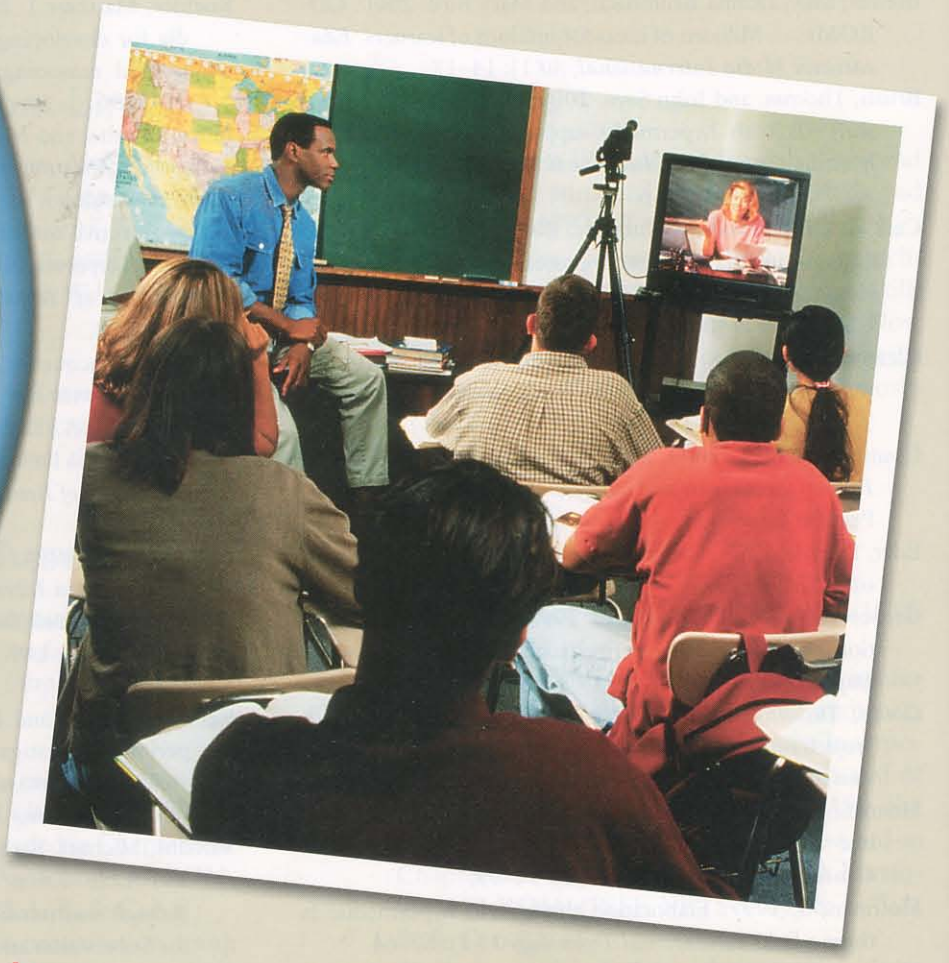
CHAPTER 7

Distance Education



Outline

Distance Education
Distance Education Roles
Instructional Communication Functions
Broadcast Radio
Audio Teleconference
Audiographic Teleconference
Television in Distance Education
Online Technologies

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 telecommunication systems and describe how they facilitate distance learning.
4. Compare the advantages and limitations of each of the types of telecommunications systems described in this chapter.
5. Distinguish between the delivery systems for one-way and two-way television on the basis of their communication capabilities.
6. Create an example of an educational application that incorporates two or more telecommunication delivery systems.
7. Describe an instructional application that would be appropriate for teleconferencing in elementary, secondary, postsecondary, or informal education.
8. Describe the functions performed by a classroom teacher in a distance education setting.

Professional Vocabulary

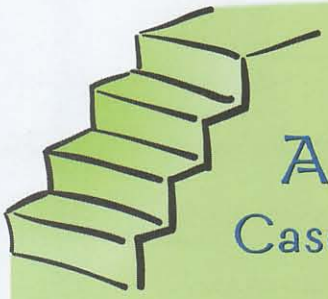
distance education
telecommunications
Star Schools
origination classroom
distance site
audio teleconference
audiographic teleconference
instructional television fixed service (ITFS)
closed-circuit television (CCTV)
compressed video

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 it 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 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. But 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. This chapter introduces the concepts of distance education and distance learning as well as providing information about audio and video telecommunication delivery systems. Chapter 8, "Online Learning," will focus on computer-based distance education.

Distance Education

Distance education has become the popular term to describe learning via telecommunications. In this chapter the term **telecommunications** embraces a variety of media configurations, including radio, telephone, and television (broadcast, wired, and satellite). What they all have in common is implied in the Greek root word *tele,* which means "at a distance"



ASSURE Case Challenge

We have developed a case study for this chapter to help you see how computers can be integrated into learning activities. At the end of the chapter you will be challenged to develop your own ASSURE lesson for a case study of your choice using the ASSURE model and incorporating the technology and media described in this chapter. To help you in preparing your lesson, we have included hints (called "ASSURE Case Connections") throughout the chapter as they relate to the ASSURE Case Challenge.

Three high school science teachers have decided to work collaboratively in teaching a unit on space exploration. They wish to expand the learning opportunities for their students by having them work together collaboratively at a distance.

The schools are located in similar communities, although they are too far apart to bring the students together except by using a telecommunications system. There are many similarities among the high schools and the students. Neither the students nor the teachers have had much experience using telecommunications prior to this unit, but are eager to learn. They hope that a successful demonstration with this unit will open the door to expanded collaborative learning opportunities in the future.

or "far off"; that is, they are systems for communicating over a distance. We will examine in Chapter 8 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
- Organized instructional program
- Telecommunications 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, programs are distributed by a combination of broadcast, wired, or satellite-relayed transmissions, and students respond through some combination of mail, fax, telephone, or computer transmissions (Figure 7.1).

Familiarity with these alternative pathways to learning is essential to today's educators. As early as 1989 the U.S. Office of Technology Assessment recognized that advances in technology will affect education.

Technologies for learning at a distance, while reaching a small but growing number of teachers today, will clearly affect the teaching force of tomorrow. Some will teach on these systems, others will use them to provide additional resources in their classrooms, and many will receive professional education and training over them. Few will be unaffected (U.S. Congress, Office of Technology Assessment, 1989).

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 *Clifford;* at the intermediate levels, *Reading Rainbow, Between the Lions, Arthur,* and *ZOOM.* These programs are used mainly as enrichment rather than as the core of instruction (Figure 7.2). Teachers who use educational television programming tend to use more

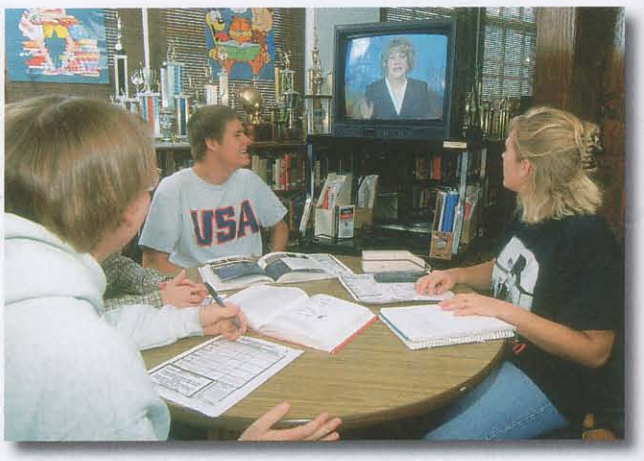


Figure 7.1
The proliferation of telecommunications makes information accessible at more and more locations, such as libraries.

Figure 7.2
Big Bird is a main character on Sesame Street, *which after more than 30 years is still the most recognized educational program for children.*

than one program (usually two or three), but not a whole series (Children's Television Workshop, 1990).

Secondary Education

At the secondary level, television is used mainly to expand the curricular offerings of a specific high school. Rural schools are 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 provide core instruction.

Distance learning at the P–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 opportunities 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 or 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.

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

The opportunities offered through such projects as StarNet and IDEA 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 camera-equipped classroom.

The fastest growing application, though, is for reaching off-campus audiences with college or university 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 2000. 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 8), 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 component of these and most other distance education programs. Virtual campuses, like the University of Phoenix, allow students to enroll in programs of study without having to attend classes on a centralized campus setting.

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 delivered by 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").

Distance Education Roles

Role of the Student

Students need to understand their roles in a distance education experience. Early attempts at this type of instruction tended to involve an instructor who only lectured with students passively sitting in the distance sites, often not attending to the instructor's "talking head." 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 organize the lessons to encourage interactivity and 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 the 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 education classroom, it is necessary to think about the setting in a new light. The classroom is now a *series* of "rooms," connected electronically. In a television environment the **origination classroom** is the one where the teacher is present. **Distance sites** or remote classrooms

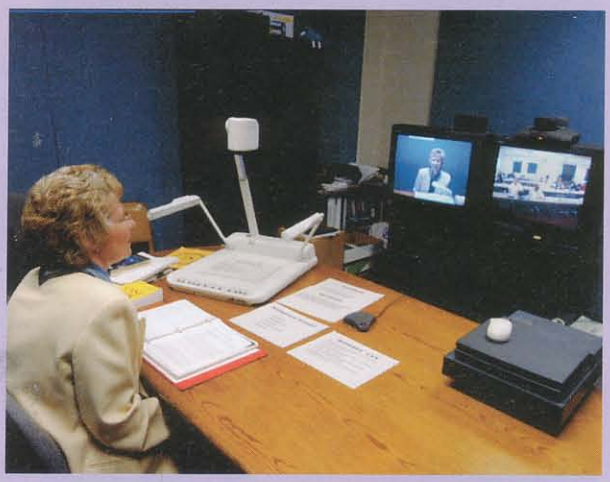
Close-Up

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.

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 P–12 education, student success increases when the teacher and the distance-site facilitator work as a team. Students learn more in cases where the distance-site facilitator does the following:

- Watch and participate actively in all programs with the students
- Encourage interaction with the teacher and other students
- Answer questions at that site
- Solve immediate problems
- Provide additional quizzes and worksheets
- Take 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 course starts 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 environment, the teacher's role may shift to that of facilitator of the learning rather than directly leading the class. With online education, the teacher must ensure that all students clearly understand their responsibilities and how to conduct themselves in the class. Further, the teacher must keep a "watchful eye" on the class to be sure no one is falling behind. So, in addition to facilitating the learning, the teacher becomes the classroom monitor as well. Many teachers will tell you that teaching online is not easier; it is often perceived as much more time consuming.

Role of Technology

With technologies for distance learning that rely on television, the teacher may need to change existing teaching materials (Figure 7.3). Students benefit from visuals

Figure 7.3
Videoconferencing systems can be designed so that the teacher can select the image to be shown with a single mouse click.

that are included in the instructional experience. Visuals used in other types of instructional settings may need to be adapted to use in a distance education classroom. The document camera 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, 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. Contrast is an issue when trying to display detail.

In an online environment, visuals can be brought into documents as well as provided by links to certain pages or sites. Scanned images, digital photos, and other types of digitized visuals can become an integral part of the materials students use in their learning experience (Figure 7.4).

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 7.5):

- *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–teacher interaction.* We know that most learning takes place when learners are participating actively—mentally processing the material. Teachers attempt 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 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 systems, CD-ROM)
  - Computer databases (e.g., for online searches)

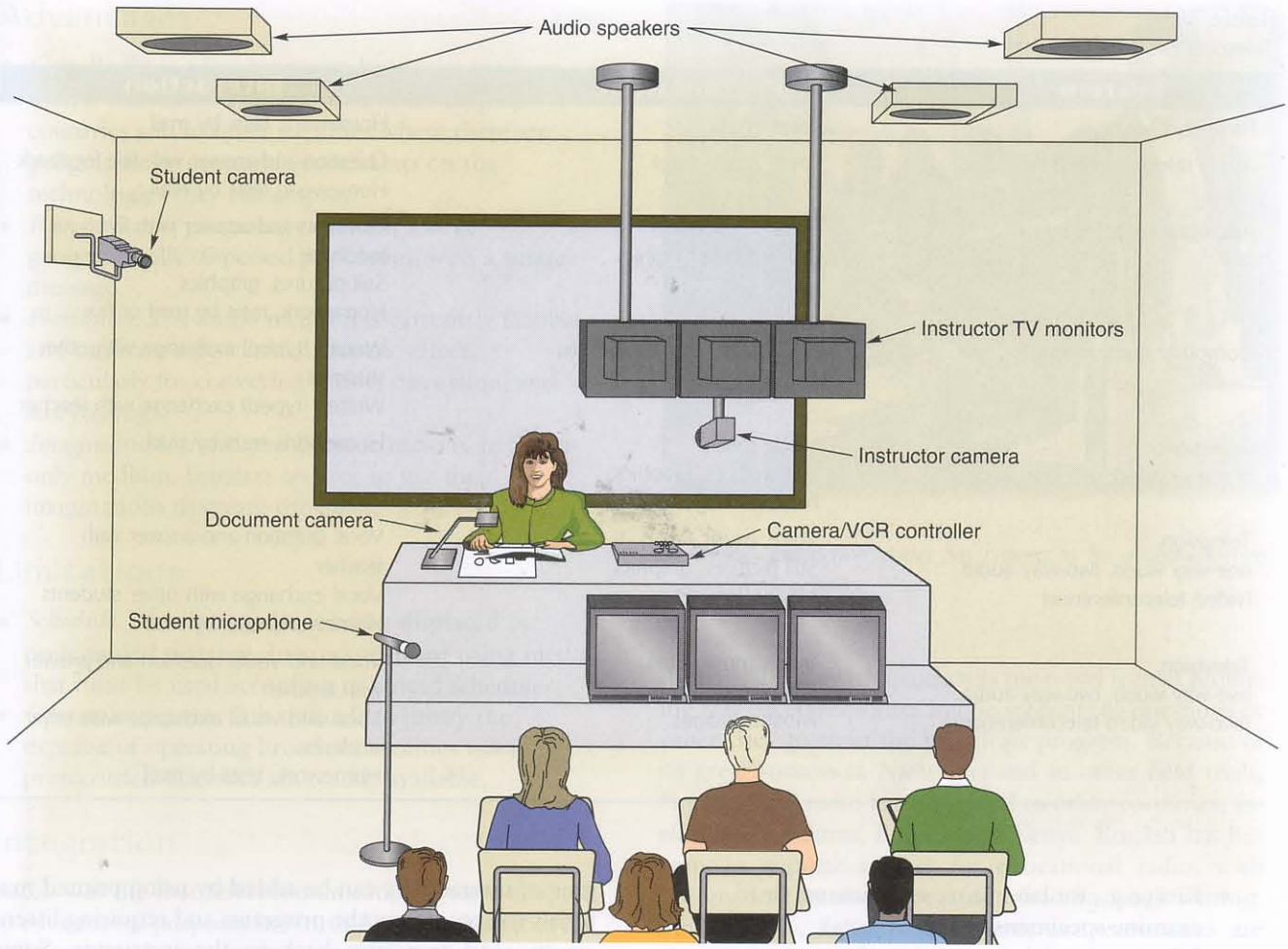


Figure 7.4

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.

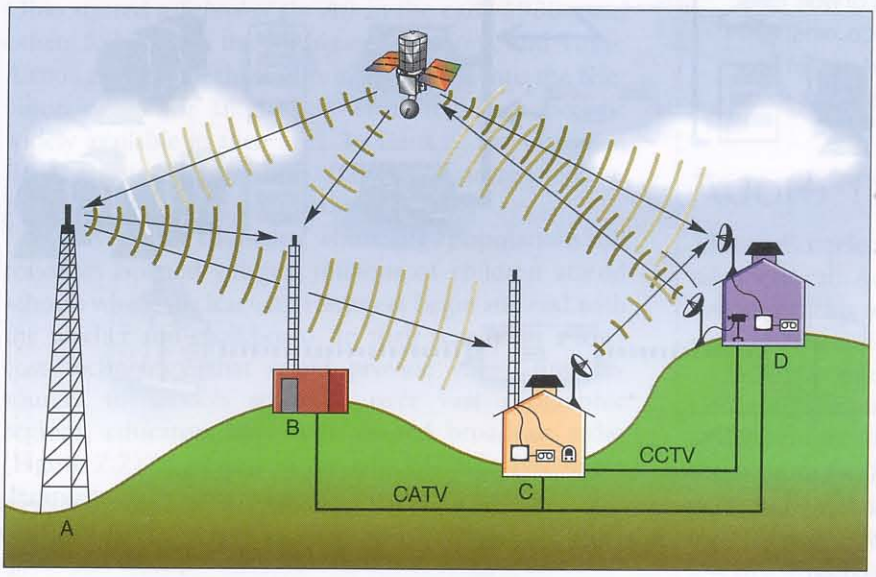


Figure 7.5

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 7.1
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

- Kits (e.g., for laboratory experiments or to examine specimens of 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 7.1 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 7.6. 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 instructor. Some programs provide a telephone number for the students to contact the instructor.

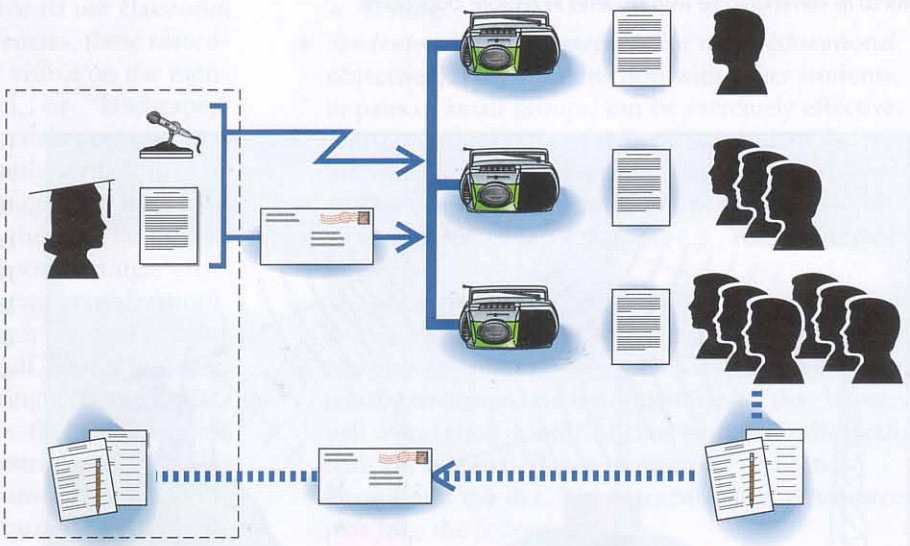


Figure 7.6
Broadcast radio. A degree of interaction can be added by sending print materials to students through the mail; they can, in turn, send written work back to the teacher for correction and evaluation.

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 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 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 P–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.

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 7.7). A project in the late 1970s in Nicaragua demonstrated success in providing mathematics lessons over the radio. Lessons were designed with embedded questions and prerecorded feedback to learners' responses. 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 are also taught by radio.

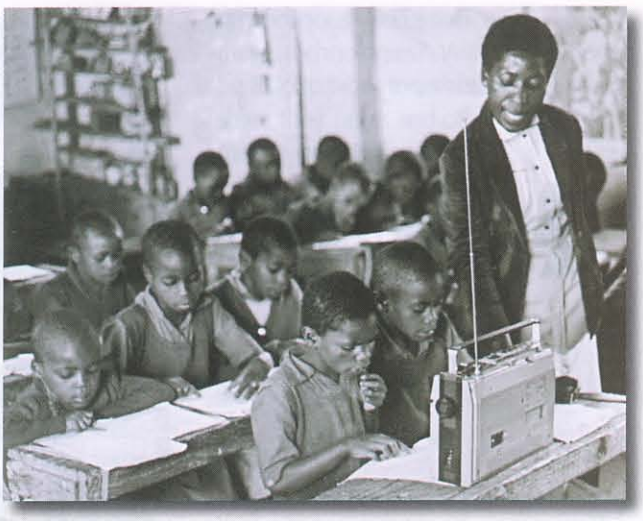


Figure 7.7
In Kenya, "interactive" radio has proved to be a cost-effective method for teaching.

ASSURE Case Connection

Radio is a viable option for a one-way delivery of information. Since the science teachers wish to have their students engage in interaction, they will have to consider how to arrange for the interactions. Could they use the radio option to deliver portions of the instruction and rely on telephone connections to have the students work together?

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 7.8).

An audio teleconference—a live, two-way conversation using telephone lines or satellites—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, a special microphone-amplifier

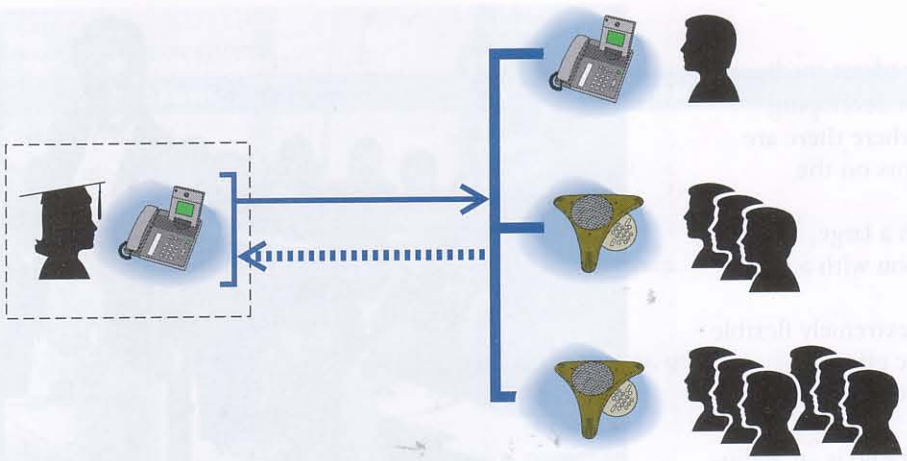


Figure 7.8
Audio teleconference. Interaction takes place through the telephone system; groups of listeners use speakerphones.

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.* Schools can invite an expert into the classroom to engage in a dialog with students. 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.
- *Easy to use.* It is the most easily accessible form of telecommunications because it uses telephone service. Commercial phone companies have made it easy to set up audio teleconferences from any phone.
- *Interactive.* All participants get the same message—and interactivity. They can talk to the instructor or to the other learners.

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 postsecondary 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.

Audiographic Teleconference

An **audiographic teleconference** adds still picture transmission to an audio teleconference (Figure 7.9). 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 8 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.* Hardware and software 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.

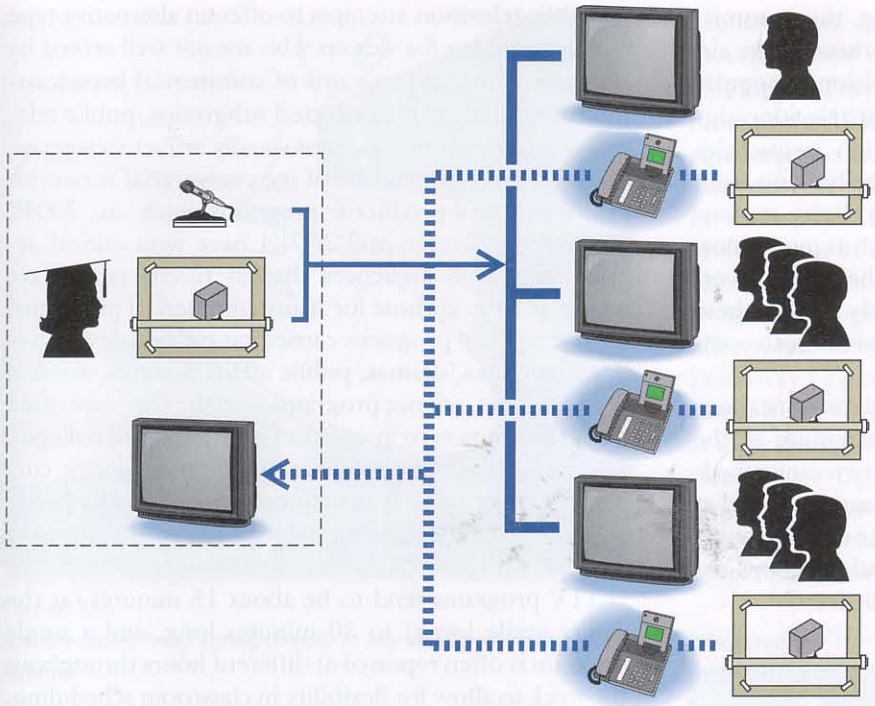


Figure 7.9
Audiographic teleconference. In addition to hearing each other, participants can see visuals sent to a TV set one frame at a time via a graphics tablet or slow-scan video.

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. Online electronic whiteboards are quickly replacing the audiographic format.

Assure Case Connection

Would a teleconferencing option be reasonable for the science teachers to consider? Can the instruction be delivered using audio and visuals, along with having synchronous discussion using any of these technologies? Will the students be able to work together so they could share their notes and other visual information quickly and easily?

Television in Distance Education

One-Way Video, One-Way Audio

Of all the uses of television in education, the viewing of prerecorded videocassettes is the most common (we discuss this application in Chapter 12). Here we will consider the next most common form of television use—live viewing of programs without direct feedback to the presenter.

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 7.10). This includes five principal types of delivery systems: broadcast, satellite, microwave, closed-circuit, and cable or fiber optics.

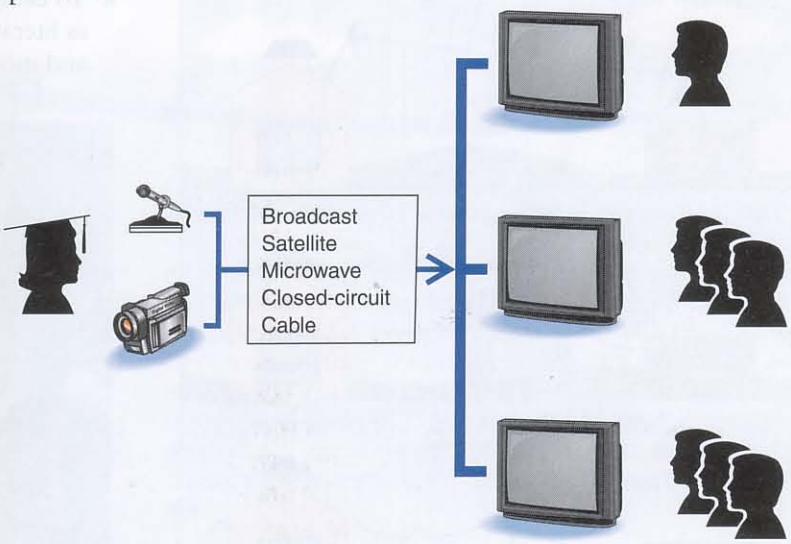


Figure 7.10
Television—one-way video, one-way audio. One-way television, such as broadcast, has no provision for immediate feedback to the source.

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 7.11). 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.

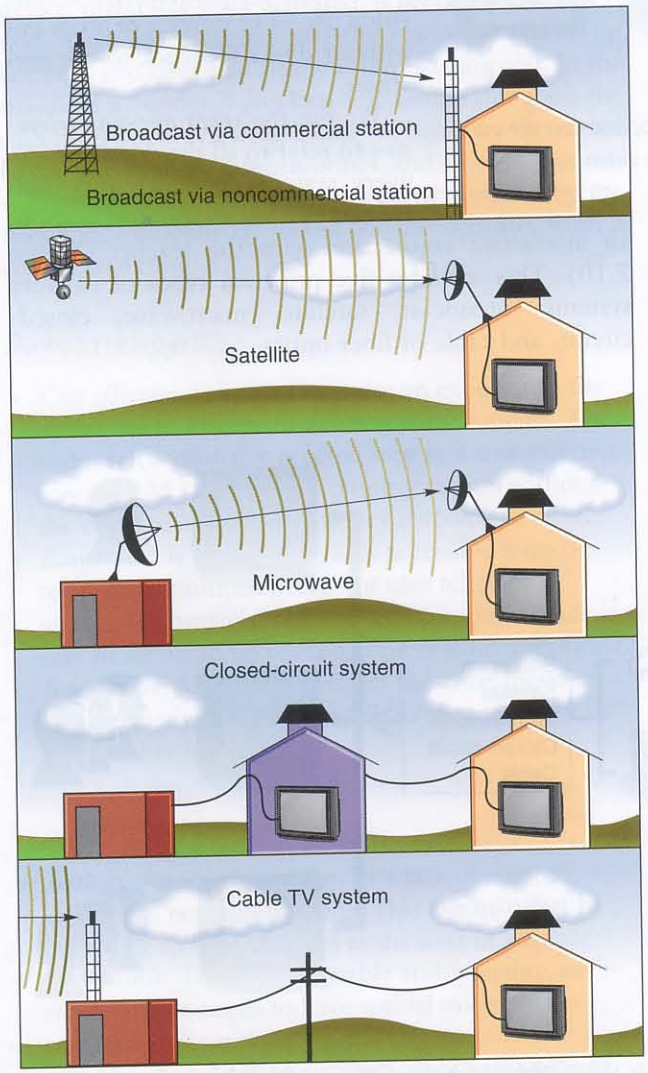


Figure 7.11
One-way video distribution systems.

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 *NOW, 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—instructional television (ITV)—are a mainstay of most public television stations' daytime schedules (Figure 7.12).

ITV 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 ITV programs usually do not present core instruction in basic subject areas. One leading researcher (Rockman, 1976) described ITV's role this way:

- 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

Figure 7.12
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 7.13
Satellite dishes bring signals directly to any setting, no matter how remote.

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 7.13). 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 international telephone calls as well as 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"). Both Channel One and Discovery have resources on the Web for students and for teachers. Similarly, many public broadcast programs have Web resources.

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

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.

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.

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, many states, such as Indiana, Iowa, and South Dakota, 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 7.14). 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

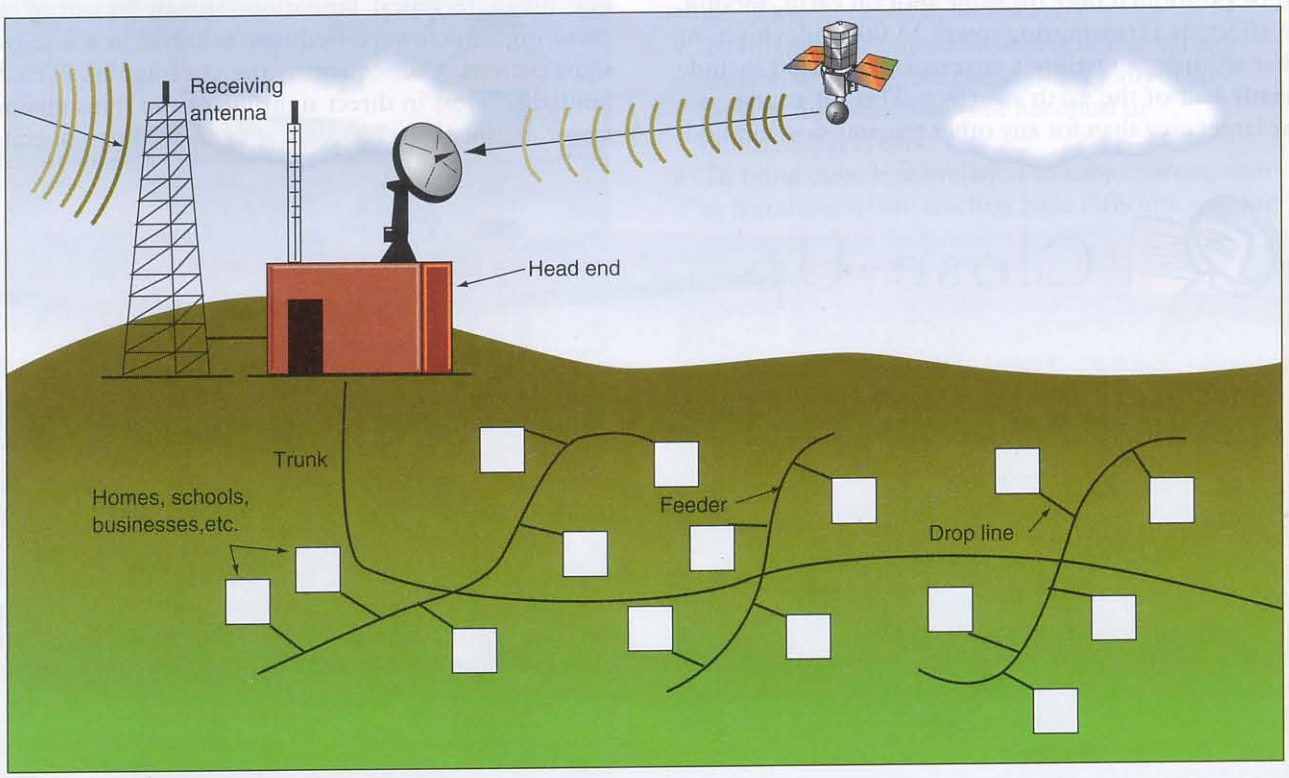


Figure 7.14
Cable television distribution system. Multiple program sources are combined at the "head end" and distributed through trunks, feeders, and drop lines to individual homes, schools, and businesses.

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 now 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 logistic struggle often associated with instructional media use

Furthermore, many cable operators provide schools with special programming, teachers' 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 Network, and C-Span are a few examples, all of which 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 7.15). 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 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.

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 replacing cables with space-saving optical fibers. 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.

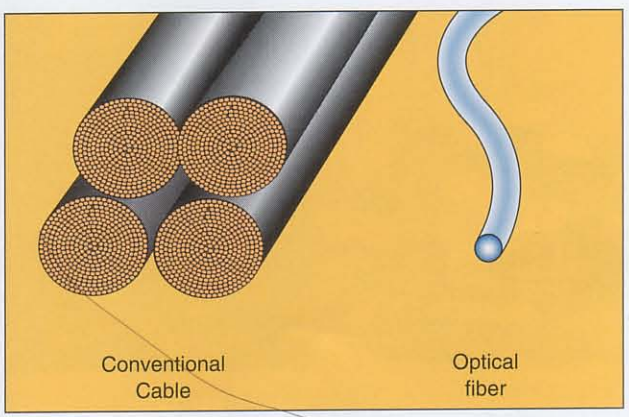


Figure 7.15
A single optical fiber can transmit as many messages as more than one hundred copper wires.

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 feedback 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 7.16).

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 particular occasions.

Many two-way video, two-way audio systems rely on full-motion video pictures (Figure 7.17). Technically, it is much more difficult and expensive to transmit a full-motion video image than a still picture. 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 gaining popularity rapidly wherever two-way television is being used. (See "Close-Up: School–University Co-

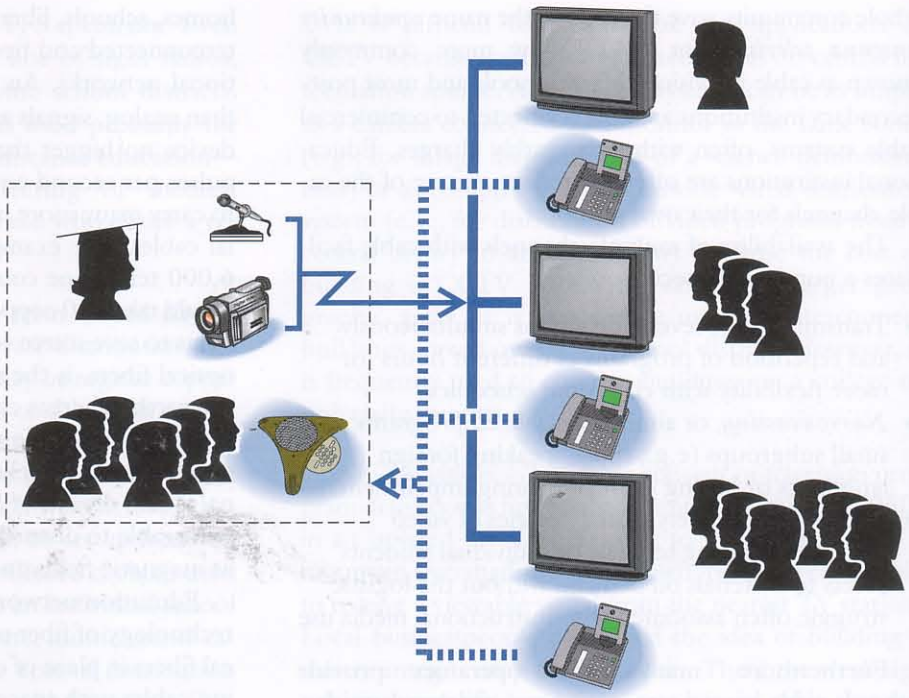


Figure 7.16
Television—one-way video, two-way audio. This is probably the most widely used and most economical means of adding immediate interactivity to instructional TV.

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: Rhondo S. Robinson, professor, Northern Illinois University, De Kalb, IL.

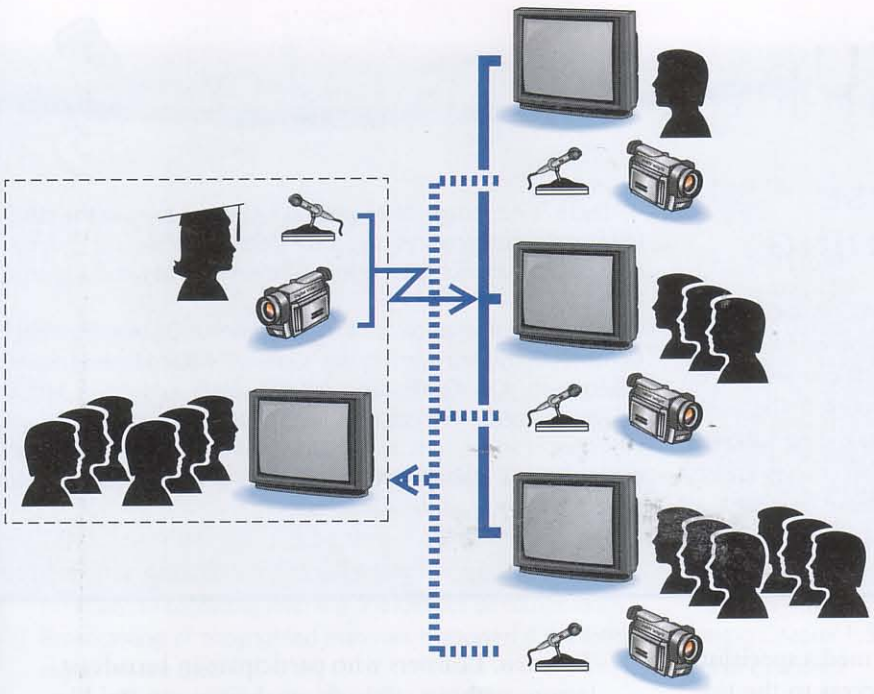


Figure 7.17
Television—two-way video, two-way audio. Full auditory and visual interactivity requires a camera and microphone at each reception site.

operation Through Compressed Video.") Compressed video is also used for computer desktop video (see Chapter 8).

Online Technologies

Online technologies (those that rely on computer-based systems) have opened up an 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 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 or text-based chat, can post to bulletin board discussions, and can access information related to coursework right from the computer. (This type of learning experience is the subject of Chapter 8.)

Accessing Resources at a Distance

One element often overlooked in a distance learning situation is the access students have to resource materials. 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

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.

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 modern; 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 7 of the Companion Website (http://www.prenhall.com/smaldino).

working closely with the school library media specialist, to ensure that all students have equal access to the materials essential for learning. While the World Wide Web has 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. Your school library media specialist will be aware of the copyright issues and will be able to help you 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 possible, 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.
- *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 accessing certain types of online connections due to their access to the Internet.

ASSURE Case Connection

A statewide interactive television system is available and the science teachers can schedule it at times that are compatible with their classes. Options for delivering visuals include faxing and the Internet. Will the use of such a system make it possible for the teachers to work collaboratively to develop and deliver the instruction? Will the students be able to work together on their assignments?

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.