROM.

Integration

Commercial and noncommercial stations are providing programming for use in educational settings. In fact, one-quarter of the programs used by teachers in schools originate from commercial stations. These include dramas, dance and music performances, documentaries, and news and public affairs programs. Popular television programs can also be used to spark discussions of social issues.

CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 12 of the Companion Website (http://www.prenhall.com/heinich).

1. *Planning Distance Instruction.* Locate a lesson on the Classroom Link Portfolio CD-ROM, or the Internet on a topic or standard of your choice. First, note the activities and media incorporated into the lesson. Second, note the changes needed to provide that learning experience at a distance. Third, identify the reasons for the change. Then, describe the assessment strategy you would use. Cite the source: (ISTE NETS-T II-B & C; III-B; VI-A)
2. *Written Reflection.* Reflect on your prior learning experiences. When have you engaged in distance learning, either formally or informally? Describe that experience. What occurred in the distance-learning experience that helped you learn? What would you like to have had included as part of that experience? What does this mean for you as a teacher? (ISTE NETS-T V-A; V-B; VI-E)

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 12 of the Companion Website (http://www.prenhall.com/heinich).

1. Investigate the use of radio for instructional purposes in a local school or college. Check with a local public radio station to see if it supports any specific instructional activities.
2. Interview a teacher who regularly uses broadcast television programs in the classroom. Prepare a brief written or recorded report addressing the objectives covered, techniques utilized, and problems encountered when using the television program.
3. Generate a list of interesting uses of telecommunications applications for a course you are currently enrolled in. Whom might you and your classmates communicate with? For what purposes?
4. Prepare an abstract of a report of a research or demonstration project related to instructional telecommunications (e.g., two schools sharing one teacher by means of interactive instructional television).
5. Observe a class taught at a distance. Describe how the teacher and students interact with each other. Also, describe the types and uses of media within the lesson.

ORGANIZATIONS

Agency for Instructional Technology (AIT)
P.O. Box A
1800 N. Stonelake Drive
Bloomington, IN 47402-0120
www.ait.net

Produces television programs and computer courseware as the coordinating agency of a consortium that includes most of the United States and the Canadian provinces. It serves as a national distribution center also. It publishes a newsletter and an annual catalog listing dozens of series incorporating several hundred separate programs. Emphasis is on the elementary and secondary levels.

Association for Educational Communications and Technology (AECT)
1800 N. Stonelake Drive
Suite 2
Bloomington, IN 47404
www.aect.org

Holds conferences, publishes journals and books related to instructional uses of media (including TV), and represents the educational communication/technology profession. Its Division of Telecommunications addresses the concerns of members who work in instructional TV and radio.

The Cable Center
2327 E. Evans
Denver, CO 80208
www.cablecenter.org

Center for Media Education
2120 L. Street, NW
Suite 200
Washington, DC 20037
www.cme.org

Sesame Workshop (formerly Children's Television Workshop)
1 Lincoln Plaza
New York, NY 10023
www.sesameworkshop.org

Corporation for Public Broadcasting (CPB)
901 E Street, NW
Washington, DC 20004-2006
www.cpb.org

Nonprofit, private corporation established and funded in part by the federal government. It performs a broad coordinating function for the nation's public radio and television stations and supports the interests of public broadcasting in general. CPB carries out research on the educational applications of television and coordinates the Annenberg Project, aimed at providing programming for higher education.

Media Communications Association–International (formerly International Television Association)
9202 N. Meridian Street
Suite 200
Indianapolis, IN 46260-1810
www.itva.org

Organization of nonbroadcast television professionals in 14 countries, primarily in North America. It supports the use of television in the private sector—training, communications, and public relations—and sponsors regional and national conferences and an awards program.

Satellite Educational Resources Consortium (SERC)
P.O. Box 50,008
Columbia, SC 29250
www.serc.org

Visit these websites through the Web Links module in Chapter 12 of the Companion Website (http://www.prenhall.com/heinich).

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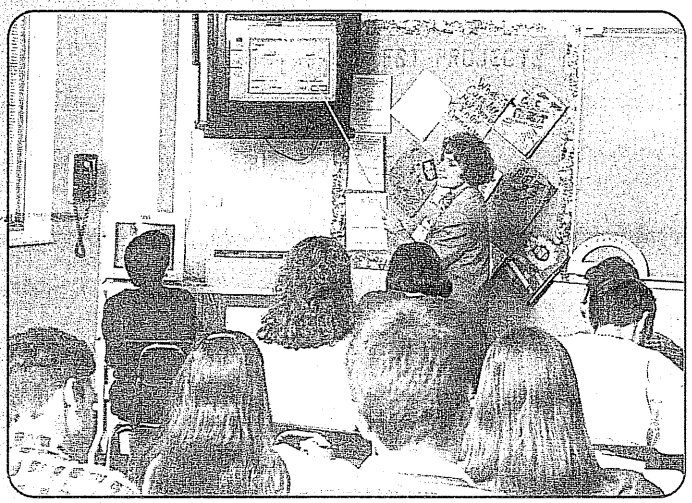
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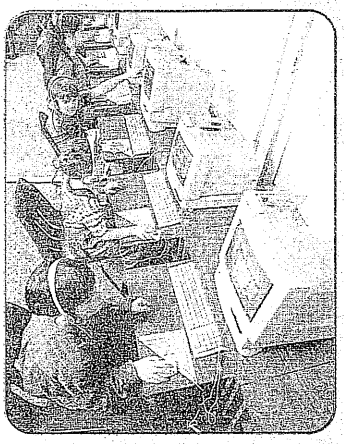
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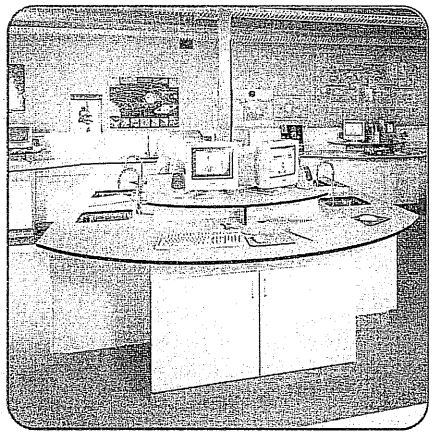
You are now prepared to move into the exciting future of instructional media and technologies for learning. The trends you will be involved with include multimedia systems and instant access to information and people around the globe.

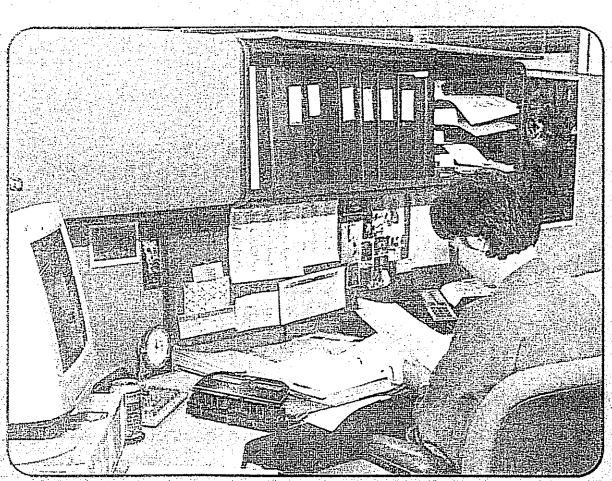
As we continue to learn more about learning, your students might well be using new interactive instructional technologies, such as those discussed in this chapter.





The school of the future will be different as well. Futurists predict that the structure of the classroom and the teaching itself will change. The role of the teacher and the use of instructional media and technologies must change if schools are to improve.





The nature of workers and the workplace will also continue to change. Consequently, education must prepare workers for the twenty-first century—much training will take place just in time, and at the workstation itself. The levels of knowledge will continue to accelerate, and workers will learn how to access specific knowledge when needed.

This is an exciting and challenging time for professionals in education and training. Learn to use media and technology to ASSURE learning.

Looking Ahead

OUTLINE

Trends in Media and Technology
Schools of the Future
Workplaces of the Future
Welcome to the 21st Century

KNOWLEDGE OBJECTIVES

1. Discuss the trends in media and technology that you feel will have the greatest impact on education and training.
2. Discuss your vision of the schools of the future.
3. Critique the conventional self-contained classroom as an organization and as a setting for incorporating technology.
4. Discuss the ways in which the roles of teachers and media/technology specialists are changing due to the impact of technology.
5. Describe the consequences of increased communication between home and school and the importance of the home as a center for technology-based learning.
6. Discuss changes in the workplace, indicating how media and technologies for learning will relate to these changes.
7. Describe the changing nature of training and how it relates to workers.
8. Predict upcoming developments in media, technology, education, and training.
9. Describe the various types of career opportunities available in educational technology.

LEXICON

desktop video conferencing
division of labor
low-cost learning technology
intelligent agent
virtual time
telecommuting
telework
just-in-time training
cold storage training
performance support system
cross-training
Total Quality Management (TQM)

Accurately predicting the future has never been easy, especially when it involves new technologies. A century ago, Western Union, the telegraph company, decided that "this 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us" (*Time,* 15 July 1996, p. 54). As chancy as making predictions was a century ago, it's even riskier today in light of the increasingly rapid pace of technological change.

Even though this is the final chapter in the book, it is really just the beginning of the rest of your career working with instructional media and technology. In this chapter, we describe trends in media and technology that apply to learning. These trends look at where the field has been, where it is today, and the directions it might take in the years ahead. We will discuss the development of these trends in both formal education and corporate training environments as they move into the twenty-first century.

Later in the chapter, we discuss trends relating to the schools and workplaces of the future. The last part of the chapter includes our predictions for the twenty-first century. We also include sections on your future in the field, professional organizations, and professional journals in educational technology.

TRENDS IN MEDIA AND TECHNOLOGY

Merging of Media Formats

A major trend in media and technology is the merging of media formats. In the 1950s, the common media were separate entities sometimes used in combination and called "multimedia," such as books with phonograph records and kits with real objects, photographs, and explanatory manuals. Figure 13.1 represents the common media of the 1950s.

In the 1980s, the computer began to combine some of these distinct media, as shown in Figure 13.2. The combination of the computer and video led to interactive video. Audio media began to evolve from audiocassettes to audio CDs. Virtual reality began to emerge. The digitization of print, images, and sound made many of these combinations possible.

Digitization has led inevitably to the development of new systems for information storage, retrieval, and transmission. It also has led to the convergence of media formats, with the potential for making older formats obsolete. For example, if still and motion images can be combined on the disc, and the same piece of equipment can display both, why have slide and video projectors? If DVDs are damage resistant and can store still and motion images, why maintain an inventory of fragile slides and videos?

Soon all of these media may exist together in a single format that will center on the computer. It will then be even more difficult to separate text, audio, visuals, and motion media (Figure 13.3).

FIGURE 13.1
In the 1950s the various types of media were distinct.

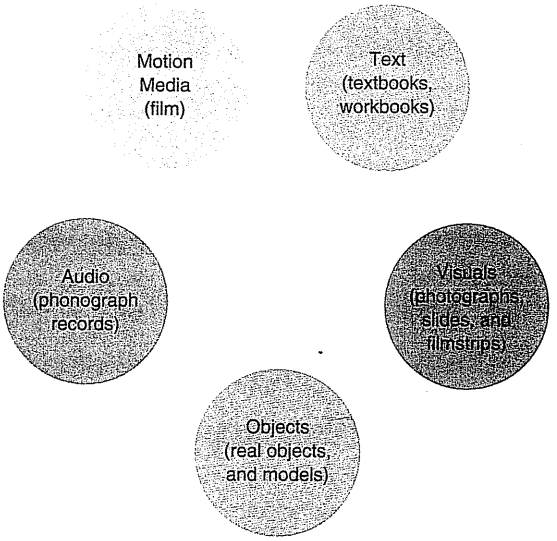


FIGURE 13.2
During the 1980s the computer fostered the convergence of the previously distinct media.

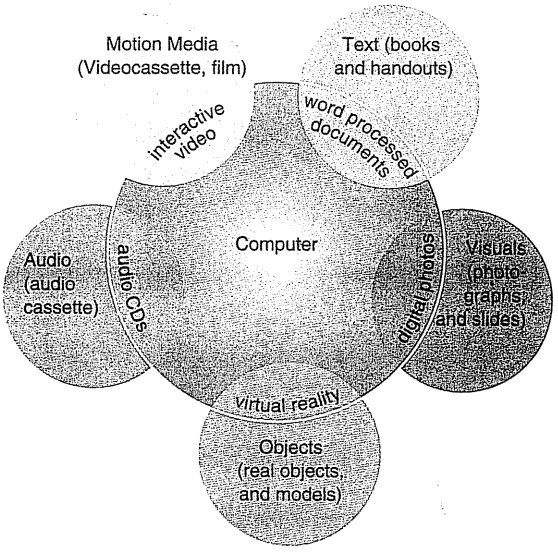
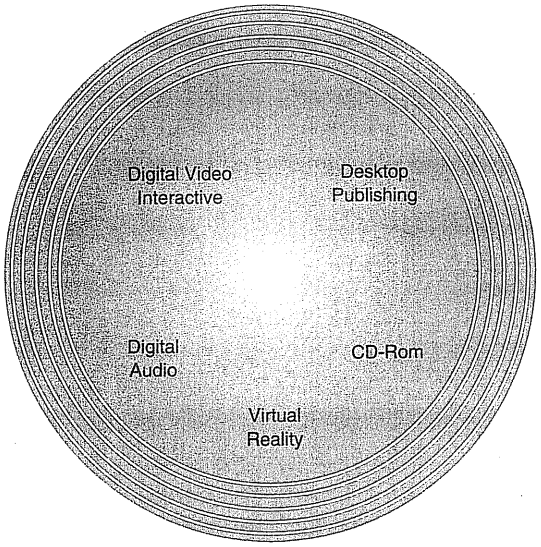


FIGURE 13.3
Soon it will be difficult to distinguish among the various types of media.



Continued Use of Traditional Audiovisual Media

Although they do not attract the attention that newer computer-based media do, traditional audiovisual media are still used far more often than computer-based media, in both the school and the corporate realm. However, even in countries with nearly universal access to traditional audiovisual media, teachers' use runs far behind availability, and complete integration of traditional audiovisual media into lessons is rarer still. In fact, both computer-based and traditional audiovisual media are used less than print-based media.

In the United States, for example, print material is the dominant media format, according to teacher self-reports (Center for Community Research, 1999). Seven times as many teachers use textbooks every day as use audio or video materials. Textbooks and other printed materials are the most common instructional tools throughout the world, although even these are frequently unavailable or of poor quality. Both in the United States and in other countries, access to media is highly correlated with economic levels, with wealthier school districts consistently reporting greater supply of hardware and software.

In the corporate world, instructor presentation/demonstration is still the most universally applied method of training, currently used in over 90 percent of companies (Industry Report, 1999). Videotapes and printed workbooks and manuals are used in over 75 percent of companies, overhead transparencies in 64 percent, audiocassettes in 44 percent, and slides in about 30 percent of the organizations surveyed. The combination of instructor plus overhead and printed materials accounts for about one-half of all the training given. Overall, the use of videotapes, transparencies, and slides seems to be receding slowly, being replaced by computer-based media.

Evolution of Computer-Based Media

In economically advanced nations, computers are found in virtually every school. The greatest number of computers are found at the secondary level, with 22 percent of elementary, 29 percent of middle level, and 31 percent of high schools labeled as including a high degree of technology resources in each building (Anderson & Ronnkvist, 1999).

In schools that use computers, Becker (1999) has noted an evolutionary pattern for their use. At first, computers were housed in computer labs, were employed within a narrow range of the curriculum—typically in "computer literacy" or mathematics—and teachers had a low level of involvement in decision making and a low sense of ownership. Over time, computers have tended to be relocated into classrooms where teachers employ them across a wider range of the curricula. More teachers now embrace them, and teachers subsequently take a larger role in technology decision making. This evolution toward wider use is probably the most notable trend in the realm of computer-based instruction and accessing the Internet (Figure 13.4).

In the corporate world, nearly half of all companies surveyed (Industry Report, 1999) used computer-based training (CBT)—including training using interactive multimedia—to train employees. Only 14 percent of all companies using CBT account for more than a quarter of all training. Two delivery systems increasing in popularity are CD-ROM and wired networks (LANs and intranets); thus, we find trends toward both centralization (e.g., CD-ROM) and decentralization (e.g., networks) in terms of distribution. Overall, the use of computer-based media for training and education is on the rise as more proven off-the-shelf courseware incorporating attractive multimedia features becomes available.

Pervasiveness of Telecommunications-Based Media

About 75 percent of U.S. schools have cable TV service and about one-half of the teachers use some cable TV programming, the most popular being *Cable in the Classroom,* a noncommercial service aimed at in-school audiences (Ely, 1996). About one-quarter of schools have satellite reception antennas, which provide a wireless path

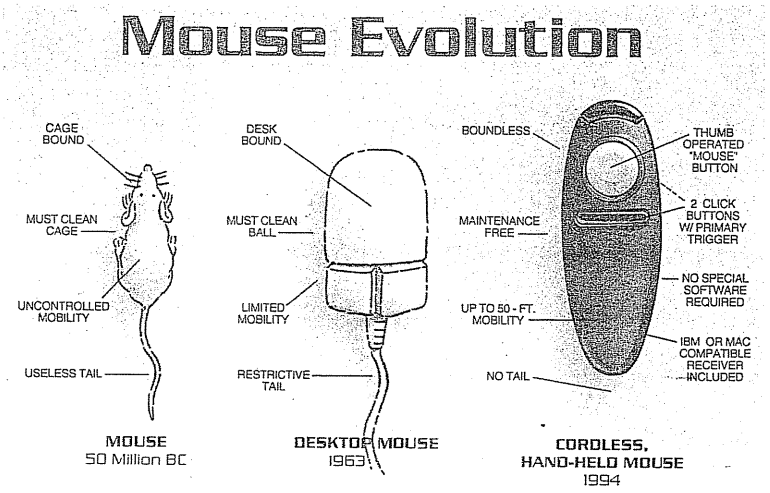


FIGURE 13.4
This Interlink Electronics ad cleverly depicts the evolution of the mouse. (RemotePoint Cordless Hand-Held Mouse, Interlink Electronics. Used by permission.)

for television reception. This path is used to receive instructional programs, such as those of the StarNet network (see "Close-Up: Satellite Serves Rural High School" in Chapter 12), and for live video conferences that provide professional development for teachers and administrators. In general, distance education courses are of limited importance to U.S. public schools. Because primary and secondary schools are inherently *local* in structure, they have little need to share courses over long distances (unlike a large business or university that might have branches all across the state or country). School systems seek whole courses only in cases where a local school cannot afford to maintain a teacher in a given subject and that subject is vital to the mission of the school (see Chapter 12).

More newsworthy is the rapid pace at which K–12 schools have become connected to the Internet and the World Wide Web. In the United States, 95 percent of all public schools had access to the Internet in the fall of 1999 (National Center for Educational Statistics [NCES], 2000). This represented a 6 percent increase since 1998. Among all schools, 66 percent of teachers used the Internet in connection with their teaching (NCES, 2000), primarily to allow students to search the Internet and the Web for information to use in reports, papers, and discussions. As with video-based telecommunications media, there is currently limited interest in computer delivery of whole courses or even intact units, such as is done with computer-assisted instruction.

The number of rooms in a given school that have access to the Internet varies. In some schools there is only one, usually a computer lab or library media center. In other schools every room has an Internet connection. In most schools, a new vision has emerged of the media center as a dynamic hub of an inquiry-based curriculum.

Universities with multiple campuses are more likely to send and receive courses through telecommunications in the synchronous mode, emulating a regular classroom as closely as possible. Universities are increasingly collaborating in their course offerings. More and more college courses are incorporating both synchronous and asynchronous delivery of instruction. Colleges and universities increasingly use the Web to deliver course materials and for interaction between instructor and student and among students.

College courses are using more desktop video conferencing as a part of courses. **Desktop video conferencing** is real-time (synchronous) person-to-person or group conferencing on the Internet. With special software and a video camera, you can experience audio and full-color video "chats" on the computer. Everyone can participate in the "live" discussion. A group can interactively share documents and information and have access to such features as a whiteboard and chat windows.

Connection to the Internet is virtually universal at the college and university level. Internet connections are available to faculty in their offices and to students in their dorm rooms, computer laboratories, and libraries. College students tend to have more and freer access to the Internet than do K–12 students. As a consequence, these institutions are providing an increasing amount of advanced instruction through the Internet. More courses will be offered totally via the Internet in the future. There also has been a rush to offer asynchronous "correspondence"-type courses to off-campus students via the World Wide Web.

Business and industry have experienced steady growth in the use of telecommunication networks, particularly among companies with more than 10,000 employees; about half of such businesses currently operate networks (Industry Report, 1999). These networks—satellites for video conferencing or wired networks for digital communication—are typically established for



FIGURE 13.5
Telecommunications-based media make communications a reality among students in different parts of the world.

purposes such as sales meetings. Video conferencing allows real-time, synchronous interaction among participants at widely dispersed locations, saving companies money formerly spent on travel. Once in place, businesses can then use these communication systems to deliver distance education (Figure 13.5).

The development that has been attracting the most notice in the training and development literature in recent years is the steep rise in use of the World Wide Web and intranets (Web-type systems internal to one company) for delivery of training and information (Bylinsky, 2000). The potential advantages of using the Web for training include a huge reduction in printing costs and a simplified method of updating material. It is predicted that by 2003 about half of all companies will be using either the Web or their own intranet for delivery of training (Bylinsky, 2000). Yet, the concept of Web-based learning is a fuzzy one, because most of this type of learning is done by individuals interacting in asynchronous sessions with text materials stored on the Net. It's difficult to estimate the time being spent this way; likewise, it's increasingly difficult to distinguish training material from reference information. This trend is likely to continue and to evolve in the future.

Combining Telecommunications Technologies

Telecommunications offers the potential for both students and teachers to break down the walls of the classroom and share ideas and information with colleagues collaboratively. In the business world, telecommunications has had the same effect—leading to a more national and international business community.

Just a decade ago, the telephone company and the TV cable provider were separate organizations. Today both types of companies can provide both phone and cable services as well as such additional services as broadcast television and Internet access. Web-dedicated set-top boxes attached to both a phone line and a television set can now connect the viewer to an interactive website.

This wider variety of services reflects the rapid changes in technological devices available. In a few years you will have access to a videophone, fax machine, and computer in the form of a single, hand-held device. You will communicate with this device by voice commands, by handwritten notes, or by typing, whichever you choose.

Technology is becoming more useful, more prevalent, more "intelligent," and more powerful, while at the same time becoming less intimidating, less noticeable, less demanding, and less expensive. User interfaces are becoming simpler and devices are becoming increasingly user friendly.

Today, if you choose, you can be "on call" 24 hours a day anywhere in the world through wireless technologies and network-based messaging systems. In the future you will carry at all times your own telephone-like communication device no larger than a credit card. Consider the development of the radio. In its early days, it was very large and attached to the wall by an electrical cord. Over the years, radios have become smaller and portable thanks to transistors and battery power.

Application of Advanced Interactive Technologies

Advanced interactive technologies include multimedia, hypermedia, and virtual reality. Multimedia CD-ROM products are commonly found in school media centers, primarily in the form of encyclopedias or other reference databases. There is still relatively little application of multimedia and hypermedia to core instruction in schools. In higher education there is widespread experimentation with locally produced multimedia and hypermedia, but standardized formats or universal acceptance of such technologies for core instruction across institutions remain to be established.

Interactive multimedia formats are beginning to gain a foothold in corporate training, primarily to deliver basic courses across multiple sites. Lack of hardware and software compatibility has restricted the availability of off-the-shelf courseware. Organizations are beginning to incorporate more multimedia courseware into their training programs as compatibility improves; thus, the supply of less expensive off-the-shelf materials is increasing as the demand rises. We believe this trend will continue well into the twenty-first century.

Increased Use of Technology for Inclusion

"Students and their parents continue to press for access to technology that can expand opportunities for expression, communication, academic success, social participation and inclusion, and preparation for an independent life" (Male, 1997, p. viii). By incorporating technology into the classroom, teachers will be better able to meet the special needs of all learners—those with learning or physical disabilities, as well as gifted students and students whose native language is not English.

With the increasing uses of and new developments in technology it is possible to include more special-needs learners; it is also possible to bypass these learners with the rush to get the newest technologies in the classroom. Thus, it is important to provide access to technology for *all* learners. We can begin by integrating technology into individualized education programs (IEPs) for special-needs learners in kindergarten through twelfth grade.

Teachers and administrators can also adapt classrooms to accommodate special-needs learners. Learning stations can be specially equipped for those with learning or physical disabilities. Students should be able to control the rate of speech delivery, enlarge information on a computer screen so they can better read the results of a database search, use a voice synthesizer to have a printed page read to them, or take notes in class through an electronic storage device that will later print out the document in braille. Some Web pages are being designed to accommodate these needs by offering user-selected graphic and text design options.

As our curricula and digital technologies emphasize more visual instruction, visually impaired students may find themselves at a disadvantage. These students can use computers to enlarge text to readable size and can use speech synthesis to have the words read aloud. Computers can tell them what the words say, but at this point in time cannot describe visuals.

Interestingly, it often happens that the techniques and alternatives that we use with special-needs learners, such as providing handouts and notes for auditorily impaired learners and using audiocassettes for visually impaired learners, can improve the learning of *all* students.

SCHOOLS OF THE FUTURE

Technology and Education

Because our society in general is receptive to new technology, we tend to assume that our subcultures are also receptive. This simply isn't always true. Education is the classic example of a subculture that has a spotty record at best in using technological developments to change instruction. As described earlier, the organization of instruction today is basically the same as it was 100 years ago.

New technology carries no imperative. What matters is how potential users perceive it. If a new development is useful, easy to master, and nonthreatening, the likelihood of acceptance is very good. The problem is that people within the same organization vary in their perceptions of new technology according to how it will affect what they do. For example, teachers accepted, and usually welcomed, the introduction of the overhead projector because they viewed it as a more versatile chalkboard, easily fit into their established practice, and reinforcing their status in the classroom. But if a principal joins a satellite network because she wants her school to benefit from the coursework offered, her staff may perceive the technologically delivered courses as an affront or a challenge to their professional status. Teachers may easily perceive whole courses delivered technologically as threats to their job security: if high school students can learn by means of two-way television, why not replace teachers entirely?

Experiences with projects such as StarNet and the Iowa Distance Education Alliance (see Chapter 12) have demonstrated that courses delivered by two-way television can successfully fill gaps in the secondary school curriculum. The demonstrated success of technology-based instruction, then, raises the possibility of expansion beyond just filling gaps. But expanding technology's role in this way would eventually alter the basic organizational and power structures of schools. It remains to be seen if the education profession, students, their parents, and other decision makers are willing to make such fundamental changes.

Courses delivered by satellite, via the Internet, or on interactive television are more likely to be accepted by rural schools. Principals and school boards in rural and poor areas are more likely to take the risk of experimenting with distance learning because such schools have little realistic hope of maintaining a faculty large and diverse enough to teach all the courses needed in a modern comprehensive curriculum. Technology can expand curriculum offerings and alter the instructional organization, as well as the curriculum, of formal education. This movement may be driven by the current and projected teacher shortages, especially in the areas of math and science.



FIGURE 13.6
The typical classroom has one teacher working with a number of students. How might this structure change with increased use of technology?

Structure of the Classroom

The typical setup of the classroom, at virtually every level almost everywhere in the Western world, has the fundamental weakness of being organized around a single adult who attempts to orchestrate diverse activities for a generally large group of learners (Figure 13.6). This one person typically is expected to be responsible for selecting and organizing the content of lessons; designing materials; producing materials; diagnosing individual needs; developing tests; delivering instruction orally to the group or through other media individually or in different groupings; administering, scoring, and interpreting tests; prescribing remedial activities; and coordinating the numberless logistical details that hold the whole enterprise together. Other sectors of society have long since recognized that improvements in effectiveness and productivity require **division of labor,** but this concept has not yet been accepted in formal education.

An example of a profession in which division of labor has been accepted is that of medicine. Physicians have tended toward specialization, enabling each to keep better abreast of innovations in practice. They have adopted differentiated staffing within their offices and clinics so that they can delegate less critical functions to paraprofessionals, such as Physician Assistants, Nurse Practitioners, and technicians, reserving for themselves the function of diagnosing and treating conditions that merit their attention. Physicians have an incentive to accept this division of labor; it allows them to maximize their profits.

The current structure of our educational system cannot adequately accommodate the effective use of computers and other nonhuman resources. Alternative classroom structures do exist, however, and have been adopted in many places. In Chapter 2 we described programmed tutoring, the Personalized System of Instruction (PSI), and cooperative learning, each of which provides a total and radically different pattern for setting up a learning environment. We envision a trend toward increased use of these powerful tools in the education of all students.

More recently, a plan that incorporates virtually all technologies for learning and that centers on the notion of division of labor has been field tested in a number of countries, including Indonesia, Liberia, and the Philippines. Under this plan, the classroom teacher, who may or may not be a fully certified teacher-training institution graduate, uses materials that are centrally designed and rather fully scripted to lead participatory lessons. Parents, volunteers, and student tutors share other teaching and logistical tasks. Thus, there is division of labor in both the design and the implementation of instruction. The plan takes a somewhat different shape in each locale and is known by a different name in each country, but the generic name and concept is **low-cost learning technology.** It is essentially a systematic method for implementing a variety of managerial and instructional innovations. It focuses on improving student learning outcomes while reducing overall costs, especially labor costs.

Changing Role of the Teacher

The teacher's role in learning is changing as new technologies appear in the classroom. Teachers are not being replaced by technology, but their role has changed from information presenter to learning resources coordinator. In addition, they serve as facilitator, manager,

counselor, and motivator. Their new role frees them to work more independently with individuals and small groups while leaving the formal presentations to another medium. Teachers help students find and process information from many sources. In the future, teachers will become more and more "the guide on the side" rather than "the sage on the stage."

The demand for teachers with computer skills is increasing. Some schools now require that potential teachers demonstrate their computer skills. It is not enough to have had a course in college. They must demonstrate to an observer that they can operate a computer and use software for instructional purposes.

The trend toward changing teacher certification requirements, primarily to permit knowledgeable laypersons to teach, will probably be accelerated by the acceptance of courses delivered by technology, the advantages of having a diversely talented staff, and the current shortage of teachers. A growing number of certified paraprofessional educational personnel is likely. Future schools will have a more varied instructional staff than in the past.

Intelligent Agents to Assist Learning

In the classrooms of the future, tools such as intelligent agents will facilitate the learning process. An **intelligent agent** is a computer program that appears to have the characteristics of an animated being (Baylor, 1999). An example of a simple intelligent agent is the "Clippit" assistant in Microsoft Office that monitors the user's actions and makes suggestions.

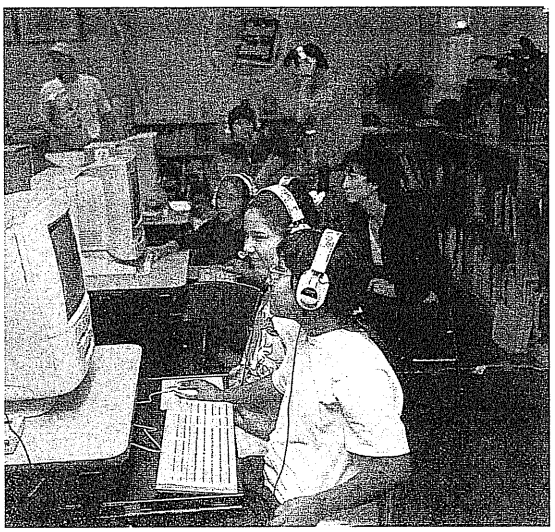
Roles for intelligent agents in the classroom might include the following:

- Information assistant to help students manage information
- Tutor to facilitate learning
- Coach/mentor to support, guide, and extend students' thinking
- Tool for creating a student's own personal intelligent agent

The intelligent agent can help students with information overload. It can (1) help them organize information, (2) provide feedback, and (3) create unique learning experiences. Intelligent agents introduce a new paradigm for instruction that is based on the concept of shared abilities and cooperative learning between humans and computers. Exploring the development of intelligent agents may affect what teachers know about good instruction.

In addition, intelligent agents can be useful tools for teachers. Intelligent agents might help teachers sort through the volumes of professional information they receive daily. Further, they might help teachers in organizing and managing learning environments for their students.

FIGURE 13.7
The modern media center distributes a variety of technology to the school.



Impact of New Technologies on School Media Centers

Materials for lifelong learning will continue to be available through libraries and information centers. Students, however, will access and explore these materials using new technologies. In many cases, cable television connections will allow learners of all ages to study these materials from their homes.

As a result, school media specialists will need to think not only in terms of shelving and circulation but also in terms of downloading and uploading—electronically receiving, storing, indexing, and distributing information to teachers, students, classrooms, and homes. Interactive technologies will create a new generation of teachers and learners who will become not only viewers of such materials, but their users and creators.

Some school libraries and media centers now have a variety of technology available (Figure 13.7). The trend is toward more technology, including online catalogs, cable news services, fax machines, presentation software, video editing decks, and CD-ROM towers. Because school media specialists are becoming more involved in finding information in cyberspace, some refer to themselves as "cybrarians." At more and more schools, the media center is emerging as the technology hub. With "total access to the world" via the Internet and other technologies, school media centers are becoming libraries without walls!

For many years librarians and media specialists have promoted information literacy, which includes a range of

critical thinking and problem-solving skills. Students are learning how to locate, analyze, and evaluate information for accuracy and bias, and to synthesize conclusions. The ability to find and use information purposefully remains an important skill.

In addition to information literacy and critical evaluation skills, students will have to become experts at using search and retrieval skills to locate information. One of the authors' junior high school science teachers told him once that "an intelligent person is not someone who knows everything, but who knows where to find it!" This is perhaps truer today than it was 45 years ago!

Callison (1993) identifies aspects of technology that will support learning now and into the next century. According to this researcher, future technology will perform the following functions for teachers and learners:

- Provide continuous access to information, 24 hours a day, seven days a week
- Allow computers on teachers' desks to act as secretaries, administrative assistants, and record keepers
- Provide for cable and satellite reception in every classroom (Many classrooms today don't even have a telephone!)
- Allow all rooms and offices to be wired so that every computer is networked with instructional programs, records, library collections, and information networks
- Design communications networks that feature e-mail; connections among media centers, classrooms, and offices; and dial-up access to various types of information, including media center catalogs, CD-ROM networks, homework hotlines, writing labs, and student files
- Design media centers that include a communications resource facility to accommodate audio conferencing and distance learning
- Allow students and teachers to access information and courses from sites throughout their region, their nation, and the world via two-way interactive television and satellite dishes
- Meet the needs of students with disabilities and special needs with the aid of computers equipped with adaptive devices
- Provide staff development opportunities throughout the year

Increasing Communication Between Schools and Homes

Telecommunications technology will provide an opportunity for a closer relationship between the school and the home. Through telephone technology (answering machines and call-in recordings) parents and teachers are able to communicate in **virtual time.** Parents can call the teacher's answering machine at any time and leave a message for their child's teacher. Parents can also call for a recording of the daily assignments for their children's classes. Teachers can also call parents and leave information on home answering machines with specific information about their child. This technology will allow students to check their assignments and to communicate with peers and teachers, too!

With this increased communication between school and home it will also be possible to lengthen the time period for learning. Technology will permit teachers to send homework and assignments over networks to homes—perhaps through the Internet and on home television sets. Parents, students, and teachers will be able to interact about the assignment. Students will be able to access their personal data files from home and also to communicate with instructional programs housed on the school's computer.

The Home as Center for Technology-Based Learning

The ever-increasing number of computers in homes, especially computers with Internet connections, has provided a major means for schooling to shift to the home. Children with access to computers at home spend hours each day on learning activities ranging from e-mailing study partners to conducting Web-based research. The larger part of this is assigned homework from school, but a growing part is "information exploring" performed on students' own initiative. Indeed, technology-based at-home study offers an affordable and feasible *alternative* to public schools.

The home market for computer-based, education-oriented software is exploding. CD-ROMs aimed at home use now occupy major shelf space in bookstores and computer stores. Studies of home-schooling families found that they are heavy users of materials of this sort, with the average family purchasing several thousand dollars of instructional materials annually. On the other end of the spectrum, those who use these materials in a less structured, often recreational way have created a huge market for "edutainment" products. The Disney multimedia conglomerate is now the leading purveyor of both educational and entertainment materials (Sullivan, 1997). There is no reason to expect any slowing of this trend.

Closing the Technology Gap

Traditionally, schools have been the avenue to opportunity. They have tried to even out the disparities in educational opportunities between lower- and upper-income families. Today, this means making sure that all students have equal access to information-handling experiences and technology. We know that many children from upper-income families have access to computers at home.

© COPYRIGHT CONCERNS: EDUCATORS AND THE COPYRIGHT LAW

What happens if an educator knowingly and deliberately violates the copyright law? The 1976 act contains both criminal and civil sanctions. The criminal penalty can be a fine up to $1,000 and a year in jail. Copyright owners may recover up to $50,000 in civil court for loss of royalties due to infringement. Furthermore, in any infringement lawsuit, the employing institution can be held liable along with the educator. In 1990, Congress amended the copyright law to strip public institutions and agencies of "sovereign immunity," a principle rooted in English law that exempts the "sovereign" from being sued without its consent.

We must remember, punitive damages aside, that in professions devoted to promoting ethical behavior, deliberate violation of the copyright law is unacceptable.

Seeking Permission to Use Copyrighted Materials

Aside from staying within the guidelines that limit but recognize our legal right to free use of copyrighted materials, what else can we do to ensure students have access to these materials? We can, obviously, seek permission from copyright owners and, if requested, pay a fee for their use. Certain requests will ordinarily be granted without payment of fee—transcripts for the blind, for example, or material to be tried out once in an experimental program. Permission is not needed for use of materials in the public domain—materials on which copyright protection has run out, for instance, or materials produced by federal government employees in the course of their regular work.

In seeking permission to use copyrighted materials, it is generally best to contact the distributor or publisher of the material rather than its creator. Whether or not the creator is the holder of the copyright, the distributor or publisher generally handles permission requests and sets fees. You can obtain the address of the producer (if not given on the material) from various reference sources, including *Literary Market Place, Audio-Visual Market Place,* and *Ulrich's International Periodical Directory.* For additional information on this topic, go to the Web Links module in Chapter 13 of the Companion Website (http://www.prenhall.com/heinich).

Be as specific as possible in your request for permission. Give the page numbers and exact amount of print material you wish to copy. (If possible, send along a photocopy of the material.) Describe nonprint material fully. State how you intend to use the material, where you intend to use it, and the number of copies you wish to make.

Remember that fees for production of copyrighted materials are sometimes negotiable. If the fee seems to be beyond your budget, do not hesitate to ask whether it can be lowered.

If for any reason you decide not to use the requested material, make this fact known to the publisher or producer. Without this formal notice it is likely to be assumed that you have in fact used it as requested and you may be charged for a fee you do not in fact owe.

Keep copies of *all* your correspondence and records of all other contacts that you make relevant to seeking permission to use copyrighted instructional materials.

Another solution is to obtain "royalty free" collections of media. Many vendors now sell CD-ROMs that contain collections of images and sounds that can be used in presentations or other products without payment of royalties. Be sure to read the fine print, however. What is meant by "royalty free" varies from one collection to the next. In some cases, there are almost no restrictions on the use of the materials; in another, you may not be allowed to use the materials in any kind of electronic product.

Primacy of First Sale

Have you ever wondered why public libraries, book rental businesses, and video rental clubs are not in violation of copyright law when they do not pay royalties to copyright owners on the items they circulate or rent? They come under the protection of what is referred to as the "primacy of first sale." This means that the purchaser of the copyrighted work may loan or rent the work without having to pay a second royalty. Great pressure is being put on Congress to amend the law to require anyone who rents a copyrighted work to pay a royalty to the copyright owner. As you might expect, the television and motion picture industries are putting on the pressure, and video rental agencies are resisting the change. The 2000–2001 litigation between the music industry and the Napster online music sharing service is a prototypical example of efforts to ensure that copyright holders receive proper remuneration for all commercial transactions involving their work.

Although it is not likely that the free circulation of materials from public libraries and regional media centers will be affected by a change such as this, college and university rental of films and videotapes certainly will be. Educators need to be aware of possible changes in the first-sale doctrine that could adversely affect access to materials.

For general information on copyright, see the Copyright Concerns on page 87 in Chapter 4. Suggested readings on copyright appear at the end of Chapter 4.

The school must make sure that children from low-income families also have access to computer facilities. If they don't, the gap between the technologically literate and the technologically illiterate will continue to widen.

WORKPLACES OF THE FUTURE

Increasing Importance of Technology

Currently, more than half of all new jobs being created require some form of information and technological literacy, and that percentage is increasing. Technology's new tools will be empowering, productive, and motivational. Workers will need to have an expanded set of technical skills in communication, problem solving, and production. Both future productivity and economic growth are linked to workers' effective uses of new technologies. Tomorrow's workers who want to stay employed or be re-employed will need the ability and opportunity to learn new skills.

Changing Workforce

The nature of the North American workforce is changing dramatically. For one thing, it is getting older. As a consequence, the educational system must be able to provide lifelong learning. In addition, the makeup of the workforce is becoming increasingly diverse, requiring education and training in a variety of languages and at various ability levels. Also, because society is becoming more mobile, job retraining will be even more necessary. Inequalities of class, gender, ethnicity, and economic status correlate highly with denied or restricted access to the tools of technology. Schools, communities, and businesses have a responsibility to ensure access to technology and to supply training for jobs involving technology. The instructional media and technologies for learning described throughout this book can help workers cope with many of these changes and possibilities.

Changing Nature of Work

About three-fourths of U.S. workers today hold jobs that primarily entail handling information. Knowledge work involves not only crunching and shuffling data, but also learning elaborate systems that combine human teams and intelligent machines. With the number of hands-on production jobs decreasing, schools must increasingly teach people to use their minds as tools.

Not only is the type of work people do being affected by advances in technology, so is the place they do that work. In the 1970s the concept of **telecommuting** entered our vocabulary, strongly promoted by information technology companies. The current preferred name for this phenomenon is telework, defined as a method of working in which the employee works away from the office, perhaps at home, using a computer and telecommunications technology to communicate with a worksite. Nearly half of all U.S. households now possess some form of home office. With personal computers, fax machines, cellular phones, and Internet connections, many people now own the infrastructure to do information work in their homes. Corporations are strongly motivated to move employees out of the company's quarters to reduce the huge overhead costs of acquiring and maintaining office space (Figure 13.8).

FIGURE 13.8
Home workstations allow individuals to be productive without wasting time traveling to work.



An increasing number of workers are telecommuting. A national survey found that more than eight million Americans described themselves as teleworkers (Emerging Technologies Research Group, 1996), a number growing at a rate of about 20 percent annually. According to the same survey, approximately 5 percent of the total U.S. workforce spends at least one day a week working at home. The likelihood of continued growth in telework is virtually certain since it is favored by both corporate and government policies in the major industrialized nations. Large cities, such as Los Angeles and Chicago, are beginning to require that companies allow a certain percentage of workers to telecommute to cut down on pollution and traffic.

Teleworkers at home can access information from the office, work with it, and send it back. Even at the worksite, coworkers are increasingly interacting electronically. These information workers must be able to use all

aspects of technology to get information, to communicate with others, and to enhance their job skills. Jobs that lend themselves to telecommuting include writing, developing instructional materials, editing, telephone sales, investment brokering, administering phone surveys, and expert diagnosis (such as "Ask a Nurse" phone lines).

Changing Nature of Training

Just as technology has revolutionized learning in the schools, it has also affected training in the business environment. Training that seeks to improve human performance and increase productivity is increasingly being provided when the worker needs it—often at the workstation, not in a classroom. This type of training is called **just-in-time training,** as opposed to **cold storage training.** The former is provided when you need it and can use it; the latter teaches skills and information you may use in the future.

More individuals are training while at their workstations, often benefiting from **performance support systems** (see Chapter 9). Once workers are on the job, traditional classroom training disrupts their performance, reduces productivity, and sometimes frustrates employees. Often classroom training does not effectively transfer to the work location. Performance support systems provide instruction and other needed information to workers as they make decisions and take actions on the job. These systems provide feedback while work is in progress. They let workers know how they are doing while performing the task.

Cross-training is used to train workers to do several jobs. With multiple skills, workers have more versatility and can "cross over" from one job to another. Cross-training increases the amount of training time, but also increases the versatility of workers for the company, and decreases the likelihood of workers being laid off.

Assessment of Training

Driven by competitive pressures, some businesses have adopted **Total Quality Management (TQM)** and other reengineering programs that require more accurate measurement of the business impact of all expenditures. This has pushed more corporate training programs to consider assessing outcomes beyond mere learner satisfaction. Kirkpatrick (1994) proposed four levels of evaluation: (1) learner satisfaction, (2) skill demonstration, (3) transfer to the job, and (4) impact on business goals. Surveys of corporate trainers over the past few years show a marked increase in companies claiming to be evaluating at levels 3 and 4. In 1996, 65 percent claimed to be applying level 3 evaluation to at least some of their courses, and nearly half claimed to be doing level 4 evaluation (Industry Report, 1997).

WELCOME TO THE 21ST CENTURY

The twenty-first century is an exciting and interesting time to be working in the fields of education and training. Current trends may or may not be sustained, and we, as educators and citizens of the world, have many challenges to address. We note here some ongoing challenges related to media and technology for educators and trainers.

Teaching and Learning with Traditional Media and New Technology

Many teachers want to forget or ignore traditional media and just focus on the "new media and technologies for learning." However, in the future there must be a balance. Traditional media will be with us well into the twenty-first century, and accomplish some tasks as well as or better than the new media. Like a carpenter, we need to know how to use all tools, both old and new, and more importantly, we must be able to select the best tool for our particular task. Teachers and students need to learn how to select from all available media those materials that will best promote learning. For example, most classrooms will continue to have chalkboards, so teachers must learn to use them to their maximum effectiveness. The overhead projector continues to be an effective tool for gaining and maintaining student attention. Don't brush off or bypass traditional media in favor of computers and digital technology.

Both traditional and digital technologies will have their place in the twenty-first century. You need to know the advantages, limitations, and appropriate applications of a range of media and technology options in order to know when to use each type. All media have their place in education and training.

There is a relatively wide range of hardware (from VCRs to computers) available for student use, but many teachers remain unprepared to use them. Despite the fact that schools have spent billions of dollars on computers, software, and other technologies, their impact has not approached what it could and should be. Little effort and less than 15 percent of schools' technology budgets have been spent to train teachers how to integrate technology effectively into the curriculum. According to *Teachers and Technology: Making the Connection* (U.S. Office of Technology Assessment, 1995), in the process of acquiring hardware and software for student use, teachers—"perhaps the most valuable part of the education equation"—often have been overlooked. Most teachers today have not had a course on the use of media and the new technologies of instruction—one like this book is intended to be used with. Many teachers graduated from college before the new technology was widely used in classrooms. Sadly, even

CLOSE-UP

YOUR FUTURE IN THE FIELD

You are entering this field at an exciting time as a teacher, trainer, or media/technology professional. This book is dedicated to helping you become a more effective instructor (or manager of instruction) through application of instructional media and technology. You may, however, wish to specialize in the fascinating and fast-growing field of instructional technology. The Association for Educational Communications and Technology copublishes a directory of graduate programs in instructional technology.[1] If so, what opportunities for professional employment are likely to be open to you? Unlike some educational areas, instructional technology is becoming more and more pervasive in formal and informal education each year. Correspondingly, ever-larger numbers of people are being employed in this specialty.

The fastest-growing specialty is school technology coordinator. Regardless of the quality and sophistication of computer hardware and software, the success of technology often depends on the support and encouragement that students and teachers receive in using it. Technology coordinators can assist with planning, selecting software and hardware, consulting on purchases, implementing, and supervising maintenance and repair.

Some schools and corporations have even divided the technology coordinator position into two specialties. A software specialist orders, catalogs, distributes, and consults with teachers on implementing software. A hardware consultant serves a similar role with hardware. In other schools, a software specialist and a hardware consultant report to the technology coordinator.

Traditionally, the growth of instructional technology has created career opportunities in the various media programs at school, district, regional, and state levels. At all these levels, media professionals are employed to run programs and, depending on the size of the organization, produce materials for use in schools. As school districts and regional media centers have built up their collections of audiovisual materials for distribution, they have employed instructional media professionals to select these materials. Another career area at all education levels is in professional management of media collections, including classification, storage, and distribution.

Instructional product design—developing valid and reliable instructional materials—has been an important specialty in the field of instructional technology for some time. Publishers and producers of instructional materials, along with school districts, community colleges, and colleges and universities, employ specialists trained in product design skills. Computer-assisted instruction, interactive media, and other emerging forms of individualized instruction constitute an important growth area within this field.



Organizations other than schools also require specialists in educational technology. Healthcare institutions, for example, are heavily involved in instructional technology and have been employing an increasing number of professionals to help develop the instruction used in those programs.

Training programs in business and industry need a variety of professionals. These specialties include the following:

- *Trainer.* Presents information, leads discussions, and manages learning experiences.
- *Instructional designer.* Assesses training needs, translates training needs into training programs, determines media to be used, designs course materials.
- *Training manager.* Plans and organizes training programs, hires staff, prepares and manages budgets.

Most training programs rely heavily on instructional media. Consequently, specialists in instructional technology are in demand in these programs.

[1] *R. M. Branch and M. A. Fitzgerald, eds. 1999. Educational media and technology yearbook, 1999. Englewood, CO: Libraries Unlimited.*

some recent graduates have not had technology instruction as part of their college curriculum. Consequently, many teacher educators do not use technology in their teaching. In defense of today's teachers, many lack access to hardware and software and most are not given the time to experiment with new technologies, share experiences, plan lessons incorporating technology, and attend technology conferences or training sessions.

Continuing Development of Hardware and Software

Hardware and software developments are occurring so rapidly that our expectation increasingly lags behind reality. In previous generations our vision extended beyond our capabilities. Now it struggles to keep up with what is available. Wireless telephone communication,

CLOSE-UP

PROFESSIONAL ORGANIZATIONS IN EDUCATIONAL TECHNOLOGY

Whether your interest in instructional technology is general or whether you intend to specialize in this area of education, you should be familiar with some of the major organizations dedicated to its advancement. For additional information on this topic or to visit the following websites, go to the Web Links module in Chapter 13 of the Companion Website (http://www.prenhall.com/heinich).

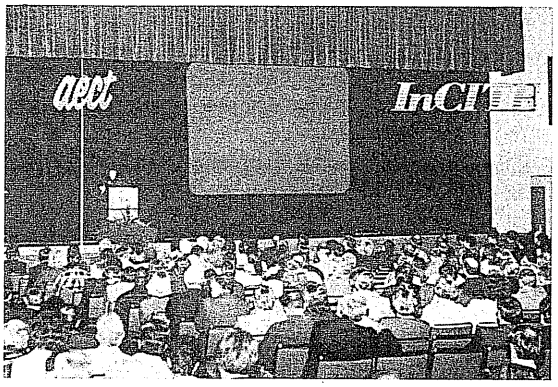
Association for Educational Communications and Technology (AECT)

AECT is the leading international organization representing instructional technology professionals working in schools, colleges and universities, and the corporate, government, and military sectors. Its mission is to provide leadership in educational communications and technology by linking professionals holding a common interest in the use of educational technology and its application to the learning process. AECT has seven divisions and two councils designed around areas of special interest represented within the membership, encompassing members' interests in instructional design, research and theory, media management, distance learning, school media programs, industrial training, media production, computer-based instruction, interactive systems, international interests, and systematic school restructuring.

The association maintains an active publications program, including *TechTrends,* published six times during the academic year; *Educational Technology Research and Development,* a research journal published four times a year; and a large number of books and videotapes (on the Internet, see http://www.aect.org/Pubs/pubs.htm). AECT sponsors an annual convention in the Fall. The annual convention features over 300 educational sessions and workshops focusing on how teachers are using new technologies and teaching methods in the classroom. In addition, the association sponsors an annual professional development seminar and leadership development conference each summer. For more information, contact AECT, 1800 N. Stonelake Dr., Suite 2, Bloomington, IN 47404, or phone tollfree 877-677-2328. Website: http://www.aect.org

American Library Association (ALA)

The ALA is the oldest and largest library association in the world. Its 57,000 members represent all types of libraries—public, school, academic, state, and special libraries serving persons in government, commerce, the armed services, hospitals, prisons,



and other institutions. The association also has 11 divisions focusing on various types of libraries and services. The American Association of School Librarians, one of the divisions, holds national conferences focusing on the interests of school media specialists. For more information, contact ALA, 50 E. Huron St., Chicago, IL 60611. Website: http://www.ala.org

American Society for Training and Development (ASTD)

ASTD is composed primarily of professionals engaged in training and human resource development programs in business and industry. It is by far the largest association for people engaged in workplace performance improvement programs in business, industry, government, and other institutions. The society publishes a monthly magazine titled *Training and Development,* sponsors research in the field of workplace performance improvement, and conducts an annual international conference that includes a varied and significant educational program. ASTD publishes a newsletter on instructional technology and organizes conference sessions on the topic. For more information, contact ASTD, 1640 King St., Box 1443, Alexandria, VA 22313-2043. Website: http://www.astd.org

International Interactive Communications Society (IICS)

The IICS is the premier worldwide nonprofit organization for interactive media professionals. Dedicated to the advancement of interactive arts and technologies since 1983, members of the IICS include professionals involved in the rapidly integrating digital "convergence" industries. Currently IICS has close to 2,000

for example, is now widely used. Not too long ago, it was science fiction. Palm Pilots and Internet-enabled cellular telephones are common among professionals who need quick and easy access to data. The combination of wireless, cellular, and miniaturized technologies allows people to access the Internet in the palm of their hand.

E-books and E-paper. An often-asked question is, "Will computers replace books in the foreseeable future?" We don't think so! In fact, the demand for books is increasing, as indicated by the rapid growth of book sales and library circulation in recent years. What may soon change, however, is the very idea of just exactly what a book *is.*

members. Membership benefits include an online newsletter, annual membership directory, local chapter activities, and various discounts on publications and services related to the interactive multimedia industry. For more information, contact IICS World Headquarters, 4840 McKnight Road, Suite A1, Pittsburgh, PA 15237. Website: http://www.iics.org

International Society for Performance Improvement (ISPI)

ISPI is the leading international association dedicated to improving productivity and performance in the workplace. Founded in 1962, ISPI represents over 10,000 members in the United States, Canada, and 33 other countries. ISPI members work in business, governmental agencies, academic institutions, and other organizations. The ISPI Annual Conference and Expo, several association publications, and more than 60 different chapters provide professional development, services, and information exchange. For more information, contact ISPI, 1400 Spring Street, Suite 260, Silver Spring, MD 20910. Website: http://www.ispi.org

International Society for Technology in Education (ISTE)

The mission of ISTE is to improve education through the use of technology in learning, teaching, and administration. It is the largest nonprofit professional organization dedicated to the improvement of education through the use of computer-based technology. ISTE members include teachers, administrators, computer coordinators, information resource managers, and educational technology specialists. The organization maintains regional affiliate memberships to support and respond to grassroots efforts to improve the educational use of technology. Their support services and materials for educators include books, courseware, and conferences. ISTE publishes *Learning and Leading with Technology, Journal of Research on Computing in Education, ISTE Update,* books, and courseware packages. For more information, contact ISTE, 480 Charnelton Street, Eugene, OR 97401-2626. Website: http://www.iste.org

Media Communications Association–International (MCAI)

Media Communications Association–International, formerly the International Television Association, was formed to enhance the skills and knowledge of video professionals working in corporate and organizational settings. It continues to evolve in response to the industry's rapid pace of change. MCAI offers its members special low-cost phone, hotel, credit card, health insurance, and production insurance services. The association has published several books and pamphlets. For more information, contact Media Communications Association–International, 9202 N. Meridian Street, Ste. 200, Indianapolis, IN 46260-1810. Website: http://www.itva.org

International Visual Literacy Association (IVLA)

The IVLA is dedicated to exploring the concept of visual literacy—how we use visuals for communication and how we interpret these visuals. It is particularly concerned with the development of instructional materials designed to foster skills in interpreting visuals. The organization draws membership from a variety of disciplines and professions, including higher education, public schools, business and communication, professional artists, production specialists, and design specialists. For more information, contact the Center for Visual Literacy, Arizona State University, Tempe, AZ 85287. Website: http://www.ivla.org

United States Distance Learning Association (USDLA)

USDLA is a nonprofit association formed in 1987 to promote the development and application of distance learning for education and training. The 3,000-plus members represent K–12 education, higher education, continuing education, corporate training, telemedicine, and military and government training. The association has become a leading source of information and recommendations for government agencies, the U.S. Congress, industry, and those entering the development of distance learning programs. USDLA has established over 30 chapters. It is a sponsor of the annual International Distance Learning and TeleCon conferences. In addition, USDLA holds regular meetings with leaders of distance learning programs in Europe and the Pacific Rim. For information, contact USDLA, 140 Gould Street, Needham, MA 02494-2397. Website: http://www.usdla.org

State Organizations

Several of the national professional organizations have state affiliates (AECT, ALA, ISTE) or local chapters (ISPI, ASTD). By joining one or more of these, you will quickly make contact with nearby professionals who share your particular concerns.

As a teacher or an instructional technology specialist, you will want to be active in at least one local or state organization. If you are a fulltime student, you can join many organizations at a reduced rate.

Two new developments, e-books and e-paper, are largely responsible for this impending paradigm shift. *E-books,* a conceptual blend of the traditional book and the computer, are handheld devices roughly the size of a hardbound book. They typically contain enough memory for 75 to 80 novel-length works. The backlit screen approximates a standard book page. Readers navigate by using buttons to "turn pages."

Two features of e-books are intriguing from an educational point of view. First, e-book texts are hypermedia (see Chapter 10). Readers may use embedded hyperlinks to jump to related topics, and texts may contain graphic

CLOSE-UP

PROFESSIONAL JOURNALS IN EDUCATIONAL TECHNOLOGY

All of the professional organizations in instructional technology publish journals of interest to their members. Various other periodicals are of special interest to teachers interested in using instructional media. *Media and Methods,* for example, highlights new software and hardware. *Booklist* will keep you current on the availability of new instructional materials. *Learning* gives practical ideas for improving instruction. *Educational Technology* addresses both teachers and educational technologists, providing articles on a range of topics, from the theoretical to the practical. For the business or industry setting, *Training* covers new developments in training techniques in a lively, popular style. For additional information on this topic or to visit the following websites, go to the Web Links module in Chapter 13 of the Companion Website (http://www.prenhall.com/heinich).

Leading and Learning with Technology (http://www.iste.org) focuses on technology integration into K–12 classrooms. Many of the articles are written by teachers, sharing what they have accomplished using the computer in their classrooms with children of all ages and abilities.

School Library Media Quarterly (http://www.ala.org/aasl/SLMQ/) publishes research that pertains to the uses of technology for instructional and informational purposes. Special issues have dealt with such themes as communications and technology and facility design for learning environments that require a great deal of technology.

T.H.E. (Technological Horizons in Education) *Journal* (http://www.thejournal.com) concentrates on technology in higher education. *The Canadian Journal of Educational Communications* gives in-depth coverage of the broad field of educational technology.



The computer area has spawned a large number of journals, such as *Electronic Learning, Journal of Educational Multimedia and Hypermedia, Journal of Computing in Childhood Education, Journal of Computers in Math and Science Teaching, Technology and Learning,* and *New Media* (http://www. newmedia.com).

As you work with instructional media and technology and gain experience in whatever position you find yourself, you may want to explore the possibility of deepening your professional interest in one of the specialties in instructional technology. Through regular reading of one or more of the journals in the field, you can stay informed about developments in instructional technology.

(and perhaps video and audio) elements. Second, an e-book's contents are volatile. "The readers can be loaded with new books, erased, and reloaded as frequently as one wishes" (Roush, 1999, p. 148). Students may soon be able to download from the publisher specific books or articles they need for a class, then replace them when they are through. Teachers may be able to assemble collections of information on their computers and have students download them as required. Such devices may also upload new text to an online file, allowing scientific, technical, educational, and other works to "be continually altered to keep pace with research" (Mann, 2001, p. 48).

Other developments are combining to bring to market within the next decade *e-paper,* "a digital display thin and flexible enough to roll into a tube or fold up like a map, yet cheap enough to be sold in reams" (Mann, 2001, p. 44). Also a hypermedia technology, e-paper promises a reading experience that combines the best of both traditional books and e-books. An e-paper book, writes Mann (2001), "will look just like a regular book. . . . But the spine will be filled with electronic circuitry and a wireless data port and maybe a stylus; the pages will be electronic displays. Readers will open the cover and . . . be confronted with a list of the works contained in the book, arranged by author, title, or subject matter" (p. 48).

In schools and businesses of this new century, we expect that textbooks and other printed materials will coexist with digital formats, with each performing the role they do best. Computers allow quick access to information and data for professional (sales figures, production outcomes) and personal purposes (airline schedules, paying bills). On the other hand, people will likely continue to prefer books for pleasure reading. You can take one anywhere and read it wherever there is light. These exciting new technologies, as Roush (1999) states, "will not fundamentally alter the *experience* of reading"; nonetheless, they will "force bibliophiles everywhere to rethink the relationship between the tangible objects we call books and the ideas they contain" (p. 148).

Software Developments. Software is developing just as rapidly. The digitization of information repre-

sents a new paradigm for software development. New software will make selecting and assembling information from a variety of sources infinitely easier and faster for teachers and students. The greater boon may be for students, who will be able to access and process information much more meaningfully because the systems will lend themselves to individualized learning strategies.

Another characteristic of new software is that with it amateurs can produce professional-quality work. Desktop publishing is just the start of a long-term transformation of the knowledge-handling industry.

All these developments and trends make this an exciting and challenging time for professionals engaged in education and training. Make the most of it!



CLASSROOM LINK PORTFOLIO ACTIVITIES

Please use the "Classroom Link Portfolio" CD-ROM and the Companion Website as resources in completing these activities. To complete the following activities online go to the Portfolio Activities module in Chapter 13 of the Companion Website (http://www.prenhall.com/heinich).

1. *Technology Use in the Profession.* Considering the various roles of a teacher, predict the ways in which technology will enhance your responsibilities as a professional. Consider how you will interact with your peers, students, parents, and the community in which you teach. (ISTE NETS-T V-B, C, & D)
2. *Technology Use in Assessment.* In considering the application of technology to learning, how might you use technology as an assessment tool? Locate rubrics online that assess content and technology use. What activities could you design to engage your students in using technology to demonstrate their learning? ISTE NETS-T IV-A & C)
3. *Individual Education Plan.* As a teacher, what are your present strengths and weaknesses in technology? What do you plan to do to address the weaknesses? What online sources are available? Technology evolves over time, providing users with newer and more creative tools. What are your plans to stay current? How will you continue your own professional development? What decisions will you have to make to continue your professional growth? (ISTE NETS-T I-B; V-A & B)

INTEGRATION ASSESSMENTS

To complete the specified activities online go to the Integration Assessments module in Chapter 13 of the Companion Website (http://www.prenhall.com/heinich).

1. Interview two or more professionals working in educational technology. Compare and contrast their duties in a two- to three-page written report or five-minute cassette recording.
2. Survey the content of several different educational technology journals and write a one- to two-page report summarizing the types of articles and information covered in each.
3. Predict the potential impact on your area of interest of one of the trends in media and technology. Write a two- to three-page report or tape a five-minute recording.
4. For a week, collect reports of new developments in electronic media from newspapers, news magazines, and other popular media sources. Write a two- to three-page report describing the potential impact on learning of these new developments.
5. If you work in a school or other instructional setting, analyze the structure or organizational factors that either impede or facilitate your full use of new media and technologies for learning.
6. Prepare an oral or a written report discussing the potential technological changes in the workplace and predict how training will adapt to these changes.
7. Acquire a recent Technology for Education Plan from a local school district or state office of education. Assess how technology will touch all areas of the school's curricula.

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APPENDIX A

Use of Standard Visuals

OUTLINE

- Photography
- Preserving Nonprojected Visuals
- Filmstrips
- Multi-Image Presentations
- Planning Sound–Visual Presentations

In this appendix we have assembled some of the "older" media and techniques, those you can use effectively in education and training.

The first section explores photography. In Chapters 4 and 6 we looked at the educational applications of media. Here we continue that discussion with a brief description of techniques for preserving and storing nonprojected visuals. We then discuss filmstrips, which had long been a very important medium, especially at the elementary school level. The appendix concludes with a look at multi-image presentations and a general discussion on how you may best plan your own sound–visual presentations.

PHOTOGRAPHY

Elements of Photography

All cameras, regardless of their size, shape, or type, operate on the same basic principles. There are four elements required for photography: a subject, light, a camera, and film (or some other recording medium). Light is reflected from the subject and passes through the lens to form an image on the recording medium. Let's look at the four elements in more detail.

Subject. For instructional purposes, the subject should be interesting and imaginative. The picture elements should be relevant to the instructional objective and should be "composed," or framed in the picture, properly. (See "How to . . . Take Better Pictures.")

Light. Light may come from natural sources (i.e., sunlight) or from artificial sources (light bulbs or camera flash units). The recording medium must be exposed to the proper amount of light. Too little exposure and the picture will be dark; too much and the picture will be too light.

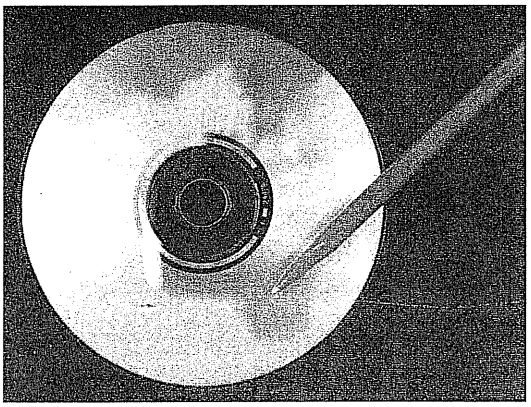
Camera. The camera is a light-tight box with a lens to collect the light from the subject and to focus the light on the film or other recording medium. The amount of light getting into the camera is controlled by the lens opening and the shutter speed.

Film (Recording Medium). The recording medium may be film or a light-sensitive detector called a **charge-coupled device (CCD).** Recent technological advances have reduced the cost and improved the quality of CCDs to the point that they are competitive with film for many purposes. Film, still the most common recording medium, is a

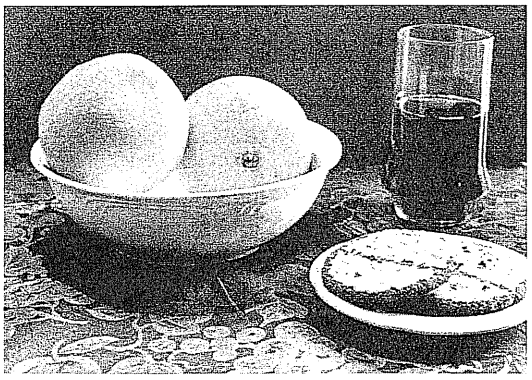
HOW TO . . . *Take Better Pictures*

Whether you are recording the things you see on a trip, creating a photo essay, shooting a historical subject, developing an instructional picture sequence, or simply taking pictures of family and friends, a few guidelines can make your photographs more effective.

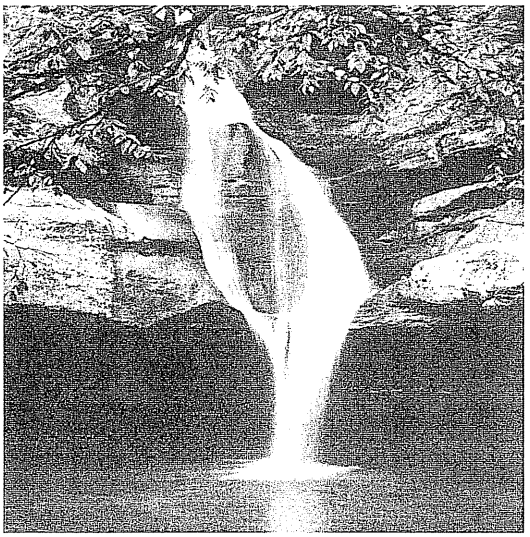
1. Choose picture elements thoughtfully.
   - Include all elements that are helpful in communicating your ideas.
   - Eliminate extraneous elements, such as distracting backgrounds. Avoid shooting directly toward mirrors or shiny surfaces.
   - Include size indicators (e.g., a car, a person, a hand, a small coin) in the picture if the size of the main object of interest is not apparent.



2. Compose picture elements carefully.



   - Remember the rule of thirds, discussed on p. 123. Divide the picture area in thirds both vertically and horizontally. The center of interest should be near one of the intersections of the lines (not cramped near the edge).
   - Avoid dividing a picture exactly in half with a vertical or horizontal line, such as the horizon. Using the rule of thirds, you would want the horizon line at either the one-third or two-thirds line.
   - When photographing a moving subject, allow more room in front of the subject than behind it.
   - When making "how-to-do-it" pictures, use a subjective point of view. That is, take the picture from the viewpoint of the learner, not the observer.
   - Dramatic effects can be obtained by shooting from high or low angles. However, such pictures may be confusing to young children.
   - If a feeling of depth is important, use foreground objects (e.g., blossom-covered tree branches) to frame the main subject.



3. Employ appropriate photographic technique.
   - Choose an appropriate film for the subject and intended use.
   - Arrange lighting that will enhance the subject.



   - Select exposure to get optimum quality; this is necessary for digital cameras as well as standard cameras.
   - Focus carefully.
   - Avoid moving or tilting your camera while snapping the picture.

These general guidelines will help you take interesting photographs that will communicate more effectively. For further steps in enhancing your photographic skills, check your local camera shop or bookstore for reference material on photography.

light-sensitive material that records the image. The image becomes visible after it is processed by chemicals. With some Polaroid film, the chemicals are part of the film package. CCDs convert the light image into electrons that can be digitized, processed, and stored electronically. You can view them on a monitor, store them on compact discs, or combine them with other digital information in a computer.

Parts of a Camera

Cameras have many parts, but the most important parts common to all cameras are the aperture, the shutter, the viewfinder, the focus mechanism, and the film advance (Figure A.1).

Aperture. The **aperture** is the lens opening that regulates the amount of light entering the camera. On some cameras the size of the opening is fixed; on other cameras there are two or three possible settings for the aperture. On many cameras, however, the size of the lens opening is adjustable over a broad range.

Shutter. The **shutter** controls the length of time that light enters the camera and reaches the film. Again, there is only one shutter speed on simple cameras but several on more complex cameras. The *shutter speed* refers to the period of time that light is allowed to enter the camera. On the shutter speed control knob the speed is usually given as a whole number such as 250, 125, or 30. However, these numbers refer to fractions of a second (i.e., $\frac{1}{250}$ of a second, $\frac{1}{125}$ of a second, and $\frac{1}{30}$ of a second). The higher the number, the shorter the time that the shutter is open. The very fast shutter speeds such as $\frac{1}{1000}$ second (with the shutter open only a very short period of time) allow you to photograph rapidly moving objects, such as race cars.

Viewfinder. The **viewfinder** allows you to see what the film will "see" when the shutter is opened. In many point-and-shoot cameras the viewfinder is near the top of the camera and set parallel to the lens opening. Consequently, when you look through the viewfinder you may not see exactly what will appear in the photograph. Except at very close range, the discrepancy is negligible. With a single-lens reflex camera, a movable mirror allows you to view directly through the lens. The mirror moves out of the way when you take a photograph.

Focus Mechanism. The focus mechanism is the setting of the lens that determines the sharpness of the image. Inexpensive cameras often cannot be focused and have just one setting, which is usually good for objects from five feet to infinity. Other cameras have a range of focus from three feet to infinity. The focus may be determined by a distance scale (to the subject) and is indicated in feet and/or meters. Many newer cameras have automatic focus mechanisms.

Film Advance. The film advance is the manual or automatic mechanism that advances the film to the next frame after you take a picture.

Selecting a Camera

The type of camera you choose depends on the kinds of pictures you find useful for instruction. If you do not take extreme close-ups and do not have use for telephoto and other special lenses, then you may prefer a point-and-shoot camera for portability, reliability, and simplicity (Figure A.2). The quality of the image taken with a moderately priced point-and-shoot camera is comparable to that of a high-quality single-lens reflex (SLR) camera under average conditions.

If, however, you need to take extreme close-ups, use a variety of lenses (e.g., wide angle, telephoto), or do a lot of copying, then a single-lens reflex camera is what you want. Although it is bulkier and more difficult to use, the

FIGURE A.1
Components of a typical camera.

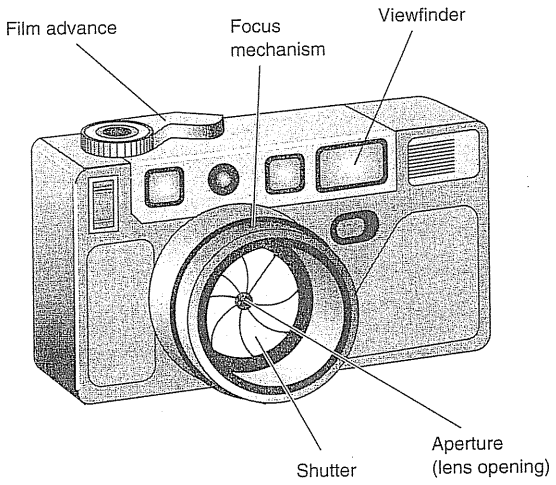
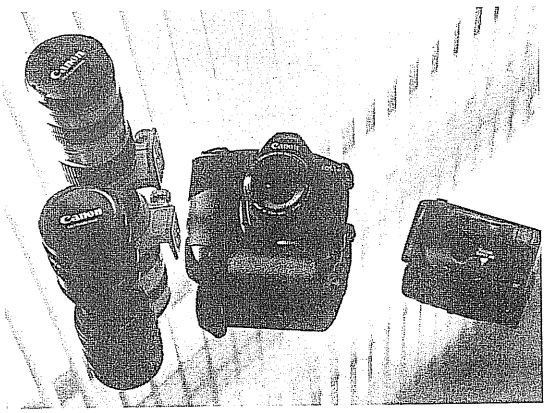


FIGURE A.2
The SLR camera (center) with extra lenses for extreme close-ups and long-distance photography compared with a point-and-shoot camera for general purpose photography.



SLR is more flexible than a point-and-shoot camera.

Both types of cameras are available in models with automatic and semiautomatic exposure controls. Before the incorporation of photocells and microprocessors into cameras, even amateur photographers had to know the relationship among film speed, lens opening (**f/stop**), and shutter speed. Today's picture taker need learn only a few simple steps from the instruction manual to achieve proper exposure on the film. Sometimes unusual lighting situations call for modifications of camera-determined settings. A little experience with the camera will guide such modifications. Relieved of the necessity to determine exposure, you can concentrate on composing the picture.

New point-and-shoot cameras are packed with computer technology. These cameras have automatic loading, film-speed setting, exposure, focus, flash, and film advance.

Digital cameras store black/white or full-color images in a digital format. A charge-coupled device in the film plane of the camera converts light energy to digital data, which is stored in a small digital recorder. Such cameras can be specially designed or can be modifications of standard SLR cameras. Since no film is used, there is no waiting for developing and printing. You may immediately view your images on a small monitor incorporated into the camera. You can transmit the images over telephone lines and/or download them to a computer for manipulation, and can store them on a computer disk or on photo CDs. Digital photography is particularly useful to create images for presentations or for desktop publishing.

Most instructors in education and training use slides far more often than they do prints. Unless you can afford the luxury of two cameras (and you don't mind carrying them around), you will probably be better off keeping slide film in your camera. If you later find that you need prints, very satisfactory ones can be made from slides (see "How to . . . Convert Visuals to Slides"). If you need very large photographs (8 by 10 inches or larger), laser technology can make prints of remarkable quality from slides. However, if you prefer using print film, slides can be made from your color negatives at many camera shops.

Having chosen a camera and type of film, you will find guidelines for taking instructionally useful photos in "How to . . . Take Better Pictures." For hints on planning a slide or slide–tape presentation, see "How to . . . Develop a Sound–Visual Presentation."

PRESERVING NONPROJECTED VISUALS

One drawback in using nonprojected visuals in the classroom is that they are easily soiled or otherwise damaged as students pass them around. Repeated display, storage, and retrieval can also add to wear and tear. Mounting and laminating are the two most effective preservation techniques, and they can contribute to the instructional effectiveness of nonprojected visuals.

Mounting

Mount nonprojected visuals on construction paper, cardboard, or other such material for durability. The color of the mounting material should not draw attention away from the visual. It is generally a good idea to use pastel or neutral tones rather than brilliant or primary colors. Using one of the minor colors in the visual as the color for the mounting can enhance harmony. The total effect of your mounting should be neat and pleasing to the eye. Borders, for example, should be evenly cut, with side borders of equal width and the bottom border slightly wider than the top.

Various glues, cements, and pastes are available for mounting purposes. When used according to directions, almost all are effective. Some white glues, however, are likely to cause wrinkles in the picture when the adhesive dries, especially if used full strength. If you run into this problem, dilute the glue; for example, use four parts glue to one part water. Cover the entire back of the visual evenly with the adhesive before placing it on the mounting board. If excess adhesive seeps out around the edges, wipe it off with a damp cloth or sponge.

Glue sticks may be used in place of liquid glues. They have the advantage of not running out around the edges of the material. Glue sticks are less likely to damage and discolor photographs.

Rubber Cement Mounting. One of the most commonly used adhesives for mounting purposes is rubber cement. It is designed specifically for use with paper products. It is easy to use and less messy than many other liquid glues. You can easily wipe away excess cement, and it is inexpensive. Rubber cement does, however, have two disadvantages. When the container is left uncovered for any length of time, the adhesive tends to dry out and thicken. Periodic doses of thinner (available commercially) may be necessary to keep the cement serviceable. A second disadvantage is that the adhesive quality of rubber cement tends to diminish over a period of time. Constant exposure to dry air may eventually cause it to lose its grip. You can compensate for this disadvantage by taking special precautions, as noted for permanent rubber cement mountings (see "How to . . . Mount Pictures Using Rubber Cement," p. 331). These mountings will not last indefinitely. One caution is that rubber cement could damage and discolor photographs.

Dry Mounting. Dry mounting employs a specially prepared paper impregnated with heat-sensitive adhesive. The paper is available in sheets and rolls. The dry-mounting tissue bonds the backing material to the back of the visual. A dry-mount press is used to supply the heat and pressure necessary to activate the tissue's adhesive. The process is rapid and clean and results in permanent, high-quality mounting (see "How to . . . Dry Mount Pictures," p. 332).

One disadvantage of dry mounting is that it is relatively expensive. However, it is possible to dry mount visuals without a dry-mount press by using an ordinary household iron. Set the iron on a setting for silk or rayon. Do not use steam. The tip of the household iron can be used in place of the special tacking iron.

Laminating

Lamination protects visuals from wear and tear by covering them with a clear plastic or plastic-like surface. Lamination helps to protect visuals against tears, scratches, and sticky fingers. You can wipe soiled surfaces clean with a damp cloth.

Lamination also allows you to write on your visuals with a grease pencil or water-soluble pen for instructional purposes. You can easily erase the writing later with a damp cloth or sponge. A teacher of mathematics, for example, might write percentage figures on a laminated illustration of a pizza or a pie to

HOW TO . . . Convert Visuals to Slides

EQUIPMENT

The Camera

The single-lens reflex camera is the best type to use for making slides of flat materials and small objects. What you see in the viewfinder is what you get on the film. Focusing is much more accurate with an SLR. When the image is sharp in the viewfinder, it will be sharp on the film. The interchangeable-lens feature adds considerably to the range of copying capability.

The Lens

The normal lens on a 35mm camera can focus as close as 1 1/2 to 2 feet. This corresponds to a picture area about 6 by 9 inches and will take care of most of your copying needs. However, if you need to copy a smaller area, you will have to modify the lens arrangement. The less expensive solution is to use supplementary lenses. These come in steps of magnification expressed as +1, +2, +3. When you buy them, take your camera to your local camera store to make sure the lens set matches your camera lens. The more expensive solution is to buy a macro lens, which replaces the normal camera lens. Macro lenses come in a variety of configurations, so consult your local camera store or media specialist to find the best arrangement for your needs.

TECHNIQUES

Exposure

Virtually every camera sold today has automatic exposure control. Because a single-lens reflex camera monitors the light as it comes through the lens, any modifications of exposure made necessary by the use of other lenses or filters will be taken care of automatically. Many cameras permit you to increase or decrease the exposure. This feature can be quite useful in compensating for material that is too light or too dark; it can also help to increase or decrease contrast. If your camera has this feature, practice with it until you learn how to use it judiciously.

Tripod Use

Although copying with a hand-held camera is possible, you will achieve the best results by mounting the camera on a stable platform such as a tripod. If you are copying flat material, you can fasten it to an outside wall about the height of the camera on the tripod. Then position the camera and tripod the appropriate distance from the material, focus the lens, and make the exposure. The material is best mounted in indirect sunlight. However, if the material has low contrast, you may need to mount it on a sunlit wall, but be sure you are not getting undesirable reflections or bright spots. A handy way of eliminating glare is to use a polarizing filter. Consult your local camera store for the proper size for your camera and helpful hints on how to use it. A polarizing filter is especially useful in eliminating glare when photographing something beneath a water surface and in darkening the sky for dramatic effects, but it also has a tendency to flatten outdoor scenes (e.g., by eliminating the reflections from sunlit leaves).

Tabletop Photography

The camera mounted on a tripod is handy for photographing small objects: coins, flowers, insects, etc. You can place the object on a coffee table in a well-lit area, with the tripod and camera oriented so that the object is well displayed. The comments about supplementary and macro lenses apply here too. Don't use a wide-angle lens, because the image will be distorted; the part of the object closest to the lens will be out of proportion to the rest of the object.

Copy Stand

If you do a lot of copying, you will want to look into using a copy stand. Your media center may have one that you can use.

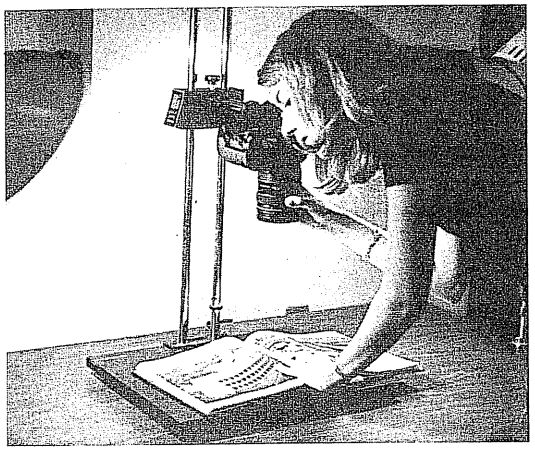


A macro lens and close-up supplementary lenses.



Using a tripod for tabletop photography.

HOW TO . . . Convert Visuals to Slides (Continued)



Using a copy stand to photograph flat materials.

At a minimum, a copy stand has a flat surface where the material is placed and a vertical post on which the camera is mounted. From there, copy stands become more elaborate and may include an adjustable surface to hold the material flat and adjustable floodlights attached to the base. After placing the material to be copied on the surface, you move the camera up and down and adjust the material until the viewfinder shows the image you want. If supplemental lighting is necessary, use the polarizing filter to take care of any glare that might result. A copy stand is best used for flat materials. Three-dimensional objects are better photographed on a table using a tripod-mounted camera because you can choose the angle and lighting that best shows the object.

Lettering

If you want to add lettering to the material you are photographing, remember to keep the letters in proportion. If the area being copied is fairly large, the letters must be large also. If the area is small, the letters must be small because they will be enlarged when the image is enlarged. Judge the size of the lettering in proportion to the material by studying what you see in the viewfinder.

Copying Slides

Copying slides requires a special piece of equipment. It looks like a miniature copy stand, and lights from beneath the slide to be copied. The camera, mounted on the vertical post, can be adjusted to copy all or part of the slide. This is a useful but expensive piece of equipment. Your media center may have one. Otherwise, for the few times you may need to copy slides, a commercial shop is the simplest way to go.

help teach the concept of fractions. You can also have students write on laminated materials. When the lesson is completed, erase the markings and the material is ready for further teaching. Many classroom materials can be laminated to add extra durability and to allow for erasable writing by teacher and students.

Clear plastic sheets with adhesive backing (such as Con-Tact® shelf paper) are available for laminating purposes. Remove the backing cover a little at a time to expose the adhesive and carefully press the clear plastic sheet on the visual. If you remove backing all at once, the plastic sheet often rolls and sticks to itself before you can get it on the visual. Cut off any portions of the plastic sheet that extend beyond the edges of the visual or fold them back for additional protection.

Laminating can be done with a dry-mount press (see "How to . . . Laminate Pictures with a Dry-Mount Press," p. 333). Rolls of laminating film for use with a dry-mount press are available from commercial sources. A laminating machine can be used as well (Figure A.3). These machines use two rolls of laminating film and cover both sides of the visual simultaneously. The visuals are fed into the machine, which provides the appropriate heat and pressure. You can then trim the excess film from around the visual with scissors or a paper cutter.

FIGURE A.3
A laminating machine can laminate both sides of a visual simultaneously.

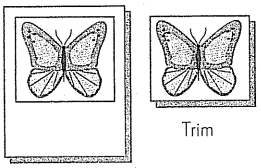


Filing and Storing

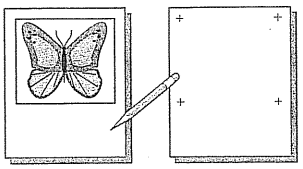
You will find it handy to have a system for filing, storing, and retrieving your nonprojected visuals. The nature of the filing system that you use will depend on

HOW TO . . . Mount Pictures Using Rubber Cement

- Cut picture to size. Edges should be straight and corners square.

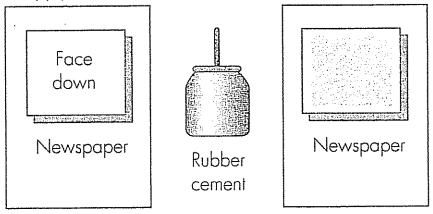


- Mark location of picture on mounting board with pencil to assist putting picture in correct position.

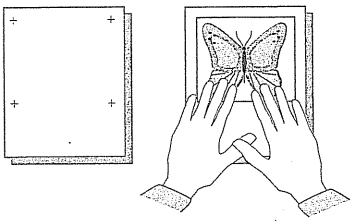


TEMPORARY

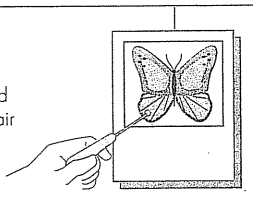
- Apply cement evenly to back of picture.



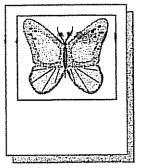
- Place picture on mounting board *before cement dries.*



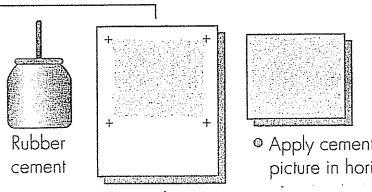
- Burnish the picture for good adhesion and removal of air bubbles.



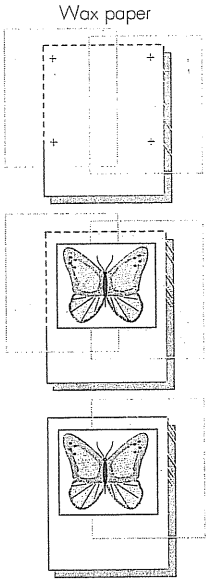
- Remove excess cement after it dries by rubbing with clean finger or ball of dried cement.
- Erase the guide marks.



PERMANENT



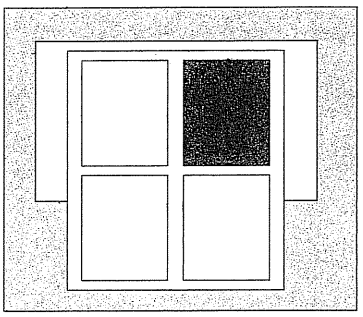
- Apply cement evenly to back of picture in horizontal direction.
- Apply cement evenly to front of mounting board in vertical direction.



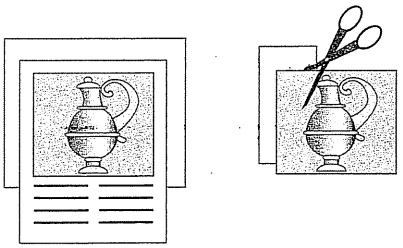
- *Allow cement to dry* until there are no shiny spots.
- Place two sheets of wax paper on mounting board to cover picture area so picture does not adhere in wrong place.
- Align picture with guide marks.
- Carefully remove wax paper while holding picture in aligned position.

HOW TO . . . Dry Mount Pictures

1. Dry the mounting board and picture before trimming picture by placing them in dry-mount press for about one minute at 225°F. Close press, but *do not lock.*
2. Place a sheet (either side up) of dry-mounting tissue over the *back* of the *untrimmed* picture, with sheet extending beyond the edges of picture.
3. Attach the tissue to the back center of the picture with tip of a tacking iron set on "medium."



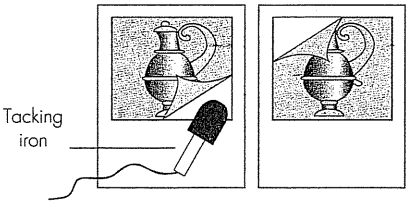
4. Turn picture and tissue over and trim both simultaneously to desired size. (A paper cutter works best, but a razor knife and metal straightedge or scissors may be used.)



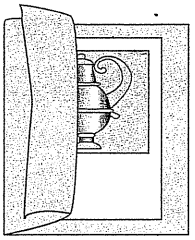
5. Place the picture and dry-mounting tissue on the mounting board and align in proper position.



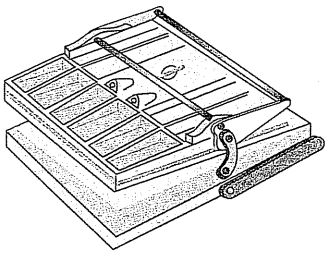
6. Tack the tissue to the mounting board *at two opposite corners.*



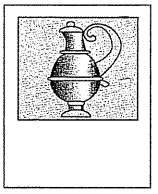
7. Cover mounting board and picture with clean paper on both sides.



8. Place in dry-mount press preheated to 225°F for about one minute.



9. Remove from dry-mount press and allow the materials to cool. (Placing the cooling materials under a metal weight will help prevent curling.)

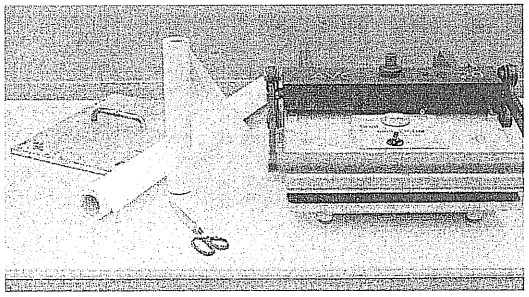


the number of nonprojected visuals in your collection and the way you intend to use them. The simplest filing system usually involves grouping the items according to the teaching units in which they are used. Elementary teachers often categorize them by curriculum area (e.g., math, science, language arts, social studies) and then subdivide them by topic (e.g., seasons, countries, jobs, addition, subtraction, place value, telling time). Some instructors, especially those who teach just one subject, set up their filing system according to the chapters in their textbook, the topics they cover, or objectives. Teachers who use just a few visuals sometimes file them with their other teaching materials for each lesson.

In addition to a workable filing system and proper size storage containers, you should have a clean, out-of-the-way place to store your visuals when they are not in use. The storage location can range from elaborate built-in drawers or filing

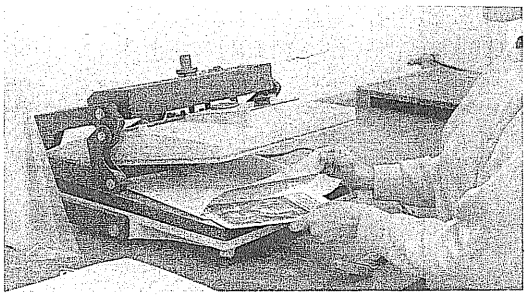
HOW TO . . . Laminate Pictures with a Dry-Mount Press

1. The dry-mount press should be heated to 225°F. If you live in an area with high humidity, you may get better results if you preheat the visual (to remove excess moisture) in the press for about one minute. Close the press but do not lock it.



2. Cover the picture to be laminated with a piece of laminating film slightly larger than the picture. The inside of the roll (dull side) contains the heat-sensitive adhesive and should be toward the visual. Press the film onto the picture with your hands. Static electricity should cause the film to stay in place.

3. Put the picture and laminating film in a cover of clean paper to protect the visual and to prevent the adhesive from getting onto the surface of the dry-mount press.



4. Insert the material in the press for one minute. Remove it; if the adhesion is not complete, put it back into the press for another minute. It may be helpful to put a magazine or a ¼-inch stack of paper on top of the picture to increase the pressure and improve adhesion between the picture and the laminating film.

cabinets to simple cardboard storage cartons. There is no problem in using cardboard cartons to store files of pictures and other visuals if you have a clean, dry location for them.

FILMSTRIPS

A **filmstrip** is a roll of 35mm transparent film containing a series of related still pictures intended for showing one at a time. Various formats have evolved since the advent of the filmstrip more than half a century ago. The standard format today is the single-frame filmstrip, in which the images are printed perpendicular to the length of the film. Commercially produced filmstrips typically contain about 20 to 60 images, or frames, and are stored rolled up in small plastic containers.

Advantages

- *Compactness.* A filmstrip of 60 frames fits comfortably in the palm of your hand and weighs only a few ounces.
- *Easy to handle.* Filmstrips load easily into simple projectors.
- *Low cost.* A commercially distributed filmstrip costs substantially less per frame than a set of slides or overhead transparencies purchased from a commercial source.
- *Permanently sequenced.* The sequential order of the frames can often be a teaching and learning advantage. You can present a chronological or step-by-step process in order without fear of having any of the pictures out of sequence or upside down, as can sometimes happen with slides.
- *Self-pacing.* In contrast to audio and motion media, you can control the pace of viewing filmstrips. This capability is especially relevant for independent study but is also important for teacher-controlled group showings. A slow, deliberate examination of each frame might be suitable for the body of a lesson, whereas a quick run-through might suffice for purposes of preview and review.
- *Teacher adaptation.* You can control the level of instruction. Particularly with silent filmstrips, the vocabulary or level of narration supplied by the presenter can be adapted to audience abilities.
- *Independent study.* Filmstrips lend themselves well to independent study. Many types of tabletop viewers are made especially for individual or small-group use. Young children have no difficulty loading the light, compact filmstrips into these viewers. The fixed sequence of the frames structures the learner's progress through the material. The captions or recorded narration add a verbal component to the visuals, creating a convenient self-contained learning package.

Limitations

- *Fixed sequence.* Having the frames permanently fixed in a certain sequence has disadvantages as well as advantages. The main drawback is that it is not possible to alter the sequence of pictures without destroying the filmstrip. Backtracking to an earlier picture or skipping over frames is cumbersome.

HOW TO . . . Operate a Filmstrip Projector

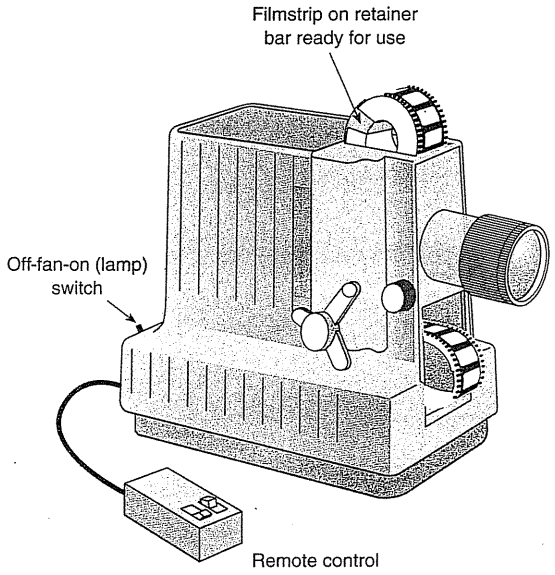
OPERATION

Set Up

- Connect power cord to AC outlet.

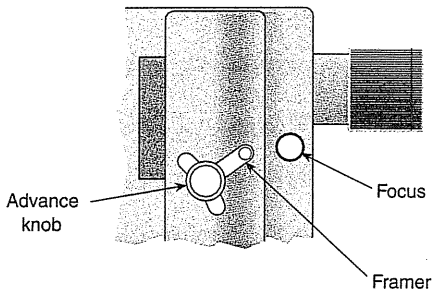
Operate

- Turn projector on.
- Place filmstrip on retainer bar.
- Thread filmstrip down into film slot. Be sure that "Start" or "Focus" appears at head of filmstrip.
- Turn advance knob until "focus" frame appears.
- Adjust framer so the full frame is projected when you click the advance knob.
- Turn projector off.



Disassemble

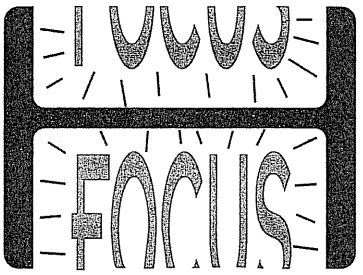
- Return filmstrip to container. Do not pull the end of the filmstrip to tighten the roll. Start with a tight roll at the center and continue rolling, holding the film by the edges.
- Restore to storage conformation.



TROUBLESHOOTING

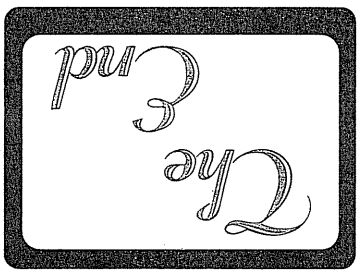
Problems/Possible Remedies

- *Dark areas or smudges projected on the screen:* Clean the lens.
- *Dirt or lint visible at edges of projected image:* Foreign matter is in the film gate. Clean with an aperture brush or other brush with no metal components.
- *Filmstrip is not properly framed:*



Correct with framer knob.

- *This frame appears first:*



If this is the first frame you see, the filmstrip has been inserted tailfirst. Withdraw it and insert the head end. (If the lettering appears backwards, you have threaded it with the wrong side facing the screen; reverse it. The ends of the strip should curl toward the screen.)

- *Susceptibility to damage.* Because the filmstrip is pulled through the projector by means of toothed sprocket wheels, the sprocket holes can get torn and the filmstrip can become damaged. Improper threading or rough use can cause tears, which are very difficult to repair (you can repair such tears if you have a 35mm splicing block; in cases where damage to the sprocket holes is extensive, you can cut the frames apart and mount them individually to be used as slides).
- *Waning popularity.* Because videocassettes and CD-ROMs are so easy to handle and equipment is so widely available, these formats are becoming more popular than the filmstrip format.

Integration

Filmstrips are suitable for use at all grade levels and for instruction in all curriculum areas. Many high-quality commercial filmstrip sets are available. In general, geography and the sciences are especially well represented with commercially distributed filmstrips.

The major difference in application between slides and filmstrips is that slides lend themselves to teacher- and student-made presentations, whereas filmstrips are better suited to mass production and distribution. Today filmstrips are usually packaged as self-contained kits; that is, the narration to accompany the pictures is provided either in the form of captions on the filmstrip or as a recorded soundtrack on cassette. The filmstrip producer also may integrate other teacher support materials into the kit.

Because they are simply packaged and easy to handle, filmstrips are well suited to independent study. They are popular items in study carrels and media centers. Students enjoy using filmstrips on their own to help prepare research reports to their classmates. Their broad appeal is evidenced by the volume of commercial materials produced. Tens of thousands of titles are available either in school library media center collections or directly from the producers.

MULTI-IMAGE PRESENTATIONS

Fairgoers at the 1890 Paris Exposition experienced a simulated balloon ascension by means of hand-tinted lantern slides projected onto 10 screens arranged in a circle. Since then, multi-image presentations have become ever more sophisticated and have survived the emergence of competitive technologies, maintaining a foothold as a powerful presentation technique. The continuing viability of the multi-image system can be traced to its ability to present powerful, visually appealing effects at a fraction of the cost of video.

A **multi-image presentation** is, simply, any visual presentation showing several images simultaneously, often using multiple screens. Multi-image presentations may incorporate moving images—film or video—but slides are used as their foundation.

Advantages

- *Combination of media.* Multi-image presentations combine the possibilities of a variety of media, such as slides, overhead transparencies, filmstrips, video, and motion pictures.
- *Special visual effects.* These presentations can show comparisons, time sequences, or wide-angle panoramic views.
- *Attention holder.* The rapidly changing images capture and hold learners' attention.
- *Emotional impact.* You can achieve dramatic effects by rapidly changing still pictures, which is possible with dissolve units and automatic programmers. Combined with appropriate music, multiple images can also set a mood.
- *Simulation of motion.* Multi-image presentations can simulate motion through rapid sequential projection of still pictures without the use of videotape. The production costs of multi-image presentations can be significantly less than that of video.

Limitations

- *Expensive to develop.* Development of multi-image materials requires considerable time and expertise because it requires more complex planning. Production time and costs can be high.
- *Time-consuming equipment setup.* The time to set up the presentation and align the projectors can also be significant. The amount of equipment required for their presentation increases the cost of using multi-image systems.
- *Hardware glitches.* Because multi-image presentations require several pieces of equipment, projectors, and programmers, there is a greater chance for problems to occur during the showing.

Integration

Multi-image presentations are heavily used in corporate communications—to impress visitors, to introduce new products at sales meetings, to review the year's accomplishments at stockholders' meetings. In the public sector, multi-image shows are commonly found at zoos, museums, and theme parks.

In education, multi-image presentations are usually locally produced for persuasive purposes—to enlist parent support for new programs, to heighten student awareness of issues such as drugs, to arouse interest in new classroom techniques. They can also serve instructional purposes by employing teaching-learning strategies such as the following:

- *Part/whole:* Showing a whole scene on one screen with a close-up of a detail beside it
- *Compare/contrast:* Showing two images side by side, for example, to allow comparison of art forms or architectural styles
- *Abstract/concrete:* Presenting a schematic diagram next to a photograph of a real object
- *Before/after:* Showing a house before and after remodeling
- *Sequencing:* Breaking down an athletic activity, such as diving, into a series of steps
- *Panorama:* Showing an outdoor scene with a sense of its full width
- *Three-dimensionality:* Presenting views of an object from several angles allows viewers to imagine its three-dimensional qualities

PLANNING SOUND–VISUAL PRESENTATIONS

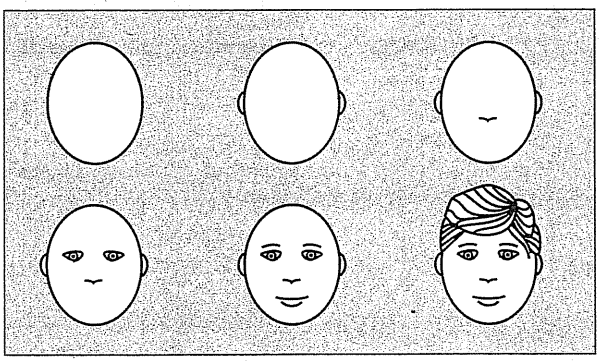
To plan a presentation that incorporates two or more media formats, such as slides and cassette tape, it is helpful to use a visual planning technique known as **storyboarding,** described on p. 131 under "Visual Planning Tools." See also "How to . . . Sketch," p. 336. Detailed suggestions for planning your presentation are given here in "How to . . . Develop a Sound–Visual Presentation," p. 337.

HOW TO . . . Sketch

Faces

Use an oval and add a minimum of lines to indicate features and expressions.

1. Start with a circle or oval.
2. Add ears in the middle on each side.
3. Draw a nose between the ears.
4. Place the eyes near the top of the nose.
5. Draw the mouth halfway between the nose and chin.
6. Add hair and other features.



Body

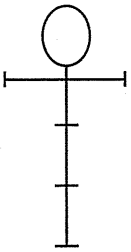
Begin with stick figures, which can show action. With practice, add detail to your characters.



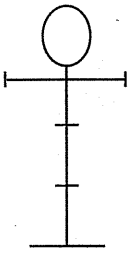
1. Determine the head size and draw.



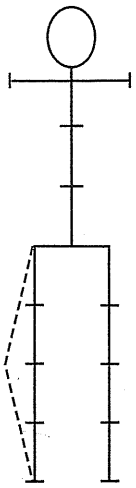
2. Draw a straight line down from that head which is an *additional* 3 heads long. This is the torso.



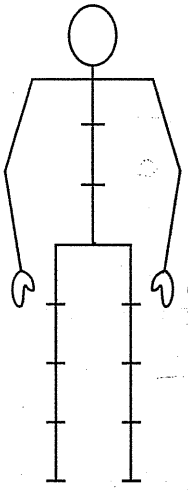
3. Just below the head draw a *horizontal* line about 2 head lengths long. This is the shoulder line.



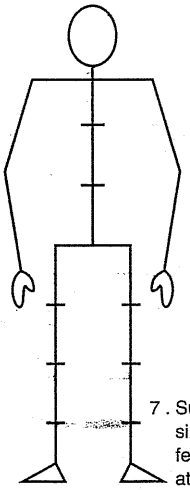
4. Draw a horizontal line about 1½ head lengths long at end of torso (slightly wider for female figure). This is the hip area.



5. Draw vertical lines down from hip "joints" 4 head lengths long. Leg length comprises *half* of entire body length. Knees would fall about halfway or 2 head lengths down.



6. Draw vertical lines down from shoulder points to below the hips. These are arms. Add "mitten" hands at the ends. Elbows fall midway on these lines.



7. Superimpose simple triangular feet on the legs at the bottom.

HOW TO . . . Develop a Sound–Visual Presentation

Here is a simple approach to developing your own sound–visual presentation.

Step 1

Analyze your audience both in terms of general characteristics and specific entry competencies (as described in Chapter 3).

- Why are they viewing the presentation?
- What is their motivation toward your topic?
- How much do they already know about the subject?

Step 2

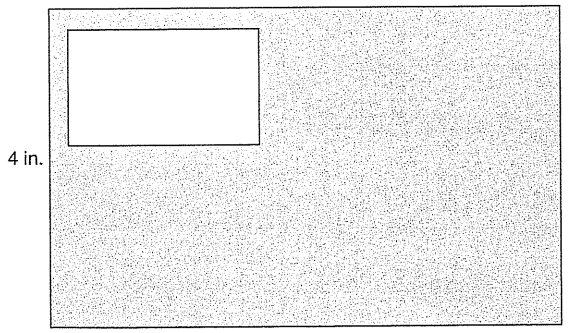
Specify your objectives (as described in Chapter 3).

- What do you want to accomplish with the presentation?
  - Knowledge
  - Attitudes
  - Skills
- What should the viewers be able to do after the presentation?
  - Activity or performance?
  - Under what conditions?
  - With what degree of skill?

Step 3

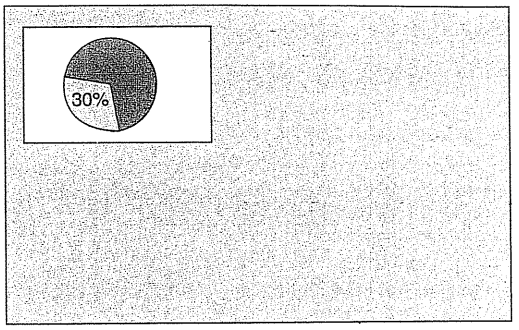
Having completed your audience analysis and stated your objectives, you now have a much clearer idea of how your presentation will fit into your overall lesson plan, including what might precede it and follow it. Perhaps you will decide at this point that a sound visual presentation is not really what you need after all.

If you decide to go ahead, get a pack of planning cards (use index cards or Post-It™ notes, or cut some sheets of paper into 4-by-6-inch rectangles). Draw a large box in the upper left-hand corner of each card.



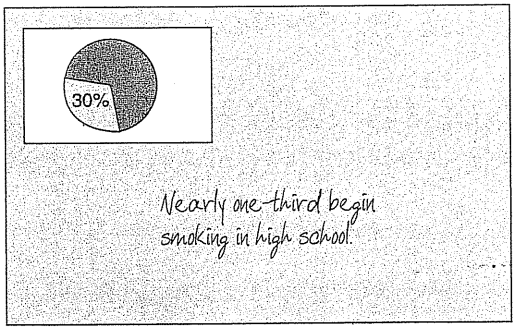
Step 4

Take a planning card. In the box draw a rough sketch of whatever image comes to your mind when you think about one of your major points. You don't have to start with the first point, just whatever comes into your mind first. Your sketch may be a symbol, a diagram, a graph, a cartoon, or a photo of a person, place, or thing, for example.



Step 5

Below your sketch, write a brief statement that captures the essence of the point you are trying to make. State it in as few words as needed to cue yourself to the thought. Some developers prefer to start with the visuals and then write the narration. Others prefer to do the narration first. Actually developing a sound–visual presentation is likely to be a dynamic process, with visual and narration evolving one from the other, separately and simultaneously. In some cases, of course, your narration will be already at hand—printed information, for example, or a story or poem—and all that remains is to develop the proper visuals to fit it. Or, the visuals may already be in hand—slides from a field trip, for example—and all you have to do is organize them and develop your script to accompany the visuals.



Step 6

Make a card for the thought that leads into the point you have just sketched. Then do another one about the thought that follows your first one. Continue like this, building a chain of ideas as you go along.

Step 7

When you run out of ideas in the chain, switch to one of the other major points that hasn't fallen into sequence yet.

Step 8

Arrange the cards in sequential and logical order. This process is called *storyboarding*.

HOW TO . . . Develop a Sound–Visual Presentation (continued)

Would some other arrangement liven up the beginning and the end of your presentation? Keep in mind the psychology of the situation as you thought it through in your audience analysis. The beginning and the end are generally the best places to make major points. Have you grabbed the viewer's attention right from the beginning?

How about pacing? Are any complicated ideas skimmed over too lightly? Do sections get bogged down in unnecessary detail? Add or subtract cards as needed.

You should have at least one slide on the screen for every point you make. Each slide should be on the screen long enough to support the point but not so long that it gets tiresome to look at.

As a rule of thumb, you can estimate the number of slides you need by timing your presentation and multiplying the number of minutes by five or six. This means one slide change about every 10 or 12 seconds. You may find that you need more slides in some instances and fewer in others. Don't be afraid to use "filler" slides to hold visual interest. They're perfectly acceptable as long as they relate to the topic.

Step 9

Edit your planning cards in terms of practicality. Be sure you have ready access to the artistic talent or photographic equipment needed to turn your sketches into slides.

Step 10

Use your notes to prepare an audio script.

Consider using two different voices for the narration, perhaps one male and one female for variety. Would sound effects add impact to your presentation? How about actual sounds from the place where you will be shooting the pictures? You can take along a recorder and pick up background sounds and personal interviews while doing the photography.

Consider, too, adding music, especially as a finishing touch to the beginning and end. Be careful to keep it unobtrusive. Avoid highly recognizable tunes, trendy songs that will date your presentation, and music aimed at very specialized tastes.

Step 11

Rehearse your presentation, imagining that your cards are slides on the screen. Time your presentation and see if you need to shorten or lengthen it. To keep your audience's attention, limit your show to 15 minutes. If you need more time than that, break it into two or more parts interspersed with audience activity.

Now you are ready to turn your sketches into slides! (To record your tape, see p. 182.)

After you have developed a series of cards, lay them out on a table or place them on a storyboard holder. You place the cards in their tentative presentation order, thus giving you an overview of the production (Figure A.4). The storyboarding technique facilitates addition, deletion, replacement, revision, and refinement of the sequence because you can easily discard, add to, or rearrange the cards. The display of cards also allows others (teachers, students, production assistants) to look at the presentation in its planning stage. Number the cards in pencil; you may wish to change numbers as your planning progresses. You can photocopy several cards in sequence on a page for use with the final script, thus avoiding duplication of effort and providing a convenient assemblage of visuals, narration, and production notes.

FIGURE A.4

Storyboards are useful for planning and presenting rough drafts of your presentation.



APPENDIX B

Equipment and Setups

OUTLINE

- Safety
- Care and Handling of Audiovisual Equipment
- Audio Setups
- Projector Setups
- Video Setups
- Computer Setups
- Computer Hardware Selection

Most users of technology are not—and do not expect to become—electronic wizards, but they want to be able to use the hardware safely and effectively. The most fundamental elements of effective technology use are simply getting the equipment properly set up, keeping it running, and being ready to cope with snags, which always seem to occur at the most inopportune times.

This appendix provides guidelines for arranging equipment and facilities properly and hints for the safe care and handling of audiovisual equipment and computer hardware.

SAFETY

Safety is the paramount concern whenever teachers and students are using technology. Accidents involving heavy pieces of equipment can be serious, even fatal. The U.S. Consumer Product Safety Commission has noted at least four deaths of children and four serious injuries resulting from top-heavy projection carts that tipped over, dumping a heavy object onto the child. In seven cases the carts had a TV monitor on the top shelf, and the eighth had a film projector there. Particularly hazardous are carts over 50 inches (127 centimeters) high. With the increasing number of TV monitors being used in schools, this hazard is a growing concern.

All educators must be aware of their responsibility—and legal liability—regarding students' exposure to hazardous conditions. The operating rule today is to *NEVER allow children to move carts with heavy equipment on them.*

Adults, too, can sustain injuries from mishandling equipment. Many back injuries occur when people attempt to lift heavy objects by simply bending over, grasping the object, and pulling directly upward. This puts a strain on the lower back. The recommended procedure is to bend at the hips and knees, and lift upward with the *legs* providing upward spring, as shown in Figure B.1.

All educators must recognize that they serve as role models for safe practices when using technology. They thus have a special responsibility to know and practice good safety habits.

CARE AND HANDLING OF AUDIOVISUAL EQUIPMENT

Overhead Projectors

The overhead projector is a simple apparatus with few components requiring

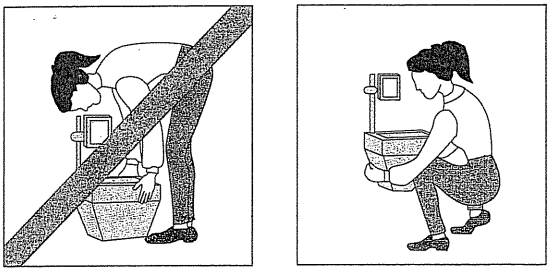


FIGURE B.1
The wrong way (left) and the correct way (right) to pick up heavy equipment.

special maintenance procedures. Reliable as it is, however, you should not take it for granted. Rather, take a few basic precautions to ensure that the projector keeps putting on a bright performance.

Keep the overhead projector as clean as possible. The horizontal stage tends to gather dust, fingerprint smudges, and marking-pen traces. Clean it regularly with window spray or a mild solution of soap and water. The lens in the head assembly should also be kept free of dust and smudges. Clean it periodically with lens tissue and a proper lens-cleansing solution. The fresnel lens under the stage may also need cleaning eventually, but this procedure is better left to the equipment specialist. The lens is a precision optical element requiring special care. In addition, some disassembly of the unit is required to get at the lens.

The best way to prolong the life of the expensive lamp in the overhead projector is to allow it to cool before moving the projector (Figure B.2). Move the projector with care. Keep it on a cart that you can roll from one location to another. When hand-carrying the apparatus, hold onto the body of the projector, not the thin arm of the head assembly. The head assembly arm is not intended to be a carrying handle; used as such, it can easily be twisted out of alignment, thus distorting the projector's image.

Slide Projectors

With normal use, slide projectors require little special attention to keep working smoothly. The only regular maintenance required of the user is to clean the front element of the projection lens if it shows finger marks. More likely to cause difficulties are the slides themselves, which you should always store away from heat and handle only by their mounts. The most frequent cause of foul-ups in slide presentations is a slide that jams because it is warped or dogeared. Remount slides that could cause jams.

The Kodak Ektagraphic III projector has a number of desirable features not found on earlier models (Figure B.3). For example, you can change the projection lamp from the rear of the projector without having to turn the projector over. There is a quick release on the elevation stand so you can raise the projected image without having to turn the adjustment knob many times by hand. In addition, the "Select" function allows you to turn the carousel tray when the power is off. Finally, the controls are on the side of the projector, where the operator usually stands.

Even though some current model projectors, such as the Ektagraphic III, do not project a distracting bright white square when there is not a slide in position, we still recommend that you include a dark slide at the beginning and end of your presentation. Solid plastic slides work best.

We highly recommend purchasing and using a carrying case for your slide projector if you will be moving the projector from location to location, especially from building to building. You should move slide projectors only on a projector cart or within a carrying case.

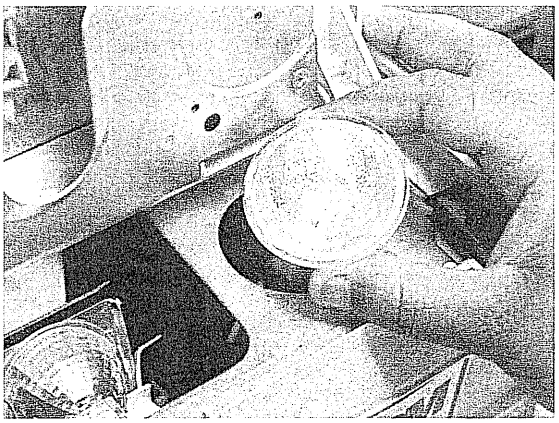


FIGURE B.2
Many overhead projectors are equipped with a spare lamp, which you can simply slide into place.



FIGURE B.3
The Kodak slide projectors feature convenient controls.

HOW TO . . . Safely Move and Use Audiovisual Equipment

Loading Projection Carts

- *Prohibit children from moving carts.* Only adults should be allowed to move loaded carts. A safety sticker showing the ICIA warning (shown below) should be placed on all carts.
- *Lock casters.* Be sure to engage caster locks before loading a cart.
- *Unplug cords.* Disconnect all power cords from wall outlets and wrap them around the equipment.
- *Use lower shelves.* Place equipment on the lower shelves before moving. Disconnect VCR from TV monitor before moving units to lower shelves.

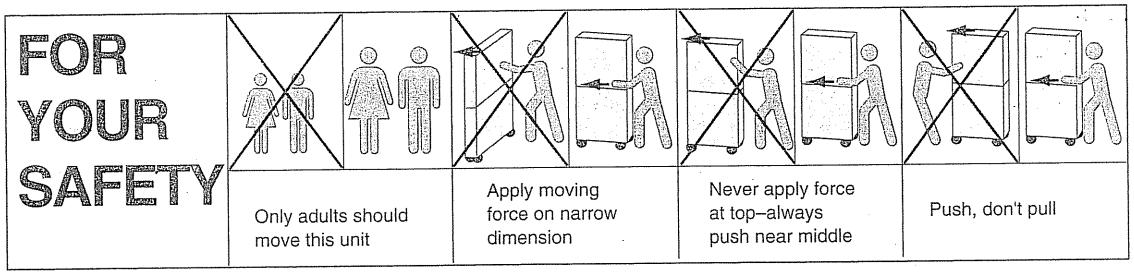
Moving Projection Carts

- *Unlock casters.* Disengage all caster locks before moving the cart.
- *Push, don't pull.* Always push the cart, applying force on the narrow dimension, and watch where you're going. Never pull the cart.
- *Elevator angle.* When entering or leaving an elevator, push the cart at an angle so that one caster at a time passes over the gap between building and elevator.
- *Strap for ramp.* If a cart is to be moved up or down a ramp, use a strap to secure equipment to the cart.

Using Equipment

- *Lock casters.* Engage the caster locks as soon as the projection cart is in place.
- *Center on shelf.* Make sure equipment is centered on the cart shelf, with nothing protruding over the edge.
- *Check power cords.* Inspect for frayed cords and loose plugs. When unplugging, pull the plug, not the cord.
- *Secure cords.*
  - Keep power and speaker cords out of ~~traffic~~ lanes; leave a lot of slack.
  - Wrap the power cord around the bottom of a leg of the cart so that if someone does trip on the cord, the cart (not the equipment) is pulled.
  - Use duct tape to cover cords that could be a tripping hazard.

Source: Adapted from guidelines provided by the International Communications Industries Association (ICIA). Additional information, including safety warning stickers for carts, is available from ICIA, 3150 Spring Street, Fairfax, VA 22031.



This safety sticker, available from the International Communications Industries Association, should be on all carts.

The case provides a place to store the projector, tray, remote control unit, a spare lamp, and extension cords. The carrying case helps to keep all the accessories together, decreasing the chances for loss, as well as providing protection from damage and dust.

More serious damage can occur if the slide projector falls because it has been propped up precariously on top of a stack of books or on some other unstable base. This happens all too often because the projector's elevation leg seems never to be quite long enough to raise the image up to the top of the screen. It is better to use a higher projection table, raise the whole projection table, or raise the whole projector by placing it on a sturdy box or similar platform.

Projection Carts

Wheeled projection carts come in many different sizes and shapes suited to different types of equipment, as shown in Figures B.4 and B.5. Carts are designed both for inside-only use and inside-outside use. You take a great risk in moving equipment out of doors on a cart designed for inside use. The small wheels can catch in cracks in the pavement and cause the cart to tip over. For this reason, even for exclusive indoor use it is wise to purchase carts with 5-inch wheels.

Manufacturers normally offer power outlet cord assemblies for their carts. These are worthwhile investments. You plug your projector into the outlet on the cart and the cord on the cart into the wall outlet. If someone should trip over the power cord, the cart moves but the projector does not crash to the floor. In addition, the cord on the cart is considerably longer than the typical power cord furnished with the projector. You can lay the longer cord on the floor along the wall, thereby reducing the risk that someone will trip over it.

The "Appraisal Checklist: Audiovisual Equipment" provides some criteria to consider when appraising new AV equipment. After purchase, there's still one major step before the process is complete—permanent identification. Most schools and other organizations identify their ownership of equipment with large, visible markings including the organization's

FIGURE B.4
The varied types of equipment carts are suited to different purposes.

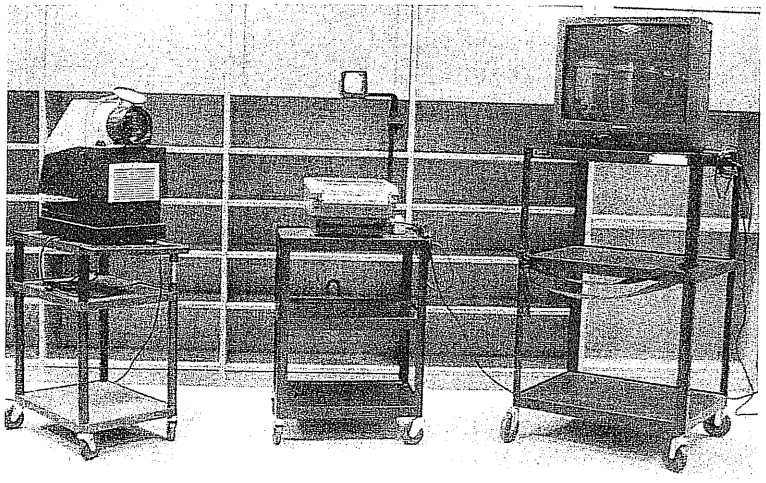


FIGURE B.5
You can secure special equipment in a locking storage compartment.



name, address, and phone number plus an inventory number and even the lamp replacement number. Such information deters theft, simplifies taking inventory, and helps ensure using the correct replacement lamp, a great aid for the harried teacher.

AUDIO SETUPS

Speaker Placement

Most audiovisual equipment intended for use in educational settings comes equipped with a built-in speaker system. This kind of unit is suitable for many but not all instructional purposes. Small speakers built into the chassis of portable recorders, filmstrip projectors, and so on often lack the fidelity necessary for audio clarity for a large audience area.

Portable cassette recorders are particularly troublesome when used for playback in an average-size classroom. Even under the best conditions, the sound quality of portable cassettes is severely limited by their undersized speakers. If you use such a unit to play back material in which audio fidelity is essential (e.g., a musical composition), use an auxiliary speaker if possible. You may be able to plug a high-efficiency speaker—for instance, one having a 6- or 8-inch diameter—into the external speaker jack or earphone jack of the cassette player to provide better fidelity.

Size alone, however, does not guarantee high-quality sound from a speaker. If you need high-fidelity audio, two-way speakers (bass and treble speaker in one cabinet) or three-way speakers (bass, midrange tweeter, and regular tweeter) are highly desirable. Such speakers may require an auxiliary amplifier when used in conjunction with AV equipment, but they are capable of reproducing the complete frequency range audible to humans.

Another problem with built-in speakers is that they are often built into the side of the machine containing the controls. This is fine when the operator of the tape recorder is also the listener. But if the apparatus is placed on a table or desk and operated by an instructor for the benefit of an audience, the speaker will be aimed away from the audience. The simple remedy for this situation is to turn the machine around so that the speaker faces the audience and operates the controls from beside rather than in front of the machine.

If you are operating in a lecture hall or auditorium that has a built-in public address system, you will want to plug your audio source into that system. This might require an adapter to match up the output plug and input jack.

The detachable speakers that accompany some stereo tape recorders are generally large and sensitive enough to provide adequate sound quality throughout the instructional area if, as with other separate speaker systems, you give consideration to their individual placement.

Whenever possible, face speakers toward the center of your audience. If reverberation is a problem, however, especially

APPRAISAL CHECKLIST

AUDIOVISUAL EQUIPMENT

Type _____ **Price** _____

Manufacturer _____ **Model** _____

Audio

Speaker Size _____ Amplifier Output _____

Inputs

_____

_____

Outputs

_____

_____

Sound controls

_____

_____

Tape

Size _____ Tracks _____

Speeds _____

Other Features

Projector

Lamp _____ Wattage _____ Exciter lamp _____

Power controls

_____

_____

Lamp level control

_____

_____

Lens _____

Rating	**High**	**Medium**	**Low**	**Comments**
Sound quality	❑	❑	❑	
Picture quality	❑	❑	❑	
Ease of operation	❑	❑	❑	
Price range	❑	❑	❑	
Durability	❑	❑	❑	
Ease to maintain	❑	❑	❑	
Ease to repair	❑	❑	❑	

Other Features

Strong Points

Weak Points

Recommended Action _____ **Name** _____ **Date** _____

Prentice Hall grants the reader permission to reproduce this checklist for personal use only. Heinich, Molenda, Russell, and Smaldino, *Instructional Media and Technologies for Learning* (2002).

A computer version of this Checklist is available on the "Classroom Link Portfolio" CD-ROM.

in long narrow rooms, aim the speaker diagonally across the audience to help alleviate this situation.

Be sure nothing obstructs the sound waves as they travel from the speaker toward your audience. Classroom furniture (e.g., desks, chairs) and the audience itself may present physical obstructions to sound. To avoid such interference, place the speaker on a table or some other kind of stand so that it is at or above the head level of your seated audience.

In summary, the rules of thumb for speaker placement are as follows:

- Face speaker toward the center of the audience.
- Place speaker near the screen.
- Raise speaker to head level of seated audience.

If you are using a stereophonic system, the speakers should be far enough apart so that the sound is appropriately balanced between the two. As a rule of thumb, the distance between the speakers should equal the distance from each speaker to the middle of the audience. Thus, in the typical 22-by-30-foot classroom, place stereo speakers about 15 feet apart, or nearly in the corners of the room.

Microphone Handling and Placement

Microphones should be placed at least 6 inches (15 centimeters) from the presenter's mouth. Placed closer to the mouth, the microphone is likely to pick up "pops" and "hisses" when the presenter says words with plosive or sibilant sounds. As shown in Figures B.6 and B.7, place the microphone below the mouth so that the presenter talks across it rather than into it. The rule of thumb for microphone placement, then, is to place the microphone *below* and at least six inches *away from* the mouth.

Feedback is that annoying squeal that sometimes intrudes when using public address systems. The usual cause is simple: the signal coming out of the loudspeaker is fed back into the microphone. The most direct remedy is to make sure to set up the speakers in front of the microphone, as shown in Figure B.8. If you experience feedback, here are possible solutions:

- Place the microphone in back of the speaker(s) or move the speaker(s) in front of the microphone.

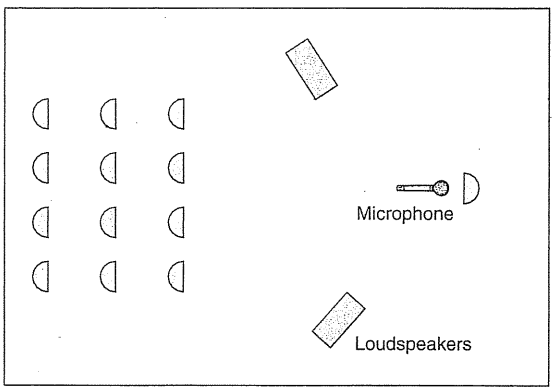
FIGURE B.6
A hand-held microphone should be held at a 45-degree angle and below the mouth.



FIGURE B.7
Clip a lavaliere microphone to the presenter's clothing below the mouth.



FIGURE B.8
To avoid feedback, keep the microphone in back of the speakers.



- If neither step is possible, adjust the volume and tone controls to reduce the interference.

Listening Centers

As discussed in Chapter 2, many classrooms, especially at the elementary level, are arranged in a more open form with flexible furnishings to allow diverse yet simultaneous activities. In such a classroom, learning centers are a common format for learning. One popular type of learning center is a *listening center,* an area especially set up for audio media. Listening centers can be set up to accommodate either an individual student or a small group, as shown in Figure B.9.

You should situate a listening center away from noisy areas or at least partially enclose it to reduce visual and auditory distractions. If intended for an individual, you will probably equip it with an audiocassette player or a CD player with a headset. Older types of headsets are designed to close the listener off from all room sounds except those coming from the player. Newer ones, referred to as "hear-through" or dynamic velocity headsets, allow the listener to hear ambient sounds in the room also.

For a small group, the listening center would typically contain a CD or cassette player and should be equipped with a multiple headset device that allows up to eight headsets to connect to a single source.

PROJECTOR SETUPS

Screen Alignment

The first requirement in projector placement is to align the projection lens perpendicular to the screen (i.e., it must make a 90-degree angle with the screen). Thus, the lens of the projector should be about level with the middle of the screen. If the projector is too high, too low, or off to either side, a distortion of the image will occur, referred to as the **keystone effect** (Figure B.10). The effect takes its name from the typical shape of a keystoned image—wide at the top, narrower at the bottom, like a keystone. To remedy this situation, move either the projector or the screen to bring the two into a perpendicular relationship (see "How to . . . Eliminate the Keystone Effect").

The keystone effect is especially prevalent with the overhead projector because it is ordinarily set up very close to the screen and lower than the center of the screen to allow the instructor to write on its stage. For this reason many screens used for overhead projection are equipped with a "keystone eliminator," a notched bar at the top that allows the screen to be tilted forward (Figure B.11).

Projector Distance

Once you have properly aligned the projector and screen, consider the distance between them. If the distance is too long, the image may spill over the edges of a given screen. If it is too short, the image will not fill the same screen properly. Your goal is to fill the screen as fully as possible with the brightest image possible. The principle to remember here is that the image becomes larger and less brilliant with an increase in distance between the projector and screen. Here are the rules of thumb:

- If the projected image is *too large* for your screen, push the projector *closer.*
- If the image is *too small,* pull the projector back.

Positioning a projector at the proper distance from the screen need not be done solely by trial and error. Because classroom-type projectors usually are fitted with certain focal length lenses, you may estimate their proper placement in advance. Figure B.12 shows the placement of overhead, slide, and 16mm film projectors when they are equipped with their most typical lenses.

FIGURE B.9
A quiet corner of a classroom may be set aside as a listening center.

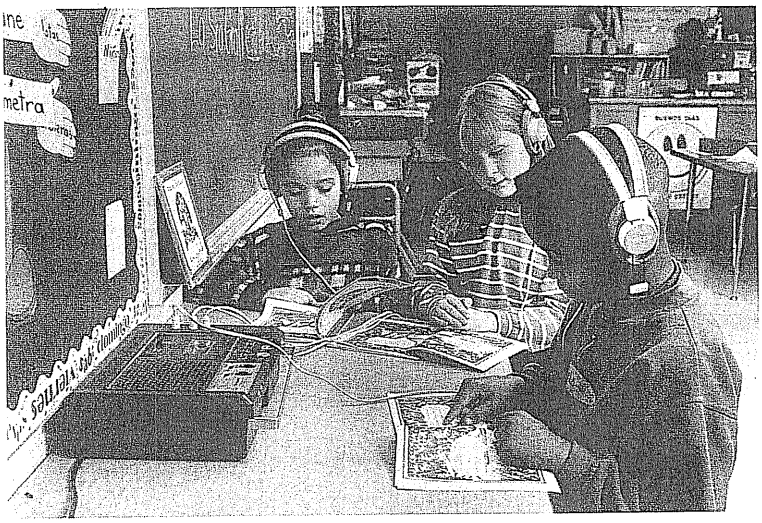


FIGURE B.10
The "keystone effect" describes a projected image that resembles the architectural keystone, the wedge-shaped stone at the top of a rounded arch that locks its parts together.

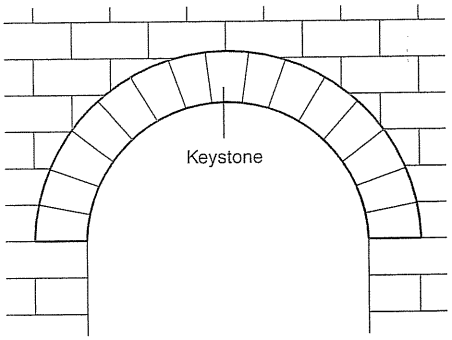
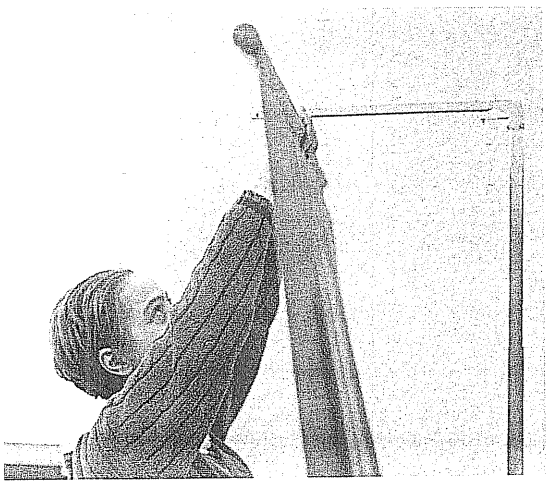


FIGURE B.11
Portable tripod screen with keystone eliminator.



HOW TO . . . Eliminate the Keystone Effect

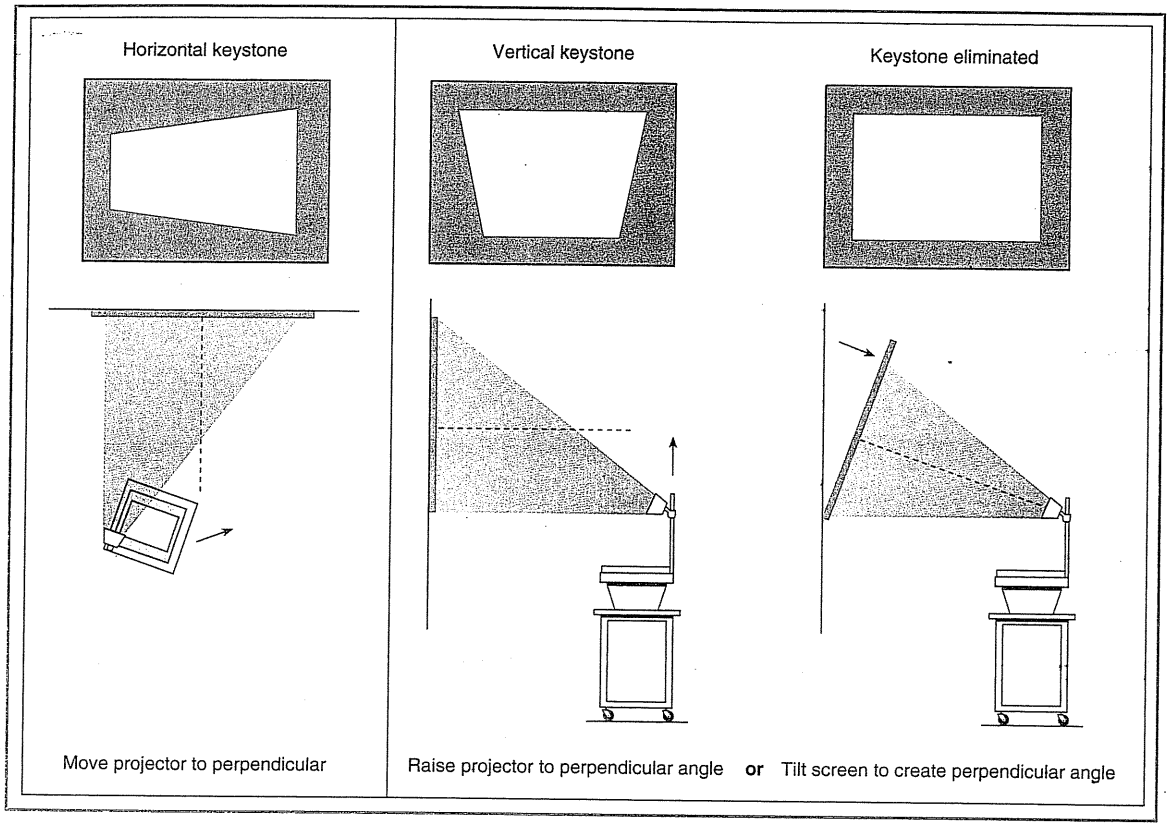
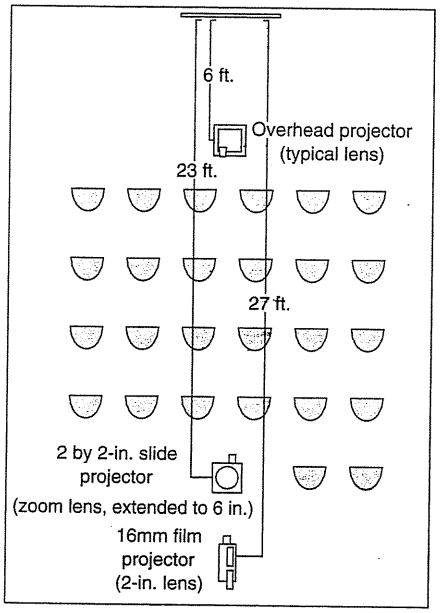


FIGURE B.12
Approximate placement of projectors when used with typical lenses and screen.



The projection distances described here assume appropriate lighting conditions. Where the room light is so bright that it is washing out the screen image and you cannot dim it any further, you must move the projector forward. This will give you a brighter image but also a smaller one. In some cases, however, you may be able to compensate for this reduction in image size by having your audience move closer to the screen.

Power Cords

It is best to place all projectors, except the overhead, behind the audience to minimize the number of people stepping over the power cords. For the same reason, use extension cords so that the power cords can run along the wall to the outlet rather than across the center of the room. Any cord that lies where someone might trip over it should do so only temporarily, and you should firmly tape it down during that time.

All modern audiovisual equipment is made with a grounded plug; you should use a matching extension cord. The outlets in older buildings may not be made for grounded plugs, so you will need to use a three-prong adapter to connect newer equipment. Extension cords are made to serve different purposes—indoor and outdoor, higher and lower power capacity. Whenever using an extension cord, be sure that you are not exceeding its power capacity. If in doubt, consult a media specialist.

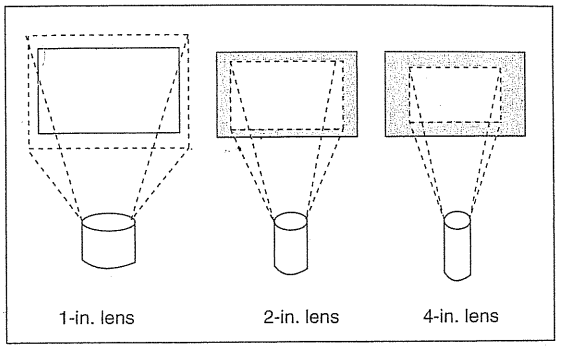
Lamps

Types. There are three types of projection lamps: incandescent, tungsten halogen, and tungsten halogen with surrounding reflector. You should watch incandescent lamps because they have a tendency to blister; such blisters can become so big that the lamp cannot be removed from the projector. If the lamp does blister to the extent that it must be broken for removal, contact an audiovisual technician.

The first innovative response to incandescent blistering was the tungsten halogen lamp. These lamps do not blister, but they do require the same high wattage and thus have the associated heat problems and fan noise.

The newest type of lamp is the tungsten halogen lamp with surrounding reflector. These lamps generally operate at one-half the wattage of incandescent and tungsten halogen lamps.

FIGURE B.13
The longer the focal length of the lens, the smaller the image.



Coding. Projection lamps are labeled with a three-letter ANSI (American National Standards Institute) code, which is printed on the lamp and on the box. In addition, many projectors now have stickers in the lamp housing with the ANSI code stating which lamp should be used in that projector.

Replacing Lamps. Replacement lamps should have the same ANSI code or an authorized substitute. Substitutes can be found in replacement guides written by the lamp manufacturers; these are available from the manufacturers or from local audiovisual dealers. Do not use higher-wattage lamps than specified—you might burn the materials in the projector!

Handling. When handling a lamp, *never* touch the clear glass bulb. The oil from your fingers can shorten the life of the lamp. Always manipulate the lamp by its base. Incandescent lamps and tungsten halogen lamps (without exterior reflector) are supplied with a piece of foam or paper around the lamp. Use this material or a cloth to hold the lamp when inserting it into the projector.

When removing a burned-out lamp, wait until the lamp has cooled to prevent burning your fingers. It is wise to always use a cloth when removing a lamp. Even a lamp that burns out when the projector is first turned on will be hot enough to burn you.

Expense. Lamps for audiovisual equipment are expensive. They usually cost about 20 times the cost of a household light bulb. Because the average lamp life is only 50 hours, turn off projectors when not using them. If the projector offers a low lamp setting, use it if possible to increase the life of the lamp. Try not to jar a projector when the lamp is on, as this can cause a premature burnout of the lamp. You should *not* leave the fan on for cooling after use unless the projector is going to be moved immediately, as this also will shorten the life of the bulb.

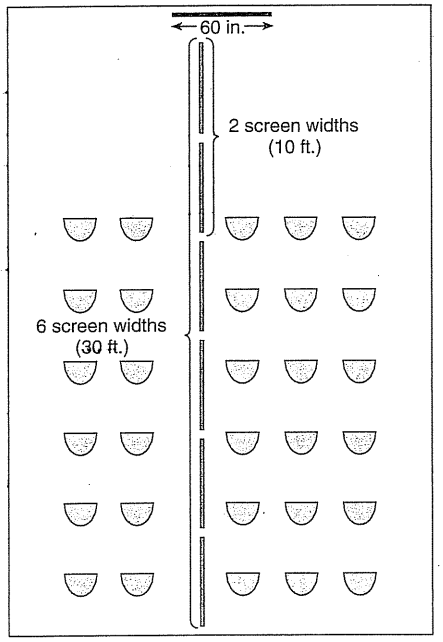
Lenses

For everyday media use you do not have to pay much attention to technicalities about lenses. Whatever lens your projector is equipped with is usually sufficient. However, understanding some basic ideas about lenses can help you cope with extraordinary situations.

First, lenses vary in focal length (measured in inches in the United States, in millimeters elsewhere). The **focal length** is the distance from the focal point of the lens to the image plane when the lens is focused on infinity. Remember, the *longer* the focal length, the *smaller* the image at a given distance. Your objective is to project an image that will fill the screen, so the shorter the projection throw, the shorter the lens (in terms of focal length) you will need to enlarge the projected image sufficiently. Fortunately, the actual length of most lenses corresponds roughly with their focal length; the longer of two lenses will have the longer focal length. Figure B.13 illustrates the relationship between the lens and the size of its projected image.

One type of lens has a variable focal length—the zoom lens. You can adjust it

FIGURE B.14
Appropriate screen size for the typical-size classroom according to the two-by-six rule.



to cast a larger or smaller picture without moving the projector or changing its lens. The most commonly encountered zoom lens (found on many slide projectors) has a focal length range of 4 to 6 inches.

When media specialists require precise specifications to select lenses for particular conditions, they use calculation guides prepared by manufacturers, such as the "Da-Lite Lens-Projection Screen Calculator" or Kodak's "Projection Calculator and Seating Guide."

Screens

Arranging a proper environment for viewing projected visuals involves several variables, including screen size, type of screen surface, and screen placement. In most cases you will have to deal with only a couple of these variables. For everyday teaching situations your classroom will often be equipped with a screen of a certain type attached in a fixed position.

There may be times, however, when you will have to make decisions about any or all of these screen variables. For example, let's assume the room you are to use for projecting visuals is 22 feet wide and 30 feet long, a fairly typical size for a classroom. Let's further assume that you must arrange seating for between 30 and 40 viewers, a fairly typical audience size. Figure B.14 illustrates a conventional seating pattern for a group of this size (in this case, 30 viewers). Note that the seats are arranged across the narrower room dimension. If the seats were turned to face the left or right side of the room and arranged across its 30-foot length, viewers along either end of the rows would have a distorted view of the screen. Note too, that the first row of seats is set back somewhat from the desk area, where the screen is to be set up, so that front-row students will not be too close to the screen for comfortable viewing.

Screen Size. A rule of thumb for the relationship between screen size and viewer seating is called the *two-by-six rule:* No viewer should be seated closer to the screen than *two* screen widths or farther away than *six* screen widths.

This means that in our hypothetical case, in which the farthest viewer could be 30 feet from the front of the room, a screen about 5 feet wide (60 inches) would be required to ensure that this farthest-away viewer is within six screen widths of the screen ($30 \div 6 = 5$). A square screen is generally preferable because you can use it to show rectangular images (slides, filmstrips, etc.) as well as square images (overhead projections). Thus, in this case a screen measuring 60 by 60 inches is recommended (see Figure B.14).

With a zoom lens on a carousel slide projector or a 16mm projector, you can put the projector at the rear of any normal-size classroom and fill a 70-inch screen.

Screen Placement. In most cases placement of the screen at the center in the front of the room will be satisfactory. In some cases, however, it may not be. Perhaps light from a window that you cannot fully cover will wash out the projected image (sunlight is much brighter than any artificial light), or maybe you wish to use the chalkboard during your presentation and a screen position in the center front will make it difficult or impossible for you to do so. Also, the screen should not be at center stage if it will attract unwanted attention while nonprojection activities are going on. An alternative position is in a front corner of the room. In any case, nowhere is it written in stone that the screen must be placed front and center. Position your screen wherever it will best suit your purpose.

In general, adjust the height of the screen so that the bottom of the screen is about level with the heads of the seated viewers. The bottom of the screen should be at least 4 feet above the floor to prevent excessive head interference (Figure B.15). Other inhibiting factors aside, this arrangement will allow reasonably clear sight lines for the most viewers. In general, the higher the screen, the greater the optimal viewing area. Of course, you must take care that viewers can see the screen without uncomfortably craning their necks.

VIDEO SETUPS

Before students can learn from any material presented on a video monitor, they first have to be able to see and hear it! This means providing proper seating arrangements, placement of the monitor, lighting, and volume control.

Seating

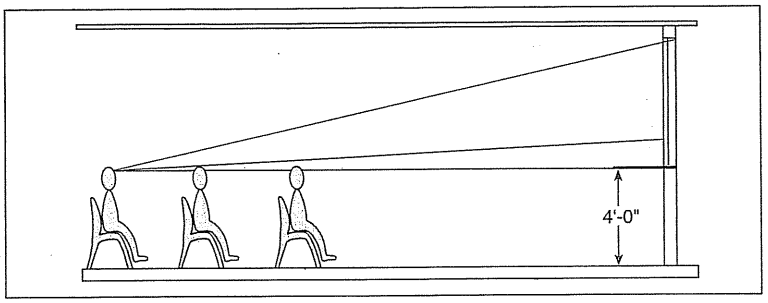
For group showings, an ideal seating arrangement may sometimes be difficult to achieve. In some cases there are simply not enough monitors available to seat all students in the most desirable viewing area. It may be possible to have students move closer together to get more people into

the desirable viewing area. Try to stagger the seats to reduce blocked sight lines.

Here are some basic rules of thumb for seating:

- The total number of viewers should be no more than the number of inches of screen size. For example, for a 23-inch monitor, the largest number of viewers would be 23.
- Seat no one closer than twice the *inches* of screen size. For example, for a 23-inch monitor, the closest viewer would be 46 inches (or about four feet) from the screen.
- Seat no one farther *in feet* than the size of the screen in inches. For example, for a 23-inch monitor, the farthest viewer would be 23 feet away. (The maximum viewing distance would be much smaller if the lesson included details that were critical to learning.)

FIGURE B.15
The bottom of the screen should be above head level to avoid obstruction of the view.



Monitor Placement

In addition to distance from the screen, you must consider viewing angles—both up and down and side to side. As shown in Figure B.16, the monitor placement should require no more than 30 degrees of head tilt. In general, a 54-inch-high monitor provides a good viewing angle for group viewing. In terms of side-to-side angles, no viewer should be located more than 45 degrees from the center line.

FIGURE B.16
Recommended monitor placement and seating distances for TV viewing.

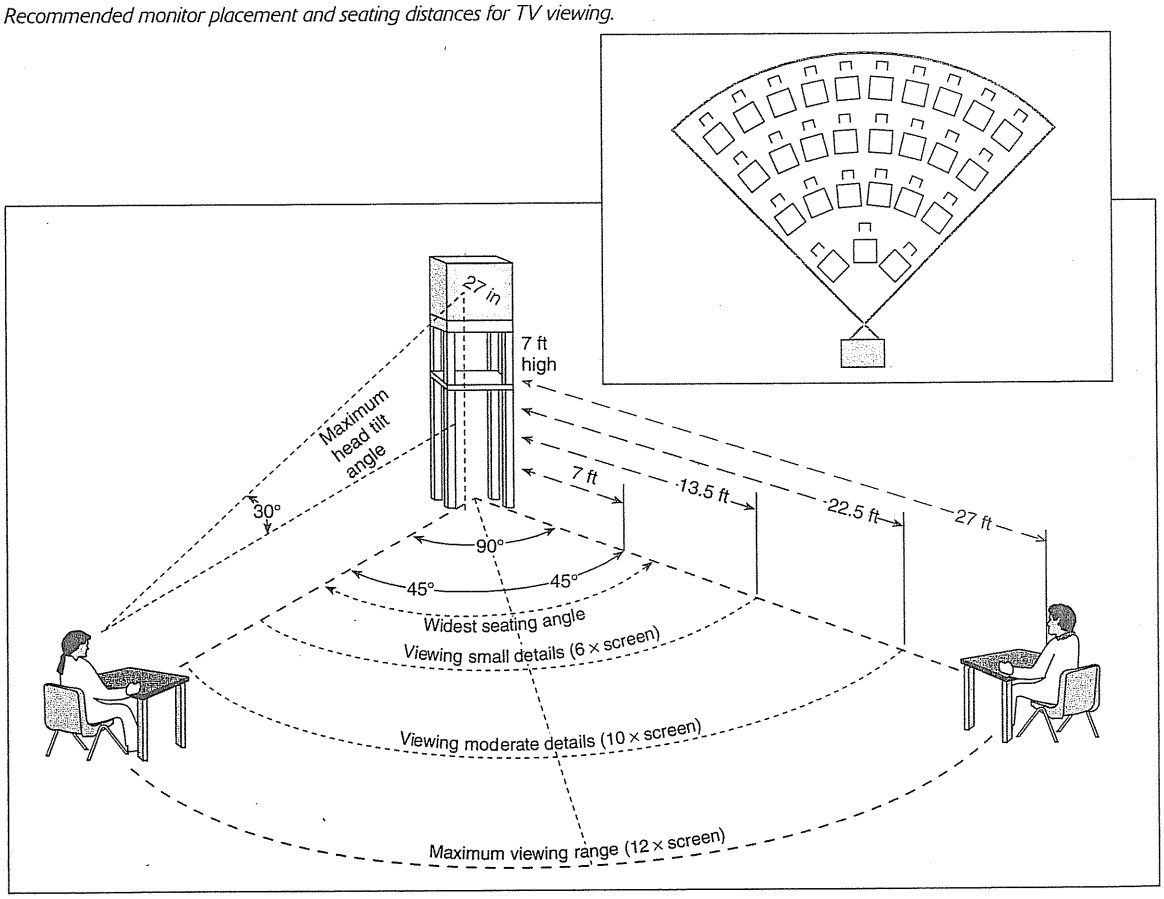


FIGURE B.17
Projection with a ceiling-mounted data-and-video projector.



Lighting

Video monitors should be viewed in normal or dim light, not darkness. Besides being more comfortable to the eye, normal illumination provides necessary light for student participative activities (e.g., for referring to handouts and for note taking).

Locate the television receiver so that harsh light from a window or light fixture does not strike the screen and cause glare. Do not place the receiver in front of an unshaded window that will compete with light from the television screen and make viewing difficult.

The rules of thumb for lighting conditions for video monitors are as follows:

- View in normal or dim light.
- Avoid direct light onto screen, causing glare.
- Avoid sunlight behind monitor.

Volume

For proper hearing, set the volume of the receiver loud enough to be heard clearly in the rear of the viewing area but not so loud that it bowls over those in the front. Normally this happy middle ground is not difficult to achieve if your seating arrangement is within acceptable bounds and your receiver's speaker mechanism is functioning properly.

Obviously, you should keep the volume low enough so as not to disturb neighboring classes. Unfortunately, open-plan buildings with only movable room dividers as walls provide a poor environment for TV and other audiovisual presentations. Under such conditions, cooperation is critical. Teachers in neighboring areas can agree to lower their sound level to minimize interference (this is better than escalating the problem by trying to drown each other out!). Sometimes the only alternative is to seek an enclosed room that can be reserved for audiovisual use.

Projected Video

Ordinary video monitors are well suited to individual or small-group viewing but not to large-group situations. Large groups require multiple monitors for adequate viewing, and playing a video recording also requires wires to connect the video player with each of the monitors. A better option in such cases is the video projector, discussed in detail on page 207. In addition to being used for showing television images, they can also be used for showing computer data, text, and graphics.

Tabletop video projectors can project an image large enough to fill a screen up to 4 by 6 feet. Units that may be permanently mounted at ceiling level or placed on low carts are used for larger screens. The smaller units require less setup adjustment and may have a video playback unit built in (Figure B.17).

The larger units require color focusing adjustments whenever they are moved. They have three color "guns," and all three images must converge precisely to have a clear image without color fringes.

Other than the special focusing considerations, projected video setups follow the size, seating, and placement rules for other sorts of projection onto a screen.

The rules of thumb for lighting conditions for video projection are as follows:

- View in dim light or darkness.
- Seat audiences as close as possible to the center of the screen.
- Make sure that all can see the image clearly.

COMPUTER SETUPS

You may arrange computers and computer workstations in an infinite variety of configurations, depending on how many computers you use in a room and for what purposes. The setups described are meant to show how to get the most out of each situation. A number of typical situations were illustrated in Chapter 9, each showing a different number of computers being used in different ways (see Figures 9.19 through 9.22). Two additional setups are shown in Figures B.18 and B.19.

COMPUTER HARDWARE SELECTION

It is becoming increasingly common for instructors to be involved in the selection of instructionally related computer hardware for their institution. This section will give you at least some general guidelines for participating intelligently in such a selection process.

FIGURE B.18
A computer setup for collaborative learning.

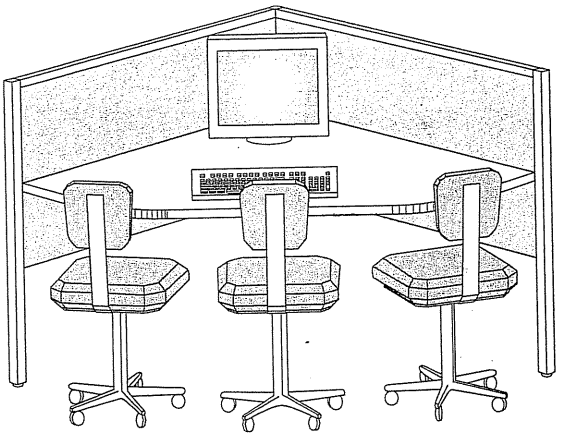


FIGURE B.19
This teaching station can accommodate individual and small-group use or large-group presentations.



Analyzing Needs

The first step in evaluating and selecting computer hardware is to identify the need for the hardware. Why are you buying the computer? What software are you planning to use on the system? Without identifying specific needs for the hardware, you may hastily purchase an inadequate system or one more elaborate than you could ever use.

The selection of computer software is the most important first step in the selection of hardware. Computer hardware is no better than the software that drives it. Without software a computer will not function. The computer's utility may be limited by an inadequate quantity or quality of available software. A computer may have great features, but they are of little value if there is no software to take advantage of them.

On the other hand, it is difficult for computer software to overcome hardware limitations. Since software written for one computer may not run on another computer, make sure software is currently available for the computer you are interested in.

The computer hardware industry is changing so rapidly that you cannot base hardware selection decisions solely on present needs. You must consider future software and hardware needs. By purchasing hardware with significant limitations, you are unlikely to be able to take advantage of new advancements without purchasing new hardware. It is difficult to make selection decisions for the present and an unknown future. To prevent unexpected problems, it is important to look at the past performance of the hardware company from which you intend to purchase. Is the company financially stable? Are other institutions using the same equipment? Is the company committed to supporting their equipment?

Compatibility

The next major factor in selecting computer hardware is compatibility with previously purchased equipment. However, do not allow yourself to be trapped by equipment that can never meet your needs. If a change is required, it is often better to make it sooner than later. What other computers do you have currently? What operating system do the other computers use? Is there a need for exchanging files and programs among different hardware? If so, mixing several different computers may make it difficult. In addition to being compatible with other systems currently in use, the new hardware components must be compatible with each other. Can you use a monitor from one manufacturer with a particular computer of a different make? Although some feel that it is cheaper to order various components from a catalog, you must beware that not all components are necessarily compatible. Get specific assurance of compatibility from the vendor.

Expandability

Expandability is also an important consideration when purchasing a computer system. You don't want the announcement of a new model shortly after your purchase to render your equipment obsolete. Nor do you want to buy a system that is sufficient for your current needs but that you cannot upgrade to accommodate your growing ambitions. To protect yourself, be sure that the system you purchase has the ports and slots to accommodate additional memory, additional disk drives, audio or video enhancement, and the like. (A *port* is an outlet on a computer where the user can plug in a peripheral. A *slot* is an area in the computer where the user can add additional electronic boards or cards for specific purposes.)

Documentation

The documentation, or user's manual, must be easy for you to understand. It should have an extensive index and table of contents to allow easy access to the information. The documentation should include complete, clear, easy-to-read diagrams showing the various parts of your system and how to put them together.

Service

Be sure the hardware company you buy from is committed to supporting and maintaining the equipment you plan to purchase. How long has its service center been established? You may want to talk with others who have used their service. Were they satisfied? Was service prompt? Finding someone to service computers often becomes a difficult and frustrating experience. Sometimes you have to ship hardware to a service location, thus being inconvenienced for a time. If shipping is required, do you have easy access to shipping locations nearby or will the shipping service pick up your packages?

A maintenance contract also may be a consideration when purchasing hardware. Such a contract may vary in cost from a few dollars a month for each machine to many times that amount. However, most personal computer systems tend to be

APPRAISAL CHECKLIST

COMPUTER HARDWARE

Manufacturer _____

Model _____

Monitor _____ **Graphics** _____

Sound _____ **Memory** _____ **Expandable** _____ **Hard Drive** _____

Peripherals _____

Rating	**High**	**Medium**	**Low**	**Comments**
Ease of operation	❒	❒	❒	
Durability/reliability	❒	❒	❒	
Availability of software	❒	❒	❒	
Monitor display quality	❒	❒	❒	
Keyboard layout and touch	❒	❒	❒	
Expandability	❒	❒	❒	
User documentation	❒	❒	❒	
Technical support	❒	❒	❒	
Local service support	❒	❒	❒	
Video display projection capability	❒	❒	❒	
Portability	❒	❒	❒	

Other Features

Strong Points

Weak Points

Recommended Action _____ **Name** _____ **Date** _____

Prentice Hall grants the reader permission to reproduce this checklist for personal use only. Heinich, Molenda, Russell, and Smaldino, *Instructional Media and Technologies for Learning* (2002).

A computer version of this Checklist is available on the "Classroom Link Portfolio" CD-ROM.

reliable. Most failures and problems occur during the warranty period. Once through the warranty period, breakdowns are infrequent as long as you take proper care of your equipment. The actual cost of the repairs may be cheaper than the cost of a maintenance contract.

In comparing models, many different criteria should be considered. The "Appraisal Checklist: Computer Hardware" includes the most important criteria for selecting a computer for instructional uses. The weighting of the criteria may vary depending on the specifics of your particular situation.

SUGGESTED READINGS

Anshel, Jeffrey. 1994. Visual ergonomics in the workplace: How to use a computer and save your eyesight. *Performance and Instruction 33*(5): 20–22.

Barron, Ann E., and Gary W. Orwig. 1997. *New technologies for education: A beginner's guide.* 3d ed. Englewood, CO: Libraries Unlimited.

Hofstetter, Fred T. 1993. Design and construction of a multimedia technology cart. *TechTrends 38*(2): 22–24.

International Communication Industries Association. 1999–2000. *The directory of video, multimedia, and audio-visual products.* Annual; text and CD-ROM. Fairfax, VA: Author.

Novak, Paul. 1993. How to use media equipment. In *The ASTD handbook of instructional technology,* edited by G. M. Piskurich. New York: McGraw-Hill.

Sherry, Annette C., and Allan Strojny. 1993. Design for safety: The audiovisual cart hazard revisited. *Educational Technology 33*(12): 2–47.

Teague, Fred A., Douglas W. Rogers, and Roger N. Tipling. 1994. *Technology and media: Instructional applications.* Dubuque, IA: Kendall/Hunt.

APPENDIX C

Information Sources

OUTLINE

- Comprehensive Information Sources
- Specialized Information Sources
- Commercial Information Sources
- Other Reference Tools

Instructors ordinarily begin their search for needed instructional media in the media collection at their own facility. School personnel then turn to the catalogs of media collections housed at the school district or regional educational service center. But where can you turn beyond your own organization? And where can your organization obtain the materials that you need? This appendix will help you to gain access to the wealth of audiovisual resources available for rental or purchase from commercial and noncommercial sources.

COMPREHENSIVE INFORMATION SOURCES

Assuming that you have identified an instructional need for which audiovisual materials are not available within your organization, where might you begin searching for another supplier? The most comprehensive information sources are listed both online and on CD-ROM and in a set of four printed directors compiled by the National Information Center for Educational Media (NICEM).

The online and CD-ROM product is "A-V Online." Here is a brief description of what it offers:

> Distributional sources for educational media on videotape, film, audiocassette, and other formats. Incorporates records from the Library of Congress, publishers' catalogs, and library collections. Materials from 1900 to present. Over 460,000 descriptions of videotapes, 16mm films, audio-tapes, filmstrips, slide sets, transparencies and film cartridges of educational, documentary, or informational nature.[1]

The NICEM *Audiovisual Online Database* (formerly a print-based NICEM reference) contains over 465,000 bibliographic records representing 605,000 nonprint educational items. These items are searchable by title, date, age level, subject area, and media type. For more information, contact

NICEM
P.O. Box 8640
Albuquerque, NM 87198
Phone: 1-800-926-8328
http://www.nicem.com
e-mail: nicem@nicem.com

The *Multimedia and Videodisc Compendium* is an index devoted exclusively to videodiscs and multimedia. It lists them by subject category for laserdiscs,

[1]From the Introduction to the "A-V Online" database. "A-V Online" is available at http://www.nicem.com, or on CD-ROM from SilverPlatter.

CDs, and multimedia software. Also included are prices and phone numbers for producers. It is published by

Emerging Technology Consultants
2819 Hemline Avenue North
St. Paul, MN 55113-7118
1-800-395-3973
http://www.emergingtechnology.com
e-mail: Support
@EmergingTechnology.com

Other reference works covering a range of media and content areas include the following:

Lipson, Eden Ross, *The New York Times Parent's Guide to the Best Books for Children,* New York: Random House, 2000.

Homa, Linda, ed., *The Elementary School Library Collection: A Guide to Books and other Media,* Phases 1-2-3. 22d ed. Williamsport, PA: Brodart, 2000.

It would be impractical to list here all the thousands of suppliers of free and inexpensive materials, much less to offer up-to-date addresses. Instead we recommend that you consult one of the many books, catalogs, and magazines devoted specifically to free and inexpensive materials. They are updated regularly and contain current addresses and cost information.

The most comprehensive information source of free and inexpensive materials is the series of guides published by

Educators Progress Service, Inc.
214 Center Street
Randolph, WI 53956
414-326-3162
http://www.ed-pak.com

There is no cost for the guides themselves; the materials listed in the guides are either free or inexpensive. Revised annually, the titles in this series include the following:

Free Teaching Aids (printed materials)
Free Films, Filmstrips, and Slides (mixed media)
Free Guidance Materials (mixed media)
Free Health, Physical Education, and Recreation Materials (mixed media)
Free Science Materials (mixed media)
Free Social Studies Materials (mixed media)
Free Videotapes

The following books and magazines also list sources of free and inexpensive materials:

Abbott, Leo. *The Official Freebies for Teachers.* Los Angeles: Lowell House, 1998.

Free Stuff Editors, *Free Stuff for Kids,* Minnetonka, MN: Meadowbrook Press, 2000.

Trumbauer, Lisa, *Free Stuff for Kids on the Net* (*Cool Sites*), Grand Ledge, MI: Millbrook Press, 2000.

Freebies: The Magazine with Something for Nothing (published five times per year); P.O. Box 5025; Carpinteria, CA 93014-5025.

The following national service offers free loan of videotapes and films:

Modern Talking Pictures Service
5000 Park Street N.
St. Petersburg, FL 33709
813-541-7571

This agency provides sponsored videos and films for free loan from its offices in major cities throughout the United States and Canada.

The U.S. government offers free and inexpensive materials, such as *Selected U.S. Government Publications,* through the following agencies:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

National Audiovisual Center
National Archives and Records Service
General Services Administration
Reference Section CH
Washington, DC 20409

SPECIALIZED INFORMATION SOURCES

Audio

Schwann Record and Tape Guide. Monthly. Boston: ABC Schwann Publications. (Available from many record and tape stores.)

Video

Roxton, Tiniki L. and Blenz-Clucas, Beth, eds. *Recommended Videos for Schools.* Santa Barbara, CA: ABC-CLIO, 1992.

Bowker's Complete Video Directory. Annual. New York: R. R. Bowker.

Stevens, Gregory I., ed. *Videos for Understanding Diversity: A Core Selection and Evaluative Guide.* Chicago: American Library Association, 1993.

Video Source Book. Annual. Syosset, NY: National Video Clearinghouse.

Simulations and Games

Gredler, Margaret E. *Designing and Evaluating Games and Simulations: A Process Approach.* Houston, TX; London: Gulf Publishing, 1994.

Computer Courseware, Multimedia

Many software programs are available free or for a nominal charge from the websites noted throughout this text. You also may find useful programs on the Internet at http://www.shareware.com.

A catalog of shareware programs for IBM PCs and compatibles is available free from

Reasonable Solutions
2101 West Main Street
Medford, OR 97501

Microcomputer Index. Annual. Santa Clara, CA: Microcomputer Information Services.

Neill, Shirley Boes, and Neill, George W. Only the Best: *Annual Guide to Highest-Rated Education Software/D Multimedia for PreschoolGrade 12.*
Education News Service
P.O. Box 1789
Carmichael, CA 95609.

Parents Guide to Highly Rated Educational Software
EPIE Institute
103 West Montauk Highway
Hampton Bays, NY 11946

The Annual Guide to the Highest-Rated Educational Software and Multimedia
Association for Supervision and Curriculum Development
1703 North Beauregard Street
Alexandria, VA 22311-1714

The Software Encyclopedia: A Guide for Personal, Professional and Business Users. For more information, contact

R. R. Bowker
121 Chanion Rd.
New Providence, NJ 07974

What's What in Educational Shareware for IBM-Compatible Computers
Computer Stewards
P.O. Box 8266
Colorado Springs, CO 80933-8266

CD-ROM

CD-ROMs in Print
Meckler Publishing
11 Ferry Lane West
Westport, CT 06880

Shelton, James, ed. *CD-ROM Finder.* 6th ed. Medford, NJ: Information Today, 1995.

Sorrow, Barbara Head, and Betty S. Lumpkin. c: *A Resource Guide to Over 300 Instructional Programs.* Jefferson, NC: McFarland, 1993.

Equipment

The Directory of Video, Computer, and Audio-Visual Products. Annual. Fairfax, VA: International Communications Industries Association.

AV Market Place: The Complete Business Directory of Products and Services for the Audio/Video Industry Including: Audio, Audio Visual, computer. Annual. New York: R. R. Bowker.

COMMERCIAL INFORMATION SOURCES

Commercial producers and distributors of audiovisual materials publish promotional catalogs of their wares. Companies often assemble a special school and library catalog, arranged by subject or medium, to display their offerings more effectively. When you use these catalogs, keep in mind the bias of the seller. The descriptions given and the claims made do not pretend to be objective. Any purchases should be guided by objective evidence such as field-test results, published reviews, and local appraisals based on previews. A sampling of major audiovisual producers and distributors follows.

AFVA Evaluations
American Film and Video Association
P.O. Box 48659
Niles, IL 60648

Booklist
American Library Association
50 East Huron Street
Chicago, IL 60611

CD-ROM Databases
Worldwide Videotex
Box 138
Babson Park
Boston, MA 02157

CD-ROM Librarian
Meckler Publishing
11 Ferry Lane West
Westport, CT 06880

CD-ROM Professional
Pemberton Press, Inc.
11 Tannery Lane
Weston, CT 06883

Curriculum Product News
992 High Ridge Road
Stamford, CT 06905

Curriculum Review
Curriculum Advisory Service
212 West Superior Street, Suite 200
Chicago, IL 60610-3533

Digest of Software Reviews: Education
School & Home Courseware, Inc.
3999 N. Chestnut Diagonal, Suite 333
Fresno, CA 93726-4797

The Educational Software Selector (TESS)
Educational Product Information Exchange Institute
P.O. Box 839
Water Mill, NY 11976

EPIE Reports
Educational Products Information Exchange Institute
P.O. Box 839
Water Mill, NY 11976

InfoWorld
InfoWorld Publishing
155 Bovet Road, Suite 800
San Mateo, CA 94402

Library Journal
Cahners Publishing Co.
249 West 17th Street
New York, NY 10011

Media and Methods
American Society of Educators
1429 Walnut Street
Philadelphia, PA 19102

New Media
901 Mariners Island Blvd., Suite 365
San Mateo, CA 94404

School Library Journal
Cahners Publishing Co.
249 West 17th Street
New York, NY 10011

School Library Media Quarterly
American Association of School Librarians
American Library Association
50 East Huron Street
Chicago, IL 60611

Science Books and Films
American Association for the Advancement of Science
1776 Massachusetts Avenue NW
Washington, DC 20036

Sightlines
American Film and Video Association (AFVA)
P.O. Box 48659
Niles, IL 60648

Software Digest Ratings Report
National Software Testing Laboratories
Plymouth Corporate Center, Box 100
Plymouth Meeting, PA 19462

Software Review
Meckler Publishing
520 Riverside Avenue
Westport, CT 06880

Teaching and Computers
Scholastic, Inc.
P.O. Box 2040
Mahopac, NY 10541-9963

Video Rating Guide for Libraries
ABC-CLIO, Inc.
130 Cremona Drive
Santa Barbara, CA 93117

OTHER REFERENCE TOOLS

For more extensive, annotated guides to media reviews or descriptions or other audiovisual information sources, consult the following:

Media Review Digest. Annual. Ann Arbor, MI: Pierian Press.

Educational Media and Technology Yearbook. Annual. Englewood, CO: Libraries Unlimited.

GLOSSARY

Acceptable Use Policy (AUP) An agreement among students, parents/guardians, and school administrators regarding appropriate use of the Internet.

Accommodation The cognitive process of modifying a schema or creating new schemata.

Acetate A transparent plastic sheet associated with overhead projection.

Advance organizer An outline, preview, or other such preinstructional cue used to promote retention of verbal material, as proposed by David Ausubel. Also referred to as *preinstructional strategies.*

Affective domain The domain of human learning that involves changes in interests, attitudes, and values and the development of appreciation.

Alignment Establishing visual relationships among elements by placing their edges along the same imaginary horizontal or vertical line.

Analogous colors Any two colors that lie next to one another on the color wheel. Contrasted with *complementary colors.*

Animation A film technique in which the artist gives motion to still images by creating and juxtaposing a series of pictures with small, incremental changes from one to the next.

Aperture The lens opening that regulates the amount of light entering the camera.

Arrangement The pattern or shape into which the elements of a visual display are organized.

Artifact Student-produced materials such as writings, videos, and multimedia presentations.

Assimilation The cognitive process by which a learner integrates new information into an existing schema.

Asynchronous Not at the same time.

Audiographic teleconference A teleconference involving voice plus graphic display. The graphics may be transmitted by a fax machine or electronically by means of slow-scan video or a graphics tablet.

Audio teleconference A teleconference involving transmission of voices only. The voices are amplified at each end by a speaker system.

Auditory fatigue The process by which attention to a sound gradually decreases because of the monotony of the sound.

Authentic assessment Evaluation that is usually performance based and that requires students to demonstrate their learning in a natural context.

Author To create on a computer a unique collection of related information.

Bandwidth The range of frequencies an electronic communications channel can support without excessive deterioration.

Bar graph A type of graph in which the height of the bar is the measure of the quantity being represented.

Baud The switching speed, or number of transitions (voltage or frequency changes) made per second; the speed at which modems transfer data. At low speeds, one baud is roughly equivalent to one bit per second.

Behaviorism A theory that equates learning with changes in observable behavior; with this theory, there is no speculating about mental events that may mediate learning.

Bit An acronym for *binary digit;* the smallest unit of digital information. The bit can be thought of as a 1 or a 0 representing a circuit on or off, respectively.

Branching programming A format of programmed instruction in which the sequence of presentation of the frames depends on the responses selected by the learner.

Broadcasting Transmission of signals to many receivers simultaneously via electromagnetic waves.

Browse To navigate through information on computer, following items of personal interest by choosing nonsequential pathways.

Bulletin board Computer system used as an information source and message posting system for a particular interest group.

Button An onscreen device used to open applications, select options, and to navigate within a hypertext environment.

Byte The number of bits required to store or represent one character of text (a letter or number); most commonly, but not always, made up of eight bits in various combinations of 0s and 1s.

Cable television A television distribution system consisting of a closed-circuit, usually wired, network for transmitting signals from an origination point (see *head end*) to members of the network. Typically, the origination point receives and retransmits broadcast programs, adding recorded programs and/or some live originations.

Carrel A partially enclosed booth that serves as a clearly identifiable enclosure for learning center activities.

Cassette A self-contained reel-to-reel magnetic tape system with the two reels permanently installed in a rugged plastic case.

CCD See *charge-coupled device.*

CCTV See *closed-circuit television.*

CD-ROM (Compact disc–read-only memory) Digitally encoded information permanently recorded on a

compact disc. Information can be accessed very quickly.

CD-R Compact disc–recordable. A compact disc on which the user may record information digitally one time and then access it many times.

CD-RW Compact disc–rewriteable. A compact disc on which the user may record information digitally many times and access it many times.

Charge-coupled device (CCD) A device that changes a pattern of different wavelengths into corresponding electrical charges.

Chat room Web or Internet subsites where users may "converse" in real time using their keyboards.

Closed-circuit television (CCTV) Any system of television that transmits signals through self-contained pathways (such as cable) rather than via broadcasting.

Cognitive domain The domain of human learning involving intellectual skills, such as assimilation of information or knowledge.

Cognitive psychology A branch of psychology devoted to the study of how individuals acquire, process, and use information.

Cognitivism A theory according to which mental processes mediate learning and learning entails the construction or reshaping of mental schemata.

Cold storage training Information or skills taught that may or may not be used in the future.

Compact disc (CD) A 4.72-inch disc on which a laser has recorded digital information.

Complementary colors Any two colors that lie directly opposite one another on the color wheel. Contrasted with *analogous colors.*

Compressed video Video images that have been processed to remove redundant information, thereby reducing the amount of bandwidth required to transmit them. Because only changes in the image are transmitted, movements appear jerky compared with full-motion video.

Computer-assisted instruction (CAI) Instruction delivered directly to learners by allowing them to interact with lessons programmed into the computer system.

Computer classroom A regular classroom furnished with one or more computers.

Computer hypermedia A computer hardware and software system that allows the composition and display of nonsequential documents that may include text, audio, and visual information and in which related information may be linked into webs by author or user.

Computer laboratory A room set apart from regular classrooms and furnished with multiple computers, usually established in schools that do not have computers in individual classrooms.

Computer-managed instruction (CMI) The use of a computer system to manage information about learner performance and learning resources and to then prescribe and control individual lessons.

Computer multimedia A computer hardware and software system for the composition and display of presentations that incorporate text, audio, and still and motion images.

Computer network An electronic connecting system that allows physically dispersed computers to share software, data, and peripheral devices.

Computer platform Different types of computer operating systems, such as *Mac OS, Unix,* or *Windows.*

Constructivism A theory that considers the engagement of students in meaningful experiences as the essence of learning.

Cooperative game A game in which the attainment of the goal requires cooperation rather than competition among the players.

Cooperative learning An instructional configuration involving small groups of learners working together on learning tasks rather than competing as individuals.

Copy board A device that makes a paper copy of what is written on a type of electronic whiteboard.

Copyright Regulations that describe the manner in which an original work can be used and copied. Copyright laws regulate the manner in which authors or artists can be reimbursed for their creative work.

Courseware Lessons delivered via computer, consisting of content conveyed according to an instructional design controlled by programmed software.

Criterion As part of a performance objective, the standard by which acceptable performance is judged; may include a time limit, accuracy tolerance, proportion of correct responses required, and/or qualitative standards.

Cross-training A method to train an individual worker to do several jobs and several workers to do the same job.

Cyberspace Informal name for the global computer network.

Database A collection of related information organized for quick access to specific items of information.

Debriefing Discussion conducted among simulation or game participants after play to elucidate what they have learned.

Desktop publishing Computer applications that allow a personal computer to generate typeset-quality text and graphics.

Desktop video Video production using a personal computer and low-cost video equipment.

Desktop video conferencing Real-time person-to-person or group interaction over a network using computers incorporating visual and auditory exchange.

Dichroic mirror A mirror coated so that only one color of the spectrum is reflected. In a video camera, three dichroic mirrors direct the three primary colors to three respective video tubes.

Digital Representation or storage of information by combinations of numbers (a series of 0s and 1s).

Digital camera Camera that uses a charge-coupled device as a recording medium in place of film, recording the image digitally.

Digital image An image that is not stored on film or processed like film, but rather stored on disk or on a computer using digital numbers to represent the image.

Digital recording A recording process in which analog information is encoded in binary form before being saved onto the recording medium.

Digital video Video recording technology that stores video images as strings of binary numbers.

Digital videodisc (DVD) A compact disc format for displaying motion video, often in the form of movies for home entertainment.

Digital video editing Taking apart and putting back together video segments using a computer and associated software.

Diorama A static display employing a flat background and three-dimensional foreground to achieve a lifelike effect.

Directional A visual device, such as an arrow, used to direct viewers' attention in a given direction or to a specific location.

Discovery method A teaching strategy that proceeds as follows: immersion in a real or contrived problem situation, development of hypotheses, testing of hypotheses, and arrival at conclusion (the main point).

Distance learning/education Any instructional situation in which learners are separated in time or space from the point of origination, characterized by limited access to the teacher and other learners.

Distance site A classroom connected remotely via a telecommunications system to a site where a teacher is present. See *origination classroom.*

Division of labor In economics, the reorganization of a job so that some tasks are performed by one person or system and other tasks are performed by others for purposes of increased efficiency or effectiveness.

Documentary A video program that deals with fact, not fiction or fictionalized versions of fact.

Document camera A video camera mounted on a copy stand to show documents, pictures, graphics, and real objects to groups.

Download To transfer programs and/or data files from a computer to another device or computer; to retrieve something from a network.

DVD See *digital videodisc.*

E-learning (electronic learning) Internet-based learning. Components can include content delivery in multiple formats, management of the learning experience, and a networked community of learners, content developers, and experts. E-learning provides faster learning at reduced costs, increased access to learning materials, and clear accountability for all participants in the learning process.

Electronic mail (e-mail) Transmission of private messages over a computer network; users can send mail to a single recipient or broadcast it to multiple users on the system.

Electrostatic film (xerography) A method of making overhead transparencies. Similar to the thermal process, this process requires specially treated film that is electrically charged and light sensitive.

Enactive experience Direct, firsthand experience.

Entry tests Assessments, both formal and informal, to determine if students possess desired identified prerequisites.

Exhibit A display incorporating various media formats (e.g., realia, still pictures, models, graphics) into an integral whole intended for instructional purposes.

Expert system A computer program, assembled by a team of content experts and programmers, that teaches learners how to solve complex tasks by applying the appropriate knowledge from the content area.

Extranet A network of intranets. See *intranet.*

Extrinsic motivator Factor unrelated to a task that stimulates someone to pursue the task. Contrasted with *intrinsic motivator.*

Fair use Basic criteria by which an educator may determine if it is appropriate to use copyrighted materials in a classroom setting.

Feedback In electronics, the regeneration of sound caused by a system's microphonic pickup of output from its own speakers, causing a ringing sound or squeal. In communication, signals sent from the destination back to the source that provide information about the reception of the original message.

Fiber optics A transmission medium using spun silicon shaped into threads as thin as human hair. It transmits more signals with higher quality than can metal cables.

Field trip An excursion outside the classroom to study real processes, people, and objects.

Figure–ground contrast The visual principle stating that dark figures show up best on light backgrounds and light figures show up best on dark backgrounds.

File server In local area networks, a station dedicated to providing file and mass data storage services to the other stations on the network.

Filmstrip A roll of 35mm film containing a series of related still pictures intended for showing one at a time in sequence.

Firewall Intranet software that prevents external users from accessing a proprietary network, while allowing internal users access to external networks.

Flip chart A pad of large paper fastened together at the top and mounted on an easel.

Focal length The distance from the focal point of a lens to a camera's film plane when the lens is focused at infinity.

Frame game Any game that lends its structure to a variety of subject matter.

Fresnel lens A flat glass or acrylic lens in which the curvature of a normal lens surface is collapsed into an almost flat plane, resulting in concentric circle forms impressed or engraved on the lens surface. Because of its low cost, light weight, and compactness, it is often used for the condenser lens in overhead projectors and in studio lights.

f/stop Term used in measuring a camera's lens opening. Larger f-numbers indicate smaller openings.

Game An activity in which participants follow prescribed rules that differ from those of reality as they strive to attain a challenging goal.

Gateway A computer that interconnects and makes translations between two different types of networks. Also called a *portal.*

Gb See *gigabyte.*

Geosynchronous satellite A communications satellite orbiting at a predetermined distance and traveling at such a speed that it appears to hover steadily over the same spot on earth.

Gigabyte (Gb) Approximately one million bytes, or 1,000 megabytes.

Goal A desired instructional outcome that is broad in scope and general with regard to criteria and performance indicators.

Graphics Two-dimensional, nonphotographic materials designed to communicate a specific message to the viewer.

Hard disk Metal disk covered with a magnetic recording material; the permanent storage device for a computer.

Hard technology The hardware, such as television, computers, and satellites, used as tools to provide instruction. Contrasted with *soft technology.*

Hardware The mechanical and electronic components that make up a computer; the physical equipment that makes up a computer system, and, by extension, the term that refers to any audiovisual equipment.

Head end The origination point of a cable television system.

Hearing A physiological process in which sound waves entering the outer ear are transmitted to the eardrum, converted into mechanical vibrations in the middle ear, and changed in the inner ear to nerve impulses that travel to the brain.

Hypermedia Software based on utilizing a hypertext environment for nonsequential access to data. See also *computer hypermedia.*

Hypertext A method of encoding data that enables the user to access continually a large information base whenever additional information on a subject is needed.

Hypertext Markup Language (HTML) The programming language that defines the format of a World Wide Web page. This relatively simple code can be purchased as software to streamline the creation of Web pages.

Hypertext transfer protocol (HTTP) The Web protocol that ensures compatibility before transferring information.

Iconic Any referent that resembles the thing it represents.

Iconic representation Pertaining to an image that resembles a real object.

Information superhighway Popular name given to the concept of an international information network of extremely high carrying capacity. Also refers specifically to the fiber-optic network being constructed in North America.

In-house video Video produced within one's own school or company.

Instruction Deliberate arrangement of experience(s) to help learners achieve a desirable change in performance; the management of learning, which in education and training is primarily the function of the instructor.

Instructional development The process of analyzing needs, determining what content must be mastered, establishing educational goals, designing materials to help reach the objectives, and trying out and revising the program according to learner achievement.

Instructional module A freestanding instructional unit, usually used for independent study. Typical components are rationale, objective, pretest, learning activities, self-test, and posttest.

Instructional television (ITV) Any planned use of video programs to meet specific instructional goals regardless of the source of the programs (including commercial broadcasts) or the setting in which they are used (including business and industry training).

Instructional Television Fixed Service (ITFS) A portion of the microwave frequency spectrum (2500–2690 MHz) reserved by law in the United States for educational use.

Integrated learning system (ILS) A set of interrelated computer-based lessons organized to match the curriculum of a school or training agency.

Intelligent agent A computer program or portion of a program that is used to assist the user to help organize information and facilitate ease of use.

Interactive media Media formats that allow or require some level of physical activity from the user, which in some ways alters the sequence of presentation.

Interactive video Computer-controlled video playback incorporating some method for users to control the sequence of presentation, typically by responding to multiple-choice questions.

Internet A worldwide system for linking smaller computer networks together, based on a packet system of information transfer and using a common set of communication standards.

Internet service provider An organization that provides access to the Internet.

Interpersonal domain The domain of learning that involves interaction among people and the ability to relate effectively with others.

Intranet Internal network for a company or school that cannot be accessed by external users.

Intrinsic motivator Factor directly related to a task that stimulates someone to pursue the task. Contrasted with *extrinsic motivator.*

Just-in-time training Instruction provided when the worker needs it, often at the workstation and not in a classroom.

Kb See *kilobyte.*

Keystone effect The distortion (usually creating a wide top and narrow bottom) of a projected image caused when the projector is not aligned at right angles to the screen.

Kilobyte (Kb or K) Approximately 1,000 bytes; more precisely, 1,024 bytes.

Lab pack Provides a number of simultaneous uses of computer software by licensing agreement.

LCD See *liquid crystal display.*

Learning A general term for a relatively lasting change in capability caused by experience; also, the process by which such change is brought about. See also *behaviorism* and *cognitivism* for different interpretations of learning.

Learning center A self-contained environment designed to promote individual or small-group learning around a specific task.

Learning style A cluster of psychological traits that determine how a person perceives, interacts with, and responds emotionally to learning environments.

Linear programming A format of programmed instruction in which the frames are arranged in a fixed, linear sequence.

Link An association between two (or more) nonsequential concepts. In hypermedia, a direct connection between two asynchronous items of data.

Liquid crystal display (LCD) A data display using a liquid crystal material encased between two transparent sheets. Liquid crystals have the properties of a liquid and a solid; a network of electrodes and polarizing filter creates a grid of pixels that open and close to pass or block light.

Listening A psychological process that begins with someone's awareness of and attention to sounds or speech patterns, proceeds through identification and recognition of specific auditory signals, and ends in comprehension.

Listserv A program that automatically sorts and distributes electronic messages over a computer network.

Local area network (LAN) A local system (typically within a building) connecting computers and peripheral devices into a network; may give access to external networks.

Low-cost learning technology An approach to formal education featuring systematic selection and implementation of a variety of managerial, instructional, motivational, and resource-utilization strategies to increase student learning outcomes while decreasing or maintaining recurrent educational costs.

Manipulative Object that can be viewed and handled in a learning setting.

Mb See *megabyte.*

Media format The physical form in which a message is incorporated and displayed. Examples include flip charts, photographic prints and slides, audio- and videotape, and computer multimedia.

Medium A means of communication. Derived from the Latin *medium* ("between"), the term refers to anything that carries information between a source and a receiver. Plural: *media.*

Megabyte (Mb or M) Basic unit of measurement of mass storage, equal to 1,048,576 bytes, or 1,024 kilobytes.

Method A procedure of instruction selected to help learners achieve their objective or to internalize a message.

Microwave transmission A television distribution system using the ultra-high

and super-high frequency ranges (2,000–13,000 MHz); includes ITFS in the United States (2,500–2,690 MHz).

Mock up Representation of a complex device or process.

Model A three-dimensional representation of a real object; it may be larger, smaller, or the same size as the thing represented.

Modem Acronym for *mo*dulator/*de*modulator. An electronic device that translates digital information to analog for transmission over telephone lines. A receiving modem translates the analog information back to digital.

Motivation An internal state that leads people to choose to pursue certain goals and experiences.

Motor skill domain The category of human learning that involves athletic, manual, and other physical action skills.

MP3 (MPEG Audio Layer 3) A format for compression of audio files to shrink them into more manageable size, especially when using the Internet.

Multi-image presentation Any visual presentation showing several images simultaneously, often using multiple screens.

Multimedia Sequential or simultaneous use of a variety of media formats in a given presentation or self-study program. See also *computer multimedia.*

Multimedia kit A collection of teaching-learning materials involving more than one type of medium and organized around a single topic.

Multipurpose board A board with a smooth white plastic surface used with special marking pens rather than chalk. The boards usually have a steel backing and can be used as a magnetic board for display of visuals; may also be used as a screen for projected visuals.

Narrowband A telecommunications channel that carries lower frequency signals; includes telephone frequencies of about 3,000 Hz and radio subcarrier signals of about 15,000 Hz.

Navigate To move about at will within a hypermedia environment by means of buttons and other onscreen devices.

Network A communication system linking two or more computers.

Newsgroup On computer networks, a discussion group created by allowing users to post messages and read messages among themselves.

Nonprojected visual Any visual teaching aid that does not require equipment to view or manipulate.

Objective A statement of the new capability that is intended to result from instruction.

Optical disc A type of disc storage device that records and reproduces digital information using a laser beam, e.g., CD and DVD.

Optical spacing Spacing typographical elements so that they appear evenly separated, regardless of their true measured distance.

Oral history Historical documentation of a time, place, or event by means of recording the spoken recollections of participants in those events.

Origination classroom Site where teacher is located when providing distance learning via a telecommunications system. See *distance site.*

Overhead projection Projection by means of a device that produces an image on a screen by transmitting light through transparent acetate or a similar medium on the stage of the projector. The lens and mirror arrangement in an elevated housing creates a bright projected image over the head or shoulder of the operator.

Overlay One or more additional transparent sheets with lettering or other information that can be placed over a base transparency.

Performance objective A statement of the new capability the learner should possess at the completion of instruction. A well-stated objective names the intended audience, then specifies (1) the performance or capability to be learned, (2) the conditions under which the performance is to be demonstrated, and (3) the criterion or standard of acceptable performance.

Performance support system A variety of online aids both to improve current job performance and to plan future training needs.

Persistence of vision The psychophysiological phenomenon that occurs when an image falls on the retina of the eye and is conveyed to the brain via the optic nerve. The brain continues to "see" the image for a fraction of a second after the image is cut off.

Personalized System of Instruction (PSI) A process technology for managing instruction that puts reinforcement theory into action as the overall framework for a whole course. Students work individually at their own pace using a variety of instructional materials. The materials are arranged in sequential order, and the student must show mastery of each unit before moving on to the next.

Photo CD A collection of digitized photographs stored on a CD-ROM.

Portal See *gateway.*

Portfolio An integrated collection of student work including a variety of media to demonstrate progress and accomplishments.

Practice Learner participation that increases the probability of learning.

Preinstructional strategies See *advance organizer.*

Prerequisites Competencies that learners must possess to benefit from instruction.

Presentation graphics software Computer software to create attractive graphic displays without specialized production skills.

Problem-based instruction High-fidelity, learner-centered, inquiry-based instruction based on real situations.

Programmed instruction A method of presenting instructional material printed in small bits or frames, each of which includes an item of information (prompt), a sentence to be completed or a question to be answered (response), and the correct answer (reinforcement).

Programmed teaching A process technology for learning involving scripted presentations, small-group instruction, unison responding by learners, cues given by the teacher, rapid pacing, and reinforcement and correction procedures.

Programmed tutoring A one-to-one process technology in which the decisions to be made by the tutor are "programmed" in advance by means of carefully structured printed instructions.

Projected visuals Media formats in which still images are projected onto a screen.

Proximity Visual principle in which viewers assume that items placed close together are related, and those placed farther apart are unrelated.

RAM See *random access memory.*

Random access memory (RAM) The flexible part of computer memory. The particular program or set of data being manipulated by the user is temporarily stored in RAM, then erased to make way for the next program.

Read-only memory (ROM) Control instructions that have been "wired" permanently into the memory of a computer. Usually stores instructions that the computer will need constantly,

such as the programming language(s) and internal monitoring functions.

Real object Not a model or simulation but an example of an actual object used in instruction.

Referent That which is referred to.

Reform See *restructuring.*

Removable-storage device High-capacity portable computer storage disks such as SyQuest, Zip®, and Jaz®.

Restructuring Approaches to change the framework of education incorporating the redesign of programs, staffing, and even facilities. Also referred to as *reform.*

Role play A simulation in which the dominant feature is relatively open-ended interaction among people.

ROM See *read-only memory.*

Rule of thirds A principle of photographic and graphic composition in which an area is divided into thirds both vertically and horizontally and the centers of interest are located near the intersections of the lines.

Sans serif Typeface style with no ornamentation on either ascenders or descenders, such as Helvetica.

Scanner A computer device that converts an image on a piece of paper into an electronic form that can be stored in a computer file.

Scenario Literally, a written description of the plot of a play. In simulation and game design, it refers to a description of the setting and events to be represented in a simulation.

Schema Mental structure by which individuals organize their perceptions of the environment. Plural: *schemata.*

Script A set of user-defined commands used to create or navigate within a hypertext environment.

Search engine A program that identifies Internet sites that contain user-identified keywords or phrases.

Showmanship Techniques that an instructor can use to direct and hold attention during presentations.

Shutter The mechanical device that controls the length of time light enters the camera and reaches the film plane.

Simulation An abstraction or simplification of some real-life situation or process.

Simulation game An instructional format that combines the attributes of simulation (role playing, model of reality) with the attributes of a game (striving toward a goal, specific rules).

Simulator A device that represents a real physical system in a scaled-down form; it allows users to experience the salient aspects of the real-life process.

Site license Provides unlimited use of software at specified locations by licensing agreement.

Slide A small-format (e.g., 35mm) photographic transparency individually mounted for one-at-a-time projection.

Slow motion A film technique that expands time by photographing rapid events at high speeds (many exposures per second) and then projecting the film at normal speed.

Social psychology The study of the effects of the social organization of the classroom on learning.

Soft technology Techniques and methods that form psychological and social frameworks for learning, as opposed to the hardware used to deliver instruction; an example is Keller's Personalized System of Instruction.

Software Computer program control instructions and accompanying documentation; stored on disks or tapes when not being used in the computer. By extension, the term refers to any audiovisual materials.

Spreadsheet Computer software that allows users to manipulate data and generate reports and charts.

Star Schools A program initiated in the United States by the Department of Education to promote instructional networks providing distance education for elementary and secondary schools.

Storyboarding An audiovisual production and planning technique in which sketches of the proposed visuals and verbal messages are put on individual cards or into a computer program; the items are then arranged into the desired sequence on a display surface.

Streaming video A video file downloaded from the Internet that starts playing before it is completely downloaded.

Study print A photographic enlargement printed in a durable form for individual or group examination.

Symbolic representation Pertaining to use of letters, numbers, and words to present information.

Synchronous At the same time.

Tb See *terabyte.*

Technology (1) A process of devising reliable and repeatable solutions to tasks. (2) The hardware and software (i.e., the product) that result from the application of technological processes. (3) A mix of process and product, used in instances where the context refers to the combination of technological processes and resultant products or where the process is inseparable from the product.

Technology for learning An application of technology to aid the learning process; may refer to either "hard" technologies (communications media) or "soft" technologies (processes or procedures that follow a technological approach).

Telecommunications A means for communicating over a distance; specifically, any arrangement for transmitting voice and data in the form of coded signals through an electronic medium.

Telecommuting A method allowing people to "commute" to work from their homes through computers and telecommunications technology.

Teleconference A communications configuration using electronic transmission technologies (audio and/or video) to hold live meetings among geographically dispersed people.

Teleconference, audio A live, two-way voice conversation among groups at different locations via telephone lines or satellites.

Teleconference, video A live, two-way communications arrangement connecting groups at different locations via telephone lines or satellites; voice is transmitted both ways, and video distribution may be either one-way or two-way.

Telelecture An instructional technique in which an individual, typically a content specialist or well-known authority, addresses a group listening by means of a telephone amplifier. The listeners may ask questions of the resource person, with the entire group able to hear the response.

Teletraining The process of using teleconferences for instructional purposes.

Television The system of transmitting moving pictures and sound electronically, either through the air or through wires, and displaying the images on a cathode-ray tube.

Telework A method in which employees work away from the office using telecommunications and computers to exchange information with the worksite.

Template A pattern used as a guide in making accurate replications of some-

thing. In computers, a ready-to-use permanent document set up with a basic layout, commands, and formulas.

Terabyte (Tb) Approximately one million megabytes.

Thumb spot A mark on a slide to assist in placing it correctly in the slide tray.

Time lapse A video technique that compresses the time that it takes for an event to occur. A long process is photographed frame by frame, at intervals, and then projected at normal speed.

Total Quality Management (TQM) Efficiency engineering system that measures to a high degree of accuracy the business impact of all expenditures.

Transparency The large-format (typically 8 by 10 inches) film used with the overhead projector.

Two-by-six rule A general rule of thumb for determining screen size: no viewer should be seated closer to the screen than two screen widths or farther away than six screen widths.

Uniform resource locator (URL) The address for an Internet site or World Wide Web page containing the protocol type, the domain, the directory, and the name of the site or page.

Upload To send a file from a computer system to a network.

Verbalism A term to describe the parroting of words without demonstrating understanding.

Video The storage of visuals and their display on a television-type screen.

Videocassette recorder (VCR) A device that records and plays back video images and sound on magnetic tape stored in a cassette.

Video teleconference A teleconference involving a television-type picture as well as voice transmission. The video image may be freeze-frame or full-motion video.

Viewfinder Viewing device on a camera that lets you see approximately what the film will record.

Virtual field trip A type of field trip in which the students do not leave the classroom setting, instead they use media to provide the experience of "being there."

Virtual reality A computer-controlled environment in which users experience multisensory immersion and interact with certain phenomena as they would in the physical world.

Virtual time Not in real time, not simultaneous.

Visual Any teaching aid whose primary mode of apprehension is optical.

Visual literacy The learned ability to interpret visual messages accurately and to create such messages.

Web See *World Wide Web.*

WebQuest A set of steps that provide guidance when seeking information about a specific topic.

Website A collection of web pages available on the Internet that provide information about products, services, events, materials, etc.

Wide area network (WAN) A communications network that covers a large geographic area, such as a state or country.

World Wide Web (the Web) A graphical environment on computer networks that allows you to access, view, and maintain documents that can include text, data, sound, and video.

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