13. DISTANCE EDUCATION

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13.1   INTRODUCTION*

Distance education, structured learning in which the student and instructor are separated by time and place, is currently the fastest growing form of domestic and international education. What was once considered a special form of education using nontraditional delivery systems is now becoming an important concept in mainstream education.

Due to the rapid development of technology, courses using a variety of media are being delivered to students in various locations in an effort to serve the educational needs of growing populations. In many cases, developments in technology allow distance education programs to provide specialized courses to students in remote geographic areas with increasing interactivity between student and teacher. Although the ways in which distance education is implemented differ markedly from country to country, most distance learning programs rely on technologies that are either already in place or are being considered for their cost effectiveness. Such programs are particularly beneficial for the many people who are not financially, physically, or geographically able to obtain traditional education.

Distance education has experienced dramatic growth both nationally and internationally since the early 1980s. It has evolved from early correspondence education using primarily print-based materials into a worldwide movement using various technologies. The goals of distance education, as an alternative to traditional education, have been to offer degree-granting programs, to battle illiteracy in developing countries, to provide training opportunities for economic growth, and to offer curriculum enrichment in nontraditional educational settings. A variety of technologies have been used as delivery systems to facilitate this learning at a distance.

In order to understand how research and research issues have developed in distance education, it is necessary to understand the context of the field. Distance education relies heavily on technologies of delivery. Print materials (see Chapter 27), broadcast radio (see Chapter 28, 16.1), broadcast television (see 11.7), computer conferencing (see Chapter 13), e-mail, interactive video, satellite telecommunications, and multimedia computer technology (see 24.6) are all used to promote student-teacher interaction and provide necessary feedback to the learner at a distance. Because technologies as delivery systems have been so crucial to the growth of distance education, research has reflected rather than driven practice. Research in distance education has focused on media comparison studies (see *39.5.4),* descriptive studies (see Chapter 41), and evaluation reports. Researchers have examined those issues that have been of particular interest to administrators of distance education programs, such as, student attrition rates, the design of instructional materials for large-scale distribution, the appropriateness of certain technologies for delivery of instruction, and the cost effectiveness of programs.

However, recent developments in interactive multimedia technologies that promise to facilitate "individualized" and "collaborative" learning (see Chapter 35) are blurring the distinctions between distance and traditional education. These technologies also have the capability of creating such new environments for learning as "virtual communities." Students in traditional settings are being given entire courses on CD-ROM multimedia disks through which they progress at their own pace, interacting with the instructor and other students on electronic mail or face-to-face according to their needs (Technology Based Learning, 1994). Through international collaboration, students around the world participate in cooperative learning activities, sharing information through the use of computer networks (Riel, 1993). In such cases, global classrooms may have participants from various countries interacting with each other at a distance. Many mediated educational activities allow students to participate in collaborative, authentic, situated learning activities (Brown & Palincsar, 1989; Brown, Collins & Duguid, 1989). In fact, the explosion of information technologies has brought learners together by erasing the boundaries of time and place for both site-based and distance learners.

Research in distance education reflects the rapid technological changes in this field. Although early research was centered around media comparison studies (see 39.5.4), educators have recently become more interested in examining how the attributes of different media promote the construc-

tion of knowledge (Salomon, Perkins & Globerson, 1991). It is within the theoretical framework of knowledge construction and expert systems (Glaser, 1992) that some of the most promising research on mediated learning appears (Barrett, 1992; Harasim, 1993; Salomon, 1993).

This chapter traces the history of the distance education movement, discusses the definitions and theoretical principles that have marked the development of the field, and explores the research in this field which is inextricably tied to the technology of course delivery. A critical analysis of current research (1988—1993) in distance education was conducted for this chapter. Material for the analysis came from four primary data sources. The first source was an ERIC search, which resulted in over 900 entries. This largely North American review was supplemented with international studies located in the International Centre for Distance Learning (ICDL) database. The entries were then categorized according to content and source. Second, conference papers were reviewed which represented current, completed work in the field of distance education. Third, dissertations were obtained from universities which produced the majority of doctoral dissertations in Educational Technology doctoral programs. Finally, four journals were chosen for further examination because of their recurrent frequency in the ERIC listing. Those journals were *Open Learning, American Journal of Distance Education, Research in Distance Education,* and *Distance Education.*

13.2   HISTORY OF DISTANCE EDUCATION

Distance education is not a new concept. In the late 1 800s, at the University of Chicago, the first major correspondence program in the United States was established in which the teacher and learner were at different locations. Before that time, particularly in preindustrial Europe, education had been available primarily to males in higher levels of society. The most effective form of instruction in those days was to bring students together in one place and one time to learn from one of the masters. That form of traditional educational remains the dominant model of learning today. The early efforts of educators like William Rainey Harper in 1890 to establish alternatives were laughed at. Correspondence study, which was designed to provide educational opportunities for those who were not among the elite and who could not afford full-time residence at an educational institution, was looked down on as inferior education. Many educators regarded correspondence courses as simply business operations. Correspondence education offended the elitist and extremely undemocratic educational system that characterized the early years in this country (Pittman, 1991). Indeed, many correspondence courses were viewed as simply poor excuses for the real thing. However, the need to provide equal access to educational opportunities has always been part of our democratic ideals, so correspondence study took a new turn.

As radio developed during the First World War and television in the 1950s (see 11.2.3), instruction outside of the traditional classroom had suddenly found new delivery systems. There are many examples of how early radio and television were used in schools to deliver instruction at a distance. Wisconsin's School of the Air was an early effort, in the 1920s, to affirm that the boundaries of the school were the boundaries of the state. More recently, audio and computer teleconferencing have influenced the delivery of instruction in public schools, higher education, the military, business, and industry. Following the establishment of the Open University in Britain in 1970, and Charles Wedemeyer's innovative uses of media in 1986 at the University of Wisconsin, correspondence study began to use developing technologies to provide more effective distance education.

13.2.1 Correspondence Study to Distance Education

In 1982, the International Council for Correspondence Education changed its name to the International Council for Distance Education to reflect the developments in the field. With the rapid growth of new technologies and the evolution of systems for delivering information, distance education, with its ideals of providing equality of access to education, became a reality. Today there are distance education courses offered by dozens of public and private organizations and institutions to school districts, universities, the military, and large corporations. Direct satellite broadcasts are produced by more than 20 of the country's major universities to provide over 500 courses in engineering delivered live by satellite as part of the National Technological University (NTU). In the corporate sector, more than $40 billion a year are spent by IBM, Kodak, and the Fortune 500 companies in distance education programs.

What, exactly, are the prospects and promises of distance education? Desmond Keegan (Keegan, 1980) identified six key elements of distance education:

- Separation of teacher and learner
- Influence of an educational organization
- Use of media to link teacher and learner
- Two-way exchange of communication
- Learners as individuals rather than grouped
- Educators as an industrialized form

Distance education has traditionally been defined as instruction through print or electronic communications media to persons engaged in planned learning in a place or time different from that of the instructor or instructors. The traditional definition of distance education is slowly being eroded as new technological developments challenge educators to reconceptualize the idea of schooling and lifelong learning. At the same time, interest in the unlimited possibilities of individualized distance learning is growing with the development of each new communication technology. Although educational technologists agree that it is the systematic design of instruction that should drive the development of distance learning, the rapid development of computer-related

technologies has captured the interest of the public and has been responsible for much of the limelight in which distance educators currently find themselves. Although the United States has seen rapid growth in the use of technology for distance education, much of the pioneering work has been done abroad.

13.2.2 Open Learning in the U.K.

The establishment of the British Open University in the United Kingdom in 1969 marked the beginning of the use of technology to supplement print-based instruction through well-designed courses. Learning materials were delivered on a large scale to students in three programs: undergraduates, postgraduates, and associate students. Although course materials were primarily print based, they were supported by a variety of technologies. No formal educational qualifications have been required to be admitted to the British Open University. Courses are closely monitored and have been successfully delivered to over 100,000 students. As a direct result of its success, the Open University model has been adopted by many countries in both the developed and developing world (Keegan, 1986). Researchers in the United Kingdom continue to be leaders in identifying problems and proposing solutions for practitioners in the field (Harry, Keegan & Magnus, 1993). The International Centre for Distance Learning, at the British Open University, maintains the most complete holdings of literature in both research and practice of international distance learning. Research studies, evaluation reports, course modules, books, journal articles, and ephemeral material concerning distance education around the world are all available through quarterly accessions lists or on line.

13.2.3 Distance Education in the United States

The United States was slow to enter the distance education marketplace, and when it did, a form of distance education unique to its needs evolved. Not having the economic problems of some countries or the massive illiteracy problems of developing nations, the United States nevertheless had problems of economy of delivery. Teacher shortages in areas of science, math, and foreign language combined with state mandates to rural schools produced a climate, in the late 80s, conducive to the rapid growth of commercial courses such as those offered via satellite by the TI-IN network in Texas and at Oklahoma State University. In the United States, fewer than 10 states were promoting distance education in 1987. A year later, that number had grown to two-thirds of the states, and by 1989 virtually all states were involved in distance learning programs. Perhaps the most important political document describing the state of distance education has been the report done for Congress by the Office of Technology Assessment in 1989 called *Linking for Learning* (Office of Technology Assessment, 1989). The report gives an overview of distance learning, the role of teachers, and reports of local, state, and federal projects. It describes the state of distance education programs throughout the United States

in 1989 and highlights how technology was being used in the schools. Model state networks and telecommunication delivery systems are outlined with recommendations given for setting up local and wide-area networks to link schools. Some projects, such as the Panhandle Shared Video Network and the Iowa Educational Telecommunications Network, serve as examples of operating video networks that are both efficient and cost effective.

13.2.4 Distance Education as a Global Movement

In Europe and other Western countries, a global concern was beginning to emerge. In a recent report, the 12 members of the European Association of Distance Teaching Universities proposed a European Open University to begin in 1992. This is in direct response to the European Parliament, the Council of Europe, and the European Community (Bates, 1990). In this report, articles from authors in nine European countries describe the use of media and technology in higher education in Europe and reflect upon the need for providing unified educational access in the form of a European Open University to a culturally diverse population.

Telecommunication networks now circle the globe, linking people from many nations together in novel and exciting ways. As the borders of our global community continue to shrink, we search for new ways to improve communication by providing greater access to information on an international scale. Emerging communication technologies, and telecommunications in particular, provide highly cost-effective solutions to the problems of sharing information and promoting global understanding between people. In today's electronic age, it is predicted that the amount of information produced will increase exponentially every year. Since economic and political power is directly related to access to information, many educators like Takeshi Utsumi, president of GLOSAS (Global Systems Analysis and Simulation) have worked to develop models of the "Global University" and the "Global Lecture Hall" which provide resources allowing less-affluent countries to keep up with advances in global research and education (Utsumi, Rossman & Rosen, 1990).

In the developing world, since the 1950s, the population has doubled to over 5 billion people, most of whom want to be literate and want greater educational opportunities for themselves and their children. The majority of this expanding population is in Asia, where there are massive problems of poverty, illiteracy, and disease. In most developing countries, such as Bangladesh, distance education offers the promise of a system of information distribution through which new ideas, attitudes, and understanding might begin to ooze through the layers of the disadvantaged environments (Shah, 1989). Drawing upon the well-known model of the British Open University, countries such as Pakistan, India, and China have combined modern methods of teaching with emerging technologies in order to provide low-cost instruction for basic literacy and job training. Turkey has recently joined those nations involved in large-scale distance learning. Only 12

years old, their distance education program has enrolled almost 1 million students and is the sixth largest distance education program in the world (Demure & McIsaac, 1993).

Because of the economies of size and distribution, both industrialized and developing countries have embarked on distance education programs. In the early 1980s, record numbers of students in developing countries have gained access to higher education through distance education programs (Rumble & Harry, 1982). In many cases, local experts are not available to develop original programs in the language and culture of the people. For this reason, the majority of educational programs are either used intact from the host country or are superficially translated with very few adaptations to the local culture. When this is done, the results are often unsuccessful. The cultural values of the program designer become dominant, desirable, and used as the standard. There are many examples of programs from North America, Australia, Great Britain, and Europe that were purchased but never used in Africa and Asia because the material was not relevant in those countries. Because the appropriate design of instructional material is a critical element in its effectiveness, the issue of "who designs what and for whom" is central to any discussion of the economic, political, and cultural dangers that face distance educators using information technologies (McIsaac, 1993). There have been a variety of efforts to identify theoretical foundations for the study of distance education. Thus far, there has been little agreement about which theoretical principles are common to the field and even less agreement on how to proceed in conducting programmatic research.

13.3 THEORY OF DISTANCE EDUCATION

The development of new technologies has promoted an astounding growth in distance education, both in the number of students enrolling and in the number of universities adding education at a distance to their curriculum (Garrison, 1990). While the application of modern technology may glamorize distance education, literature in the field reveals a conceptually fragmented framework lacking in both theoretical foundation and programmatic research. Without a strong base in research and theory, distance education has struggled for recognition by the traditional academic community. Distance education has been described by some (Garrison, 1990; Hayes, 1990) as no more than a hodgepodge of ideas and practices taken from traditional classroom settings and imposed on learners who just happen to be separated physically from an instructor. As distance education struggles to identify appropriate theoretical frameworks, implementation issues also become important. These issues involve the learner, the instructor, and the technology. Because of the very nature of distance education as learner-centered instruction, distance educators must move ahead to investigate how the learner, the instructor, and the technology collaborate to generate knowledge.

Traditionally, both theoretical constructs and research studies in distance education have been considered in the context of an educational enterprise that was entirely separate from the standard, classroom-based, classical instructional model. In part to justify, and in part to explain, the phenomenon, theoreticians like Holmberg, Keegan, and Rumble explored the underlying assumptions of what it is that makes distance education different from traditional education. With an early vision of what it meant to be a nontraditional learner, these pioneers in distance education defined the distance learner as one who is physically separated from the teacher (Rumble, 1986), has a planned and guided learning experience (Holmberg, 1986), and participates in a two-way structured form of distance education that is distinct from the traditional form of classroom instruction (Keegan, 1988). In order to justify the importance of this nontraditional kind of education, early theoretical approaches attempted to define the important and unique attributes of distance education.

Keegan (1986) identifies three historical approaches to the development of a theory of distance education. Theories of autonomy and independence from the 1 960s and 1970s, argued by Wedemeyer (1977) and Moore (1973), reflect the essential component of the independence of the learner. Otto Peter's (1971) work on a theory of industrialization in the 1 960s reflects the attempt to view the field of distance education as an industrialized form of teaching and learning. The third approach integrates theories of interaction and communication formulated by Bääth (1982, 1987), and Daniel and Marquis (1979). Using the postindustrial model, Keegan presents these three approaches to the study and development of the academic discipline of distance education. It is this concept of industrialized, open, nontraditional learning that, Keegan says, will change the practice of education.

Wedemeyer (1981) identifies essential elements of independent learning as greater student responsibility, widely available instruction, effective mix of media and methods, adaptation to individual differences, and a wide variety of start, stop, and learn times. Holmberg (1989) calls for foundations of theory construction around the concepts of independence, learning, and teaching: Meaningful learning, which anchors new learning matter in the cognitive structures, not rote learning, is the center of interest. Teaching is taken to mean facilitation of learning. Individualization of teaching and learning, encouragement of critical thinking, and far-reaching student autonomy are integrated with this view of learning and teaching (Holmberg, 1989, p. 161).Holmberg summarizes his theoretical approach by stating that:

Distance education is a concept that covers the learning-teaching activities in the cognitive and/or psycho-motor and affective domains of an individual learner and a supporting organization. It is characterized by non-contiguous communication and can be carried out anywhere and at any time, which makes it attractive to adults with professional and social commitments (Holmberg, 1989, p. 168).

Garrison and Shale (1987) include in their essential criteria for formulation of a distance education theory the elements of noncontiguous communication, two-way interactive communication, and the use of technology to mediate the necessary two-way communication.

13.3.1 Theoretical Constructs

Recently, a wider range of theoretical notions has provided a richer understanding of the learner at a distance. Four such concepts are transactional distance, interaction, learner control, and social presence.

13.3.1.1.   Transactional Distance. Moore's (1990) concept of "transactional distance" encompasses the distance that, he says, exists in all educational relationships. This distance is determined by the amount of dialogue that occurs between the learner and the instructor, and the amount of structure that exists in the design of the course. Greater transactional distance occurs when an educational program has more structure and less student-teacher dialogue, as might be found in some traditional distance education courses. Education offers a continuum of transactions from less distant, where there is greater interaction and less structure, to more distant, where there may be less interaction and more structure. This continuum blurs the distinctions between conventional and distance programs because of the variety of transactions that occur between teachers and learners in both settings. Thus distance is not determined by geography but by the relationship between dialogue and structure.

Saba and Shearer (Saba & Shearer, 1994) carry the concept of transactional distance a step farther by proposing a system dynamics model to examine the relationship between dialogue and structure in transactional distance. In their study, Saba and Shearer conclude that as learner control and dialogue increase, transactional distance decreases. It is not location that determines the effect of instruction but the amount of transaction between learner and instructor. This concept has implications for traditional classrooms as well as distant ones. The use of integrated telecommunication systems may permit a greater variety of transactions to occur, thus improving dialogue to minimize transactional distance.

13.3.1.2. Interaction. A second theoretical construct of recent interest to distance educators, and one that has received much attention in the theoretical literature, is that of interaction. Moore (1989) discusses three types of interaction essential in distance education. Learner-instructor interaction is that component of his model that provides motivation, feedback, and dialogue between the teacher and student. Learner-content interaction is the method by which students obtain intellectual information from the material. Learner-learner interaction is the exchange of information, ideas, and dialogue that occur between students about the course, whether this happens in a structured or nonstructured manner. The concept of interaction is fundamental to the effectiveness of distance education programs as well as tradi-

tional ones. Hillman, Hills, and Gunawardena (1994) have taken the idea of interaction a step farther and added a fourth component to the model learner-interface interaction. They note that the interaction between the learner and the technology that delivers instruction is a critical component of the model, which has been missing thus far in the literature. They propose a new paradigm that includes understanding the use of the interface in all transactions. Learners who do not have the basic skills required to use a communication medium spend inordinate amounts of time learning to interact with the technology and have less time to learn the lesson. For this reason, instructional designers must include learner-interface interactions that enable the learner to have successful interactions with the mediating technology.

13.3.1.3. Control. A third theoretical concept receiving attention in the distance education literature is that of independence and learner control. Studies that examine locus of control (Altmann & Arambasich, 1982; Rotter, 1989) conclude that students who perceive that their academic success is a result of their own personal accomplishments have an internal locus of control and are more likely to persist in their education. Students with an external locus of control feel that their success, or lack of it, is due largely to events such as luck or fate outside their control. Thus, externals are more likely to become dropouts. Factors of control that influence dropout rate have been of concern to distance educators as they search for criteria to predict successful course completion. Baynton (1992) developed a model to examine the concept of control as it is defined by independence, competence, and support. She notes that control is more than independence. It requires striking a balance among three factors: a learner's independence (the opportunity to make choices), competence (ability and skill), and support (both human and material). Baynton's factor analysis confirms the significance of these three factors and suggests other factors that may affect the concept of control and which should be examined to portray accurately the complex interaction between teacher and learner in the distance learning setting.

13.3.1.4. Social Context. Finally, the social context in which distance learning takes place is emerging as a significant area for research. Theorists are examining how the social environment affects motivation, attitudes, teaching, and learning. There is a widespread notion that technology is culturally neutral, and can be easily used in a variety of settings. However media, materials, and services are often inappropriately transferred without attention being paid to the social setting or to the local recipient culture (McIsaac,1993). Technology-based learning activities are frequently used without attention to the impact on the local social environment. Computer-mediated communication attempts to reduce patterns of discrimination by providing equality of social interaction among participants who may be anonymous in terms of gender, race, and physical features. However, there is evidence that the social equality factor may not extend, for example, to participants who are not good writers but

who must communicate primarily in a text-based format (Gunawardena, 1993). It is particularly important to examine social factors in distance learning environments where the communication process is mediated and where social climates are created that are very different from traditional settings. Feenberg and Bellman (1990) propose a social factor model to examine computer networking environments that create specialized electronic social environments for students and collaborators working in groups.

One social factor particularly significant to distance educators is social presence, the degree to which a person feels "socially present" in a mediated situation. The notion is that social presence is inherent in the medium itself, and technologies offer participants varying degrees of "social presence" (Short, Williams & Christie, 1976). Hackman and Walker (1990), studying learners in an interactive television class, found that cues given to students such as encouraging gestures, smiles, and praise were social factors that enhanced both students' satisfaction and their perceptions of learning. Constructs such as social presence, immediacy, and intimacy are social factors that deserve further inquiry.

13.3.2 Toward a Theoretical Foundation

Although there have been numerous attempts to formulate a theory base for the field, American distance education remains "chaotic and confused. There is no national policy, nor anything approaching a consensus among educators of the value, the methodology or even the concept of distance education" (Moore, 1993). Shale (1990) calls for theoreticians and practitioners to stop emphasizing points of difference between distance and traditional education, but instead to identify common educational problems. Distance education is, after all, simply education at a distance with common frameworks, common conceptual concerns, and similar research questions relating to the social process of teaching and learning. Many distance educators are beginning to call for a theoretic model based on constructivist epistemology (Jegede, 1991). Technological advances have already begun to blur the distinction between traditional and distance educational settings. Time and place qualifiers are no longer unique. The need to test assumptions and hypotheses about how and under what conditions individuals learn best leads to research questions about learning, teaching, course design, and the role of technology in the educational process. As traditional education integrates the use of interactive, multimedia technologies to enhance individual learning, the role of the teacher changes from knowledge source to knowledge facilitator. As networks become available in schools and homes to encourage individuals to become their own knowledge navigators, the structure of education will change, and the need for separate theories for distance education will blend into the theoretical foundations for the mainstream of education.

More than 35% of the literature reviewed reported the need for developing a central, theoretical framework on which future distance education development can be based. While numerous journal articles and conference presentations discussed the lack of theoretical framework in the field, most of the work was descriptive rather than research oriented. However, several writers have contributed to theory formulation.

Verduin and Clark (1991) offer a rationale by suggesting that confusion over distance education terminology may be to blame. In response to this theoretical void, Gibson (1990) suggests borrowing a theory from existing disciplines. Miller (1989) concurs by suggesting that "it is important that the study of distance education be informed by work done in other disciplines" (p. 15). Boyd and Apps (1980) struggle with the idea of borrowing a theory, as they see the important issue being the development of a clearly defined structure, function, purpose, and goal for distance education. "We must ask ourselves what erroneous assumptions we may be accepting when we borrow from established disciplines to define distance education" (pp. 2—3). Furthermore, borrowing extensively from other fields in order to define and solve problems allows the field to define the borrowed field (Gibson, 1990) In an effort to define theoretically the field of distance education, the literature advances three strategies. Deshler and Hagen (1989) advocate a multidisciplinary and interdisciplinary approach resulting in a diversity of perspectives. They caution that anything short of this approach may "produce theory that suffers from a view that is narrow, incomplete, discipline-based and restricted.., to a predominant view of reality" (p. 163).

A second approach is advocated by Hayes (1990), who supports the work of Knowles (1984) and Brookfield (1986). Hayes emphasizes that theoretical development relative to adult learning must be distinct from youth learning. While past experiences may occasionally interfere with an adult's openness to new learning experiences, the majority of literature views experience as a resource for new learning. Knowles (1984), for example, supports an andragogical, learner-focused foundation in his belief that "adults draw on previous experiences in order to test the validity of new information" (p. 44). A third strategy for theory development from an international perspective has been proposed by Sophason and Prescott (1988). They caution that certain lines of questioning are more appropriate in some countries than in others, thus the emanating theory "may have a particular slant" (p. 17). A comparative analysis strategy would undoubtedly be influenced by cultural bias and language barriers (Pratt, 1989). Pratt further indicates that understanding different culturally related beliefs about the nature of the individual and society may be critical in defining appropriate distance education theories. Pratt clarifies his belief through a description of how differences in societies' historical traditions and philosophies can contribute to differing orientations toward self-expression and social interactions within educational settings.

Although these three strategies for the advancement of a theoretical foundation for distance education are repeated in current literature, Ely (1992) foresees a road block to the theoretical progression. "What seems to be needed is an unclouded understanding of distance education. This includes the audience, setting, and delivery methodologies" (p. 43). Loesch and Foley (1988) concur and ask for further research in this area in their statement that only when a clear understanding of distance education becomes available can concise questions be developed that can lead to establishment of theory. Evans and Nation (1992) contribute some of the most thoughtful and insightful comments on theory building when they suggest that we examine broader social and historic contexts in our efforts to extend previously narrow views of theories in open and distance education. They urge us to move toward deconstruction of the instructional industrialism of distance education, and toward the construction of a critical approach that, combined with an integration of theories from the humanities and social sciences, can enrich the theory building in our field.

Although there has been no central theoretical framework to guide research in distance education, there have been a number of important studies that have examined the interactions of technologies with learning, course design, and instruction. Because of the heavy use of technology in distance education, it is appropriate to examine its role in this context.

13.4 DISTANCE LEARNING TECHNOLOGIES

Until the advent of telecommunications technologies, distance educators were hard pressed to provide for two-way, real-time interaction, or time-delayed interaction between students and the instructor or among peers. In the correspondence model of distance education, which emphasized learner independence, the main instructional medium was print, and it was usually delivered using the postal service. Interaction between the student and the instructor usually took the form of correspondence of self-assessment exercises that the student completed and sent to the instructor for feedback. Formal group work or collaborative learning was very rare in distance education, even though attempts have been made to facilitate group activities at local study centers. Also, traditionally, distance education courses were designed with a heavy emphasis on learner independence and were usually self-contained. With the development of synchronous (two-way, real-time interactive) technologies, such as audio teleconferencing, audio graphics conferencing, and videoconferencing, it is now possible to link learners and instructors who are geographically separated for realtime interaction. However, the type of interaction that takes place is usually on a one-to-one basis, between one learner and another and between one learner and the instructor at one particular time. These technologies are not very suitable for promoting cooperative learning between groups of learners located at different sites. Also, the synchronous nature of these technologies may not be suitable or convenient for many distance learners.

The asynchronous (time delayed) feature of computermediated communications (CMC; see 14.2.3), on the other hand, offers an advantage in that the CMC class is open 24 hours a day, 7 days a week, to accommodate the time schedules of distance learners. Although CMC systems may be either synchronous (real time) or asynchronous (time delayed), it is asynchronous CMC, because of its time-independent feature, that is an important medium for facilitating cooperative group work among distance learners.

Current developments in digital communications and the convergence of telecommunications technologies, exemplified by international standards such as ISDN (Integrated Services Digital Network), make available audio, video, graphic, and data communication through an ordinary telephone line on a desktop workstation. Therefore, as we look at distance learning technologies today and look to the future, it is important to think in terms of integrated telecommunication systems rather than simply video vs. audio vs. data systems. More and more institutions that teach at a distance are moving toward multimedia systems integrating a combination of technologies both synchronous and asynchronous that meets learner needs. Therefore, while in the 1970s and 1980s many distance education institutions throughout the world used print as a major delivery medium, by the year 2000 many institutions will probably have adopted telecommunications-based systems for the delivery of distance education. This does not necessarily mean that print will no longer be used in distance education. It is more likely that print will be used as a supplementary medium in most telecommunications-based systems, and better ways of communicating information through print will be investigated and incorporated into the design of study guides and other print-based media.

In order to describe the technologies used in distance education, we have selected "The 4-Square Map of Groupware Options" that was developed by Johansen et al. (1991) which is based on recent research in groupware (see Fig. 13-1). This model seemed most suitable to our purpose, because we see distance education moving from highly individualized forms of instruction, as in correspondence education, to formats that encourage teaching students as a group and collaborative learning among peers. The "4-square map of groupware option" model is premised on two basic configurations that teams must cope with as they work: time and place. Teams or groups of people who work together on a common goal deal with their work in the same place at the same time as in face-to-face meetings, and sometimes they must work apart in different places and at different times, as in the use of asynchronous computer conferencing. They also need to handle two other variations: being in different places at the same time, as in the use of telephones for an audio
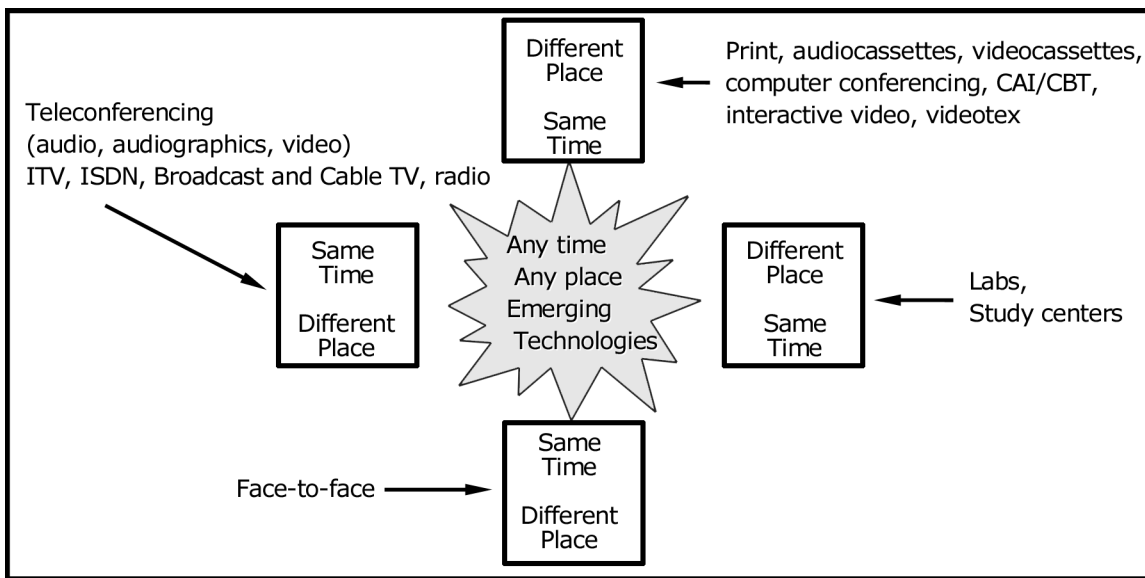
Figure 13-1. The 4-square map of distance education technology options. (Adapted from R. Johansen et al., p. 16.)

teleconference, and at the same place at different times, as in workplaces, study centers, or laboratories. Based on these configurations, the 4-square model classifies four types of technologies that support the group process: (1) same time/same place, (2) different time/different place, (3) same time/different place, and (4) same place/different time. These four categories are used for describing technologies that currently support distance teaching and learning.

While we use the 4-square model to discuss the major distance education technologies currently being used, we feel that this model does not lend itself very well to discussing new and future developments in integrated telecommunications. Since these integrated systems incorporate many of the features that we classify separately in the 4-square model, we have decided to describe new and future developments in a separate section titled "Future Directions and Emerging Technologies" (p. 417).

13.4.1 Same Time/Same Place Instruction

Same time/same place group interaction is the most familiar format of face-to-face meetings. Certain objectives in distance education programs can only be met by meeting face-to-face. The British Open University, which teaches entirely at a distance, brings students on campus during the summer to participate in laboratory experiments. When course objectives require the careful demonstration, observation, practice, and feedback of such life-threatening procedures as a surgical procedure, it is important to organize face-to-face meetings. In a face-to-face setting, accepted practices are modified only slightly to accommodate electronic media. Basic technologies that facilitate a face-to-face meeting involve an overhead projector, a flip chart, electronic blackboard, or a projection system that displays computer screens via a LCD monitor. At the more sophisticated end

are desktop workstations for each group member which run on special software that helps the group to brainstorm, generate ideas, rank solutions, and vote. Also, a record of the group process can be produced at the conclusion of the groups' activities. IBM's Decision Conference Center in Bethesda, Maryland, employs such sophisticated groupware to facilitate group decision-making processes. However, innovative approaches are now being adopted to design laboratory work at a distance by using technologies—as in the dissection of a fetal pig experiment that was designed by the University of Maine using a combination of two-way interactive television— videotape, and group work at sites.

13.4.2 Same Time/Different Place Instruction

There are two kinds of same time/different place instruction: (1) a meeting through a telecommunications medium or teleconferencing during which participants who are separated by geographic distance can interact with each other simultaneously, and (2) the use of noninteractive media such as open broadcast television and radio to instruct a vast number of students at the same time without the ability of the students to call back and interact with the originators of the program. Teleconferencing can be classified into four separate categories depending on the technologies that they use: audio teleconferencing, audiographics teleconferencing, video teleconferencing, and computer conferencing. There are two types of computer conferencing: synchronous computer conferencing, when two or more computers are linked at the same time so that participants can interact with each other, and asynchronous computer conferencing, when participants interact with each other at a time and place convenient to them. Asynchronous computer conferencing is described under different time/different place instruction.

The four major types of teleconferencing vary in the types of technologies, complexity of use, and cost. However, they have several features in common: All of them use a telecommunication channel to mediate the communication process, link individuals or groups of participants at multiple locations, and provide for live, two-way communication or interaction. One advantage of teleconferencing systems is that they can link a large number of people who are geographically separated. If satellite technology is used for the teleconference, there is no limit to the number of sites that can be linked through the combination of several communications satellites. In order to participate in a teleconference, participants usually have to assemble at a specific site in order to use the special equipment necessary for a group to participate in the conference. The only exceptions are (1) audio teleconferences that can link up any individual who has access to a telephone; (2) computer conferences that can link up individuals, their computers, and modems at home; or (3) direct broadcast satellites that can deliver information directly to participant's homes. However, if more than two people are present at a participating site then it is necessary for the participants to gather at a location equipped with teleconferencing equipment in order to participate in a teleconference. This may restrict access for some learners. In terms of control, participants will have control over the interaction that takes place in a teleconference only to the extent that the instructional design allows for it. However, if the teleconference is taped for later review, students will have more control in the use of the conference.

The unique advantage of teleconferences is that they provide for two-way interaction between the originators and the participants. Teleconferences need to be designed to optimize the interaction that takes place during the conference. Interaction needs to be thought of not only as interaction that occurs during the teleconference but pre and postconference activities that allow groups to interact. Monson (1978) describes four design components for teleconferences: humanizing, participation, message style, and feedback. Humanizing is the process of creating an atmosphere that focuses on the importance of the individual and overcomes distance by generating group rapport. Participation is the process of getting beyond the technology by providing opportunities for the spontaneous interaction between participants. Message style is presenting what is to be said in such a way that it will be received, understood, and remembered. Feedback is the process of getting information about the message, which helps the instructor and the participants complete the communications loop. Monson (1978) offers excellent guidelines for incorporating these four elements into teleconferencing design. The symbolic characteristics and the interfaces that are unique to each medium are discussed, along with the description of each technology.

13.4.2.1.   Audio Teleconferencing. Audio teleconferencing or audioconferencing is voice-only communica-
tion. Even though it lacks a visual dimension, audio teleconferencing has some major strengths: It uses the regular telephone system, which is readily available and a familiar technology; it can connect a large number of locations for a conference; the conferences can be set up at short notice; and it is relatively inexpensive to use when compared with other technologies.

The interconnection medium for an audio teleconference is usually the telephone, which can incorporate microwave, satellite, fiber optic, or coaxial cable transmission. The conference call between three or more persons at different locations is the simplest type of audio teleconferencing. For multipoint teleconferencing among three or more sites, an audio bridge is required to enable sites to interact clearly. The bridge links the telephone lines together so that parties at each location can hear and talk to each other. Olgren and Parker (1983) observe that there are many system options for audio teleconferencing, but the most common forms are: (1) user-initiated conference calls or ("ad lib" teleconferencing), (2) operator-initiated or dial-up or (dial-out) teleconferencing, (3) dial-in or meet-me teleconferencing, and (4) dedicated audio networks.

In order to facilitate group-to-group communication, audio teleconferencing requires the use of some type of amplified telephone equipment with a loudspeaker and microphones. The equipment may be built into the room or may be portable. Audio teleconferencing equipment can be described as simplex, quasi-duplex, or full-duplex, depending on the kind of interactivity and interruptibility of the conference connection.

Olgren and Parker (1983) observe that one should keep in mind that voice communication is the backbone of any teleconferencing system, with the exception of computer conferencing. Sophisticated video or graphics equipment can be added to any audio system. But it is the audio channel that is the primary mode of communication. If the audio is of poor quality, it will have a negative impact on users of even the most sophisticated graphics and video technologies. This is very important to keep in mind, because the evaluation of interactive television systems have shown (Dillon, Gunawardena & Parker, 1992) that the most often-cited technical problem in television systems is the poor audio quality. While expensive investments have been made in video and graphics systems, very little attention has been paid to the improvement of audio quality in video and audiographics conferencing systems. Therefore, in compressed video, full video information is compressed by a piece of technology known as a Codec, in order to send it down the narrower bandwidth of a special telephone line. The compressed video method is cheaper and more flexible than the TV broadcast method.

13.4.2.4. Full-Motion Video Teleconferencing. *Full-motion video teleconferencing* became popular with the advent of satellite technology. For the past decade, educational de-

velopers have provided credit courses via satellite television over networks such as the National Technological University (for graduate engineering course), the Arts & Sciences Teleconferencing Service at Oklahoma State University, the TI-IN Network in Texas (for advanced placement high school courses). Both remote and urban schools and businesses have found these educational services valuable enough for their students and employees to make the investment in satellite hardware and tuition fees. Standard C- or Ku-band satellite TV signals can be received by consumer-level hardware costing well under $2,000. For a producer of educational programming, satellite delivery is still more economical than any other format for point-to-multipoint video transmission. Video compression standards and the introduction of fiber-optic cable infrastructure by many telephone and cable companies promises to make terrestrial line transmission of video much cheaper in the near future.

There are, however, at least two reasons that satellite television will probably remain available and, in fact, increase in the foreseeable future. First, there are still many remote areas of the world, even in North America, where telephone service, if it exists at all, is supported by antiquated technology barely able to provide a usable audio or data signal, let alone carry video. These remote areas simply need to point a relatively inexpensive satellite dish— powered by solar panels, batteries, or generators—at the appropriate satellite to receive its signal. Additionally, new higher-powered satellites are making it unnecessary to use today's large unwieldy satellite dishes. The new generation of Ku-band satellite is already offering direct broadcast service (DBS) to European households. These receivers, known as VSATs (or very small aperture terminals), are no larger than 1 to 3 feet in diameter and currently cost less than $500.

The proliferation of smaller, less-expensive satellite television reception technology, along with the continued launching of new, higher-powered satellites, will ensure a continuing niche for this technology to deliver instructional video and data to even the remotest areas of the world that lack other information infrastructure.

Fiber optics is gaining in popularity as a transmission medium for video teleconferencing. Fiber optics is a transmission technology using an attenuated glass fiber hardly thicker than a human hair, which conducts light from a laser source. A single glass fiber can carry the equivalent of 100 channels of television or 100,000 telephone calls, and even more capacity is possible by encasing many fibers within a cable. Fiber optics offers several advantages: It can carry a tremendous amount of data at high transmission speeds; it does not experience signal degradation over distance as does coaxial cable; and it is a multipurpose system that can transmit video, audio, data, and graphics into the school through a single cable. A single fiber-optic cable can carry over a billion bits per second, enabling several video teleconferences to run simultaneously. Many companies, universities, and states in the United States are building fiber-optic transmission networks to carry voice, data, and video.

Video teleconferencing can also use digital or analog microwave systems or dial-up digital transmission lines. Current developments center on converging the different transmission channels and using a combination of telecommunications channels, satellites, fiber optics, microwaves, and coaxial cables to deliver full-motion video teleconferencing.

13.4.2.5. Compressed Video Teleconferencing. Video-compression techniques have greatly reduced the amount of data needed to describe a video picture, and have enabled the video signal to be transmitted at a lower and less-expensive data rate. The device used to digitize and compress an analog video signal is called a *video codec,* short for COder/ DEcoder, which is the opposite of a modem (MOdulator/ DEModulator). Reduction of transmission rate means trade-offs in picture quality. As the transmission rate is reduced, less data can be sent to describe picture changes. Lower data rates yield less resolution and less ability to handle motion. Therefore, if an image moves quickly, the motion will "streak" or 'jerk" on the screen.

Currently most compressed video systems use either T-1 or half a T-1 channel. In a T-1 channel, video is compressed at 1.536 Mbps, which is the digital equivalent of 24 voice-grade lines. Many users of T-1 codecs opt for transmission at 768 kbps, which is half a T-1 channel. The difference in video quality between transmission at 768 kbps and 1.536 Mbps is slight, but the cost savings are significant. With the proliferation of fiber-optic networks, some private video teleconferencing networks are taking advantage of high-quality 45-Mbps transmission. Digital video compression technology has allowed video teleconferencing to become less cost prohibitive. It is not as cost effective as audio teleconferencing and audiographics teleconferencing, but it may soon compete with more-sophisticated audio-graphics systems with future developments in video compression technology.

13.4.2.6. Desktop Video Teleconferencing. Future developments in video teleconferencing will move toward integrated desktop video teleconferencing combining audio, video, and data. A fusion of network, personal computer, and digital video has produced the field of desktop videoconferencing. Saba (1993) observes that several telecommunications companies have introduced integrated systems (voice, video, and data) that reside in a desktop computer and provide two-way synchronous communications with voice, image, and file-transfer and screen-share capabilities. This technology allows users to see each other, speak to each other, transfer application files, and work together on such files at a distance. Most systems do not require advanced digital communications technologies such as ISDN to operate. For those wanting to utilize ISDN, it is possible to purchase an ISDN card, while most systems are now be-

ing designed to work with telecommunications standards such as ISDN.

Education can use this technology as a method of presenting class material and forming work groups, even though they may be at a considerable distance from each other. An instructor could conceivably present material to the entire class either "live" or through delivery of an audio file to each student's electronic mail account. Students could then work together in real time if they wished to share information over telephone lines.

In one current example, German officials are making use of desktop videoconferencing to form what has been dubbed a "virtual government." As planing progresses to move offices from Bonn, the current capital, to Berlin, planners meet regularly using on-line workstations rather than traveling to meetings. The results provide faster interaction at a much lower cost (Merwyn, 1993).

As more technologies begin to dovetail, desktop videoconferencing becomes laptop videoconferencing. The use of cellular telephone technology combined with high-speed laptop modems will make it possible for people to hold meetings and work group sessions whether they are at home, in an office, or on the beach.

13.4.2.7. Interactive Instructional Television (ITV).

Interactive instructional television (ITV) systems usually use a combination of "instructional television fixed service (ITFS) and point-to-point microwave. They can transmit either two-way video and two-way audio, or one-way video and two-way audio, to several distant locations. The advantage of combining ITFS and microwave is that microwave is a point-to-point system, while ITFS is a point-to-multipoint system. Therefore, large geographical areas can be covered by the combination of the two technologies. Microwave connects one location to another electronically with its point-to-point signals, while ITFS distributes that signal to several receiving stations around a 20-mile radius. In the U.S., several states such as Iowa and Oklahoma support statewide networks that use a combination of ITFS, microwave, satellite, fiber optics, and coaxial cable.

In an ITFS and microwave television system, the course delivered over the system originates from a "studio classroom" on the campus. The classroom is specially designed to facilitate the extension of a conventional class through television. The audio feedback permits interaction between the teacher and students at distant locations. If a student viewing the class at a remote location has a question, he or she asks it through a talkhack system, and it is heard by both on-campus and off-campus class members. The talk-back system uses either the telephone or FM microwave technology, called *radio talkback.*

Interactive instructional television systems also use satellite, fiber optics, or compressed video to extend the tradi-

tional classroom. However, these systems are currently not as cost effective as systems that comprise of ITFS and point-to-point microwave.

13.4.2.8. Integrated Services Digital Network (ISDN).

ISDN is a new international telecommunications standard that offers a future worldwide network capable of transmitting voice, data, video, and graphics in digital form over standard telephone lines or fiber-optic cable. ISDN transmits media using digital rather than analog signals. In order to move toward a global network, ISDN promises end-to-end digital connectivity, multiple services over the same transmission path, and standard interfaces or conversion facilities for ubiquitous or transparent user access. Saba (1988) points out ISDN's applications for distance education: convergence, multitasking, and shared communications. Convergence refers to the convergence on audio, video, and data media in an integrated telecommunication system. Instruction is possible through voice, data, graphics, and video images. Multitasking refers to the variety of telecomputing capabilities that are available to the learner through integrated telecommunication systems based on minicomputers or microcomputers. Learners can gain access to on-line databases worldwide and explore multimedia libraries comprising of digital sound, text, and images. The shared communications feature allows the teacher and a group of learners separated by distance to work interactively on the same screen, sharing graphics, text, or data at the same time. Therefore, it is possible to solve a problem together or draw a graphic together, even though a group of learners may be at different geographic locations. Currently available audiographics systems and desktop video teleconferencing systems provide for the features that will be available in a more user-friendly and cost-effective manner with the development of ISDN systems.

13.4.2.9. Broadcast Television and Radio.

Broadcast television (see 11.7) and radio (see 28.1.6.1) fall under the classification of same-time/different-place instruction. The difference between broadcast television and radio and the previously discussed technologies under the same category is that broadcast television and radio do not provide for real-time, two-way interaction between presenters and participants. These media, however, can be used to instruct a vast number of students at the same time, even though the students do not have the ability to call back and clarify a statement or ask a question in real time. Many distance education institutions in developing countries, as well as institutions in developed countries such as the British Open University, use broadcast television and radio extensively to deliver programming to a large number of distant learners.

In the United States, while television—both open-broadcast cable and ITV—is the most popular media for delivering distance education, radio remains an underutilized medium (Gunawardena, 1988). It is in the developing countries that radio programming has been produced to either support

and supplement print-based materials or to carry the majority of the course content.

In the United States, the most common pattern of open-broadcast use for delivering distance education is for an institution to make arrangements with the Public Broadcasting Service (PBS) and/or a commercial television station to distribute the educational programming (see 11.7). One of the limitations of this type of distribution is that educational programming is confined to broadcast schedules predetermined by the broadcasting station, which may not be times convenient for students taking the course.

Bates (1984) observes that broadcasts are ephemeral, cannot be reviewed, are uninterruptable, and are presented at the same pace for all students. A student cannot reflect on an idea or pursue a line of thought during a fast-paced program without losing the thread of the program itself. A student cannot go over the same material several times until it is understood.

Therefore, it is difficult for the learner to integrate or relate broadcast material to other learning. Hence, the need for broadcast programming to be accompanied by support materials in the form of prebroadcast notes and follow-up exercises and activities. Research at the British Open University has indicated that "most students find it impossible to take notes while viewing, and those that do are usually very dissatisfied with their notes" (Bates, 1983, p. 61). Access to a videotape of the broadcast, however, will alleviate these problems by giving the learner control over the medium, with the ability to stop and rewind sections that were not clear.

Despite its ability to reach a large section of the student population, open-broadcast television is a one-way communication medium. It does not provide for interaction (two-way communication) between the student and the teacher and lacks flexibility and ability to respond to student feedback. Since students cannot question the instructor to clarify problems, and since professional broadcast production "makes the learner dependent on 'responsible' broadcasting" (Bates, 1983, p. 61), this system of distribution can encourage passive acceptance of the instruction. To make the system interactive, open-broadcast distribution requires an added system to provide either an audio or audio-video return circuit.

13.4.2.10. Cable Television. In the United States, cable television began in remote rural areas, expanded into the suburbs, and has now penetrated into large urban areas. Cable has evolved from a way of improving reception in rural areas to a technology capable of providing many channels and even two-way video communication. Microwave relays have enabled cable operators to pick up signals from television stations too distant to be picked up over the air. Satellite interconnection of cable systems makes possible the importation of programming from virtually any part of the world.

Today, cable technology is readily available and reaches a large number of homes and apartment units in the United States.

Where cable can provide access to a large section of the population of a given geographic area, it can be used to distribute distance education. Cable can be used to replay programming offered over open-broadcast television, usually at more convenient times for the students than open-broadcast schedules, or used as a means of delivering nationally distributed television programs, where terrestrial broadcasting facilities are not available.

Interactive cable in most cases is not two-way video. It is one-way video with telephone feedback from the viewer to the instructor, or a technology that provides viewers with one-way video and one-way audio feedback combined with keypads or polling devices with which they can transmit impulses to a central computer in response to questions posed by the instructor. Student responses, such as "yes," "no," "do not understand," "slow down," etc., are immediately summarized by a central computer for the instructor, and often for the viewing audience, thereby adding an element of interaction to the experience.

13.4.3 Different Time/Same Place Instruction

This type of instruction usually takes place in a lab or study center where distance learners gather at different times to interact with instructors, tutors, and other students. Certain types of instructional objectives can only be successfully met by arranging for learners to conduct an experiment in a lab and observing this experiment for evaluation purposes. Local study centers are used by major distance teaching universities such as the British Open University to support the distance learner by offering meetings with tutors, discussion with peer groups, and library facilities. A survey of distance teaching institutions in the United States (Gunawardena, 1988) found that only 41% of the total number of institutions surveyed used local study centers. The types of services provided by most of the institutions were student access to media equipment such as videocassette players and microcomputers, and library facilities such as books, tapes, and cassettes, rather than arrangements for tutor-student interaction.

13.4.4 Different Time/Different Place Instruction

The technologies used in this category are further classified as those that transmit one-way information such as print, audio- and videocassettes, and those that provide for interaction. Technologies that provide for interaction are divided into two groups: (1) those that permit interaction between the instructor and the learner, and among groups of learners such as computer-mediated communication (CMC) (see Chapter 14); and (2) those that provide learner-machine interaction as in computer-assisted instruction (CAI)/ computer-based training (CBT) (see 12.2.3) and interactive video and

videotex. CAI/CBT, interactive video, and videotex are highly individualized learning experiences that can be designed to give learners control over their learning. Since the technologies that provide learner-machine interaction are discussed elsewhere in this book, they will not be discussed in this chapter.

13.4.4.1. Print. Until the beginning of the 1970s and the advent of two-way telecommunications technologies, print and the mail system were the predominant delivery medium for distance education. Correspondence study relied primarily on print to mediate the communication between the instructor and the learner. Currently, many distance education institutions in developing countries use print-based correspondence study as the main distance education medium, as the use of communications technologies is often cost prohibitive. Garrison (1990) refers to print-based correspondence study as the first generation of distance education technology. It is characterized by the mass production of educational materials, and Peters (1983) describes it as an industrial form of education. The difficulty with correspondence education has been the infrequent and inefficient form of communication between the instructor and the students. Also, it was difficult to arrange for peer interaction in correspondence-based distance education. The development of broadcast technologies and two-way interactive media have mitigated the limitations of correspondence study, especially in relation to facilitating two-way communication, However, print remains a very important support medium for electronically delivered distance education. Printed study guides have become a very important component of electronic distance education. In a survey of distance teaching institutions in the United States that use television as a main delivery medium, Gunawardena (1988) found that a majority of institutions cited the study guide, which provides printed lesson materials and guidelines for studying, the most important form of support for distance learners. A study guide can steer and facilitate the study of correspondence texts, television programs, and other components in a distance education course. A study guide, if well designed, can provide the integration between various media components and activate students to read and or listen to presentations of various kinds, to compare and criticize them, and to try to come to conclusions of their own. In a study guide or correspondence text, simulated conversation can be brought about by the use of a conversational tone, advance organizers, mathemagenic (see 30.4, 30.6) devices such as directions, and underlining, self-assessment, and selfremediation exercises.

13.4.4.2. Audiocassettes. Audiocassettes afford the learner control over the learning material, because learners can stop, rewind, and fast-forward the tape. They offer great flexibility in the way they can be used, either at home or while driving a car. Since audiocassettes are a fairly cost-effective medium, they are easily accessible to students. Audiocassettes can be used to tape lectures or can be specially designed with clear stopping points in order to supplement print or video material. For example, in order to facilitate student learning, audiocassettes can be used to describe diagrams and abstract concepts that students encounter in texts. An audiocassette can be used to record the sound portion of a television program if a videocassette recorder is not available, and an audiocassette can provide a review of a television program in order to assist students to analyze the video material. The audiocassette can also be used to provide feedback to student assignments and is a very useful medium to check student pronunciation when languages are being taught at a distance. Audiocassettes can be an excellent supplementary medium to enrich print or other media and can provide resource material to distance learners. Since they can be produced and distributed without much cost, audiocassettes are also a very cost-effective medium for use in distance education.

13.4.4.3. Videocassettes. Videocassettes are like broadcast television in that they combine moving pictures and sound, but unlike broadcast television, videocassettes are distributed differently and viewed in different ways. An institution using videocassettes for distribution of video material to distant learners can use them as (a) a copy technology for open-broadcast, satellite, or cablecast programming; (b) a supplementary medium, for instance, providing the visual component for educational material carried over audio teleconferencing networks; (c) a specially designed video program that takes advantage of the cassette medium, e.g., its stop/review functions, so that students can be directed at the end of sequences to stop and take notes on, or discuss, what they have seen and heard.

An important advantage in using videocassettes is that students can exercise "control" over the programming by using the stop, rewind, replay, and fast-forward features to proceed at their own pace. Videocassettes are also a very flexible medium allowing students to use the cassettes at a time that is suitable to them. Bates (1987) observed that the "videocassette is to the broadcast what the book is to the lecture" (p. 13).

If videocassettes are designed to take advantage of their "control" characteristics and students are encouraged to use the "control" characteristics, then there is opportunity for students to interact with the lesson material. Students can repeat the material until they gain mastery of it by reflecting on and analyzing it. The control features that videocassettes afford the learner give course designers the ability to integrate video material more closely with other learning materials, so that learners can move between lesson material supplied by different media. "The ability to create 'chunks' of learning material, or to edit and reconstruct video material, can help develop a more-questioning approach to the presentation of video material. Recorded television therefore considerably increases the control of the learner (and the teacher) over the way video material can be used for learning purposes" (Bates, 1983, pp. 61—62).

Bates (1987) discusses the implications of the "control" characteristics for program design on videocassettes: (a) use of segments, (b) clear stopping points, (c) use of activities, (d) indexing, (e) close integration with other media (e.g., text, discussion), and (f) concentration on audiovisual aspects.

When videocassettes are used in a tutored video instruction (TVI) program, where tutors attend video-playback sessions at workplaces or study centers to answer questions and to encourage student discussion, students can take advantage of the features of a lecture (on videocassette) and a small-group discussion, which gives them the opportunity for personal interaction available in on-campus instruction.

13.4.4.4. **Computer-Mediated Communication (CMC).** CMC supports three types of on-line services: electronic mail (e-mail), computer conferencing, and on-line databases (see Chapter 14). In e-mail systems, a message is routed by the system to the addressee's mailbox on the host computer and remains there until it is read by the addressee. This message can be read, replied to, left in the mailbox for later perusal, saved to the hard disk on the microcomputer, deleted, or forwarded to someone else. Most e-mail systems have a bulletin board feature that allows users to read and post messages and documents to be seen by all. However, the messages in the bulletin board system are not linked to each other and provide for only a very limited form of group communication.

Computer conferencing systems, on the other hand, provide a conferencing feature in addition to e-mail, which supports group and many-to-many communication. In these systems, messages are linked to form chains of communication, and these messages are stored on the host computer until an individual logs on to read and reply to messages. Most conferencing systems offer a range of facilities for enhancing group communication and information retrieval. These include directories of users and conferences, conference management tools, search facilities, polling options, cooperative authoring, the ability to customize the system with special commands for particular groups, and access to databases (Kaye, 1989). Databases can be made available on the same host computer used for an e-mail or computer conferencing system, or users can access public or private databases resident on other computers. Some of the well-known computer conferencing systems are: EIES, PARTI, CAUCUS, CONFER, COSY, VAX NOTES, and TEAMATE. Recent developments in groupware, the design of software that facilitates group processes especially in the CMC environment, will have a tremendous impact on facilitating group work between participants who are separated in time and place.

The key features of computer conferencing systems that have an impact on distance education are the ability to support many-to-many interactive communication and the asynchronous (time-independent) and place-independent features.

It offers the flexibility of assembling groups at times and places convenient to participants. The disadvantage, however, is that since on-line groups depend on text-based communication, they lack the benefit of nonverbal cues that facilitate interaction in a face-to-face meeting. Levinson (1990) notes that research into education via computer conferencing must be sensitive to the ways in which subtle differences in the technology can impact the social educational environment. "The importance of social factors suggests that 'computer conferencing' may be a better name for the process than is 'computer-mediated communication'; the term 'conferencing' accentuates the inherent 'groupness' of this educational medium" (p. 7). Harasim (1989) emphasizes the necessity to approach on-line education as a distinct and unique domain. "The group nature of computer conferencing may be the most fundamental or critical component underpinning theory building and the design and implementation of on-line educational activities" (p. 51). Gunawardena (1993) reviews research related to the essentially group or socially interactive nature of computer conferences, focusing on factors that impact collaborative learning and group dynamics.

Globaled, a project that linked graduate classes in six universities—San Diego State University, Texas A&M University, University of New Mexico, University of Oklahoma, University of Wisconsin-Madison, and the University of Wyoming—to engage in the discussion of research related to distance education, is an example of the potential of computer conferencing to link students and instructors in learning communities (Gunawardena, Campbell Gibson, Cochenour, Dean, Dillon, Hessmiller et al., 1994). While the six major participating universities conducted research projects and moderated the discussions of their findings on Globaled, several interested students and faculty from other U.S. and overseas universities, including the Pennsylvania State University and the University of Wollongong in Australia, participated in the discussions. The Globaled community had approximately 90 participants. Globaled was premised on a learner-centered collaborative learning model in which the learner would be an active participant in the learning process involved in constructing knowledge through a process of interaction and discussion with learning peers and instructors.

13.5 FUTURE DIRECTIONS AND EMERGING TECHNOLOGIES

The field of distance education is in the midst of dynamic growth and change. The directions that distance education takes will depend on such factors as the development of new media and computing technologies, different methods of group learning and information gathering, and the development of government telecommunications policies.

While the phenomenal growth of electronic networks (exemplified by recent public attention to the Internet) has pro-

vided the primary technological thrust, several other emerging technologies also promise to drastically change the landscape of education, in general, and distance education, in particular.

13.5.1 Electronic Networks

The past few years have produced an explosion of electronic information resources available to students, teachers, library patrons, and anyone with a computer. Millions of pages of graphics and text-based information can be accessed directly on-line through hundreds of public, private, and commercial networks, including the biggest network of all: the Internet. The Internet is, in fact, a collection of independent academic, scientific, government, and commercial networks providing electronic mail and access to file servers with free software and millions of pages of text and graphic data that even thousands of elementary and secondary students are now using (McIsaac & Barnard, 1995).

For example, Mosaic and Netscape are two applications that have been made available on the Internet by the World Wide Web project, which enables users to browse around databases and supercomputers on the Internet using a hypermedia format. The World Wide Web project is a distributed hypermedia environment that originated at CERN with the collaboration of a large international design and development team that continues to work informally on the project to bring about new innovations on the Internet. Mosaic and Netscape, World Wide Web applications, are Internet-based global hypermedia browsers that allow you to discover, retrieve, and display documents and data from all over the Internet. For example, using these interfaces, learners can search the databases in museums all over the world that are connected to the Internet by navigating in a hypermedia format. Browsing tools such as these help learners explore a huge and rapidly expanding universe of information and gives them the powerful new capabilities for interacting with information.

The Clinton-Gore administration came into office with plans for developing a new U.S. high-speed electronic network that will vastly extend the capabilities of current Internet services to learners through an information superhighway. The plan, *The National Information Infrastructure: Agenda for Action* (U.S. Department of Commerce, 1993), is ambitious and will have far-reaching effects on education by expanding access to information.

The Clinton administration has proposed a federal assistance program to help schools acquire the hardware necessary to access the Internet. The plan would include providing matching grants to schools through the Commerce Department to buy computers and other telecommunications equipment needed to provide access to the Internet and any new information infrastructure. Plans are to include all levels of education, and to create a federal task force to provide telecommunications standards for education (West, 1993).

The fiber-optic infrastructure in the United States that will provide the backbone of the NII is rapidly expanding through both public and commercial efforts. Fiber optics are capable of carrying much greater bandwidth technologies, such as full-motion video. These lines can provide two-way videoconferencing, on-line multimedia, and video programming on demand. Iowa, for example, has installed nearly 3,000 miles of fiber-optic cable linking 15 community colleges and 3 public universities with a 48-channel interactive video capability (Suwinski, 1993).

The ultimate goal of electronic networks is, as Christopher Dede (Dede, 1991) puts it, to "widen the bandwidth of communication" between people regardless of their locations. Virtual communities of learners and educators are already sharing information resources, which are growing exponentially over the Internet and will grow even faster with a more extended international information infrastructure. Global "virtual libraries" are now emerging through connections between university research libraries (Rossman, 1992). These shared on-line public databases form the beginning of a comprehensive worldwide knowledge resource that is becoming available to anyone with access to a network gateway.

13.5.2 CD-ROM

CD-ROM is one of the most promising of the rapidly emerging technologies for education. An ever-increasing amount of text, graphic, and even full-motion video data is being recorded and distributed on CD-ROM. There is also a constantly expanding hardware base for CD-ROM as more and more personal computers are being shipped with CD-ROM drives and people are retrofitting PCs with the drives. As digital video compression improves, CD-ROM, or a similar optical-storage format, could replace videotape and laser discs as the most popular medium for distributing full-motion video programming, films, and telecourses.

Current versions of CD-ROMs hold about 600 Mb of digitized information. Most multimedia applications are CD-ROM—based, since video, audio, and graphic files require enormous amounts of storage space. An example of a popular CD-ROM title is the *Compton 's Multimedia Encyclopedia,* which provides both the traditional text and still images along with animation and video. Essentially a hypermedia database, the encyclopedia allows random access to any of its material guided by the interests of the user.

A good example of how CD-ROM can affect education is the creation of a graduate media design course developed by the College of Education at Arizona State University. With the help of a grant from the Intel Corporation, this course was redesigned and transferred to CD-ROM. The entire class and all supporting materials are now available to students and Intel trainers to learn at their own pace and in any setting (Technology Based Learning, 1994). If it is now possible to offer a graduate course completely packaged on one

CD-ROM, then virtually any other academic course could be designed, developed, and produced for this medium.

There are currently nearly 4,000 CD-ROM titles listed in media directories. Although heralded as the wave of the future for years, CD-ROM has languished as a technology while suffering a "chicken-or-the-egg" problem. CD-ROM titles grew slowly because there was only a small installed hardware base. Meanwhile, many people were hesitant to buy CD-ROM drives until more titles were offered. Recently, however, the market has begun to snowball as faster, less-expensive drives are being installed by manufacturers, and the CD-ROM developers are finding a rapidly expanding market for their products.

13.5.3 Personal Digital Assistants

Apple's introduction of personal digital assistants (PDAs) has opened a new realm of freedom and power for computing and telecommunications users that could well have important implications for educational users, PDAs provide a screen that can interpret what is written on it with a stylus and convert that to text. These handheld devices currently are used to send and receive fax messages via cellular telephone technology, store calendars, store telephone numbers, and dial them for voice communications, and the devices can send and receive data with the user's desktop computer.

PDAs offer convenient audio and data storage for the relatively small amounts of information that professionals working in the field need. Although they are used for writing notes and keeping track of schedules, their future value may be more in the order of complete wireless telecommunications devices.

Combined with the rapid proliferation of cellular telephone service in the United States, these technologies can free learners from the need to be tied to a particular hardwired location to access information. Additionally, a consortium of major telecommunications, electronics, and aerospace firms is currently planning a global satellite network that would offer direct telephone service without the need for satellite dishes to literally any location on Earth. This could provide not only voice but also direct-data and fax access to anyone anywhere utilizing PDA technology. How viable this will be for remote populations depends on the cost for this service, but the technology could soon be in place.

With the profusion of microprocessor technology in offices, homes, cars, and all forms of electronics, PDAs could someday become the ultimate remote control allowing people to access records on home or office computers and control functions of electronics in these locations using cellular-phone technology.

What we see in all of these technologies is that once-separate devices are now merging to form information appliances that eventually will allow users to communicate seamlessly with each other, control home and office environments, and, most importantly of all, access most of the world's information, whether in text, audio, or visual form, at any place and any time,

13.5.4 Virtual Reality

Virtual reality (VR) (see 15.3) offers the promise of training future students in ways that currently are far too dangerous or expensive. Virtual reality combines the power of computer-generated graphics with the computer's ability to monitor massive data inflows in real time to create an enclosed man/machine interactive feedback loop. VR participants, wearing visors projecting the computer images, react to what they see, while sensors in the visor and body suit send information on position and the head and eye movement of the wearer. The computer changes the scene to follow the wearer and gives the impression of actually moving within an artificial environment.

Medical students wearing a virtual-reality visor and data suit could perform any operation on a computer-generated patient and actually see the results of what they are doing. Pilots could practice maneuvers as they do now in trainers, but with far more realism. The U.S. Defense Department has already used primitive networked versions in their SIMNET training. This network connects and controls training simulators in the U.S. and Europe, so that hundreds of soldiers can practice armored maneuvers while the computer reacts to their judgments and allows them to see each other's moves as if they were all together (Alluisi, 1991).

Beyond practical training needs, virtual reality could put students on a street in ancient Rome, floating inside of a molecule, or flying the length of our galaxy. Many scientists are now beginning to understand the power of visualization in understanding the raw data they receive. Virtual reality will be used by students and professionals alike to interpret and understand the universe.

Individuals interacting in a virtual world will undoubtedly create unanticipated communities and possibly even new and unique cultures. There are concerns, however. Dede (1992) warns that "the cultural consequences of technology-mediated physical social environments are mixed." While providing a wider range of human experience and knowledge bases, these environments can also be used for manipulation and to create misleading depictions of the world.

13.5.5 Video Servers/Digital Video

The next step in the delivery of full-motion video is the advent of reasonably priced video servers. Video servers are essentially nothing more than a large hard drive fast enough to play back the digitized video signal. With current compression techniques, 1 minute of full-motion video and audio requires about 6 Mb of storage space.

One impressive example of how video servers are already being used for education is the Holocaust Museum in Washington, D.C. Museum visitors have instant random access to 35 hours of documentary film stored on a 60-gigabyte-drive array from any one of 25 touchscreen kiosks (Lauriston, 1993). With the installation of greater bandwidth telecommunications lines, it is possible that in the near future students and researchers anywhere could have access to this and thousands of other global video servers from their desktops. A local area network within the museum provides a graphical front-end user interface at several kiosks for simultaneous patron access to any of the material.

Such servers could also provide access to filmed or videotaped footage for military trainers, flight simulators, or other industrial types of training needs. It also becomes possible, as video compression becomes more efficient and digital storage capacity becomes larger and less expensive, to place more and more of the historical visual archives of the 20th century in an accessible format on demand.

Indeed, we believe that the trumpeted phenomena of 500- and 600-channel cable television will be short lived, if in fact it ever is implemented. Instead, consumers and learners will need only one channel into their homes. They will have access to thousands of video databases to order up telecourses, documentary footage, movies, shows, and news over fiber-optic cable.

Dialing into these resources should be no more difficult than calling a phone number. The main challenge will be how to navigate this sea of visual resources. Artificial-intelligence software will be needed that will track all of the databases, their contents, and, most importantly, that will be able to learn what the users needs and interests are.

Current federal programs are providing funds to the National Science Foundation and NASA to develop the technology for turning massive amounts of audio, text, and visual databases into on-line "digital libraries" (Polly, .1993). Setting national standards and formats for these data could open the floodgates to the digitizing and subsequent public access to enormous amounts of information beginning with government agencies such as the National Archives, the Library of Congress, and the collections of the Smithsonian museums.

13.5.6 Personal Computers

Personal computers are not new as technology, but they are rapidly evolving into new areas. During the past decade, PCs have been used in education to run tutorials and teach students to use the big three: word processing, database management, and spreadsheets. Now personal computers are poised to explode into new areas.

PCs will provide the hub for new electronic information appliances. These will control incoming video over cable and fiber-optic lines, handle both incoming and outgoing electronic mail over the Internet and the newer National Information Infrastructure, and even search globally for text, audio, graphic, and video files needed by the user. Children in many schools are already piloting some of these computer-based uses by navigating the Internet to find files, downloading information from the networks, and electronically copying and pasting reference material from network resources to their papers. They are also discovering the ease of communicating with their peers around the world through their computers.

As more people migrate to laptop computers, the additional portability makes it possible to carry all files, papers, financial records, and any other text-based materials. New software is making communication, writing, publishing, and learning easier. Further miniaturization and increased power of microprocessors will help control everything from cooking to telecommunications. As protocols are standardized so that they can work together, one personal network can become seamless as processors control fax, copying, and telecommunications functions, as well as environment and power utilization. Combining them with data storage devices like CD-ROM makes it possible to create more educational support for personal computers.

These new technologies can lead to more empowerment and thus more learner control of instruction for distance education students who have access to them. Access, however, may turn out to be the key problem. The Internet is currently paid for by federal government funds and its constituent members. Students at institutions on the network rarely have to pay for their accounts. Will this change when more and more commercial interests take part?

Students in developing countries with limited assets may have very little access to these technologies and thus fall further behind in terms of information infrastructure. On the other hand, new telecommunications avenues such as satellite telephone service could open channels at reasonable cost to even the remotest areas of the world. One very encouraging sign from the Internet's rapidly developing history is not only the willingness but also the eagerness with which networkers share information and areas of expertise. Networks have the potential of providing a broad knowledge base to citizens around the world, and those networks will offer opportunities for expanded applications of distance education. Research is just beginning to indicate how these newer technologies can benefit learners.

13.6 RESEARCH RELATED TO MEDIA IN DISTANCE EDUCATION

Much of the early research in distance education focused on comparisons between delivery media such as television, video, or computer and traditional face-to-face teaching. Other research compared the effectiveness of one distance delivery medium over another. Most of these media com-

parison studies (see 4.3.4.2) found no significant differences (NSD) in learning (Boswell, Mocker & Hamlin, 1968; Chu & Schramm, 1967; Chute, Bruning & Hulick, 1984; Hoyt & Frye, 1972; Kruh, 1983; Whittington, 1987). Critiquing these early media comparison studies, Spenser (1991) points out that they tended to report comparative statistics that gave no indication of the size of differences, if any, between the types of instruction. Conclusions tended to be based on the presence or absence of a statistically significant result. "When groups of research were reviewed there was a tendency to use a 'box score' tally approach, frequently resulting in a small number of studies favoring the innovation, a similar number favoring the traditional approach, and the vast majority showing NSD" (p. 13).

Whatever methods have been used to report the results of media comparison studies and their instructional impact, these studies have yielded very little useful guidance for distance education practice. This prompted Clark (1984) to make the following observation: "Learning gains come from adequate instructional design theory and practice, not from the medium used to deliver instruction" (p. 3).

Although Clark's statement has been debated (Kozma, 1994), educational technologists agree that the quality of the instructional design has a significant impact on learning. It is time, therefore, to move away from media comparison studies that often yield no significant differences and begin to examine factors such as instructional design, learning and instructional theory, and theoretical frameworks in distance education, which when applied to learning, might account for significant differences in levels of performance. The questions that need to be asked are not which medium works best, but rather how best to incorporate media attributes into the design of effective instruction for learning. Studies that compare two different instructional designs using the same medium may yield more useful results for practice than simple media comparisons. Little research has been done to examine what happens in the learning process when students interact with various technologies.

Research in the area of distance education falls into areas of traditional and exploratory research. Traditional research occurs within the field and is reported in the distance education literature. Exploratory research is often interdisciplinary and found in related literature. It is frequently the result of interest in educational application of newer technologies in various related disciplines.

The traditional research literature in distance education is brief and inconclusive. Both quantitative and qualitative studies have generally lacked rigor. Driven by practice, much research has taken the form of program evaluation, descriptions of individual distance education programs, brief case studies, institutional surveys, and speculative reports. Although well-reported case studies offer valuable insights for further investigation, the literature in distance education lacks rich qualitative information or programmatic experimental

research that would lead to testing of research hypotheses. Also, because of the international nature of the field, research is reported in international journals, many of which are not peer reviewed. A number of research reports are generated by governmental agencies and institutions responsible for large-scale distance delivery programs. These may be proprietary and are often not readily available.

Much traditional research in distance education has focused on issues of technology. More than 23% of the literature reviewed concerned issues related to technology and the role of the distance educator. As we said, most of those related to technology were media comparison studies that resulted in no significant difference. Issues concerning new technological advancements were most frequently a concern of North American writers.

13.6.1 Research Development

Scholars have approached the question of distance education research in a variety of ways. Coldeway (1990) notes that researchers in the field have not tested the various theories that have been advanced, and hypotheses have not been identified for experimental research. He calls for the development of a research base using, for example, Keller's Personalized System of Instruction to build a baseline of data for distance education research. Shale (1990) comments that research within the field is not productive because the field has limited itself to studies of past and present practices that look at "distance" as the significant concept. He calls for an examination of broader issues in education that look at communication technologies as part of education at a distance. He cautions that:

> In sum, distance education ought to be regarded as education at a distance. All of what constitutes the process of education when teacher and student are able to meet face-to-face also constitutes the process of education when teacher and student are physically separated (p. 334).

This view has not been popular within the distance education community. However, it has become apparent that more significant research dealing with variables that affect distance learners is being done outside of distance education than within it. Model studies, often exploratory, are appearing not within traditional distance education literature, but across disciplines where researchers are examining the interaction of learners with newly developing technologies. Nonetheless, there are a number of significant research studies both in traditional and exploratory areas of distance education.

A few recent studies have attempted to examine learning style variables and the media and methods used in distance education. Davie (1987) conducted a study of the interaction of learning styles (as measured by the Kolb instrument) and computer-mediated communication (see Chapter 14), and noted the need to conduct similar studies using larger samples and the importance of examining the relationship of learn-

ing style to student achievement. Gunawardena and Boverie (1992) conducted a study that examined the interaction of learning styles and media, method of instruction, and group functioning in distance learning classes that used audiographics conferencing as the predominant delivery medium. The learning style instrument used for this study was the Kolb LSI (1985). The major finding of this study was that learning styles do not impact how students interact with media and methods of instruction, their instructor, or other learners. But learning styles do affect satisfaction with activities involving other learners. Accommodators appear the most satisfied and Divergers the least satisfied with class discussions and group activities. Class type, whether students were on campus or off campus, rather than learning styles impacted student satisfaction with media, methods, learner-instructor interaction, learner-learner interaction, group satisfaction, goal setting, and group climate. The results of this study cannot be generalized because of the small sample in the distance class. The authors suggest that further research involving larger samples is necessary to validate these results.

13.6.2   Research and Technology

Garrison (1990) begins the discussion of technology with this statement:

> Distance education is inexorably linked to the technology of delivery. It can be seen as a set of instructional methods based largely on mediated communication capable of extending the influence of the educator beyond the formal institutional setting for the purpose of benefiting the learner through appropriate guidance and support. Without technology, a future for distance education does not exist (p. 45).

Most distance education programs today require the use of technology, and many authors (Baker, 1989; Clark, 1989; Stubbs & Burnham, 1990) are calling for revised evaluation techniques. In 1983, Clark startled the educational community with his statement that there is nothing intrinsic to technology that makes the slightest difference to student achievement. Hoko (1986) agreed with Clark in his hypothesis that there is no distinct advantage to one medium over another. Six years later, however, Clark (1989) called for an evaluation plan to determine both the basic needs of students and instructors and the technological components that mesh with those needs. Baker (1989) went a step further by saying that the evaluation process must be ongoing. As each new technology emerges, evaluation of that technology should be done prior to and throughout its implementation.

Stubbs and Burnham (1990) take a slightly different view. They argue that most media evaluation models like the Reiser and Gagne model (Reiser & Gagne, 1983) do not deal with critical dimensions of distance education. In distance education, media provide primary rather than secondary materials for learning. Winn (1990) suggests that the technology chosen for instruction may not affect the eventual achievement outcome, but "it greatly affects the efficiency with which instruction can be delivered" (p. 53). Distance education developers, worldwide, face the challenge of selecting the most efficient medium for delivery of instruction. Wagner (1990) believes that as technologies become more complex— i.e., interactive television, computer-based instruction, and teleconferencing—the need to be more accountable and effective when selecting and utilizing instructional delivery systems becomes increasingly more important.

Early distance education programs relied primarily on print materials for instruction. This format is still the medium of choice in places like Spain and Latin America where the cost of broadcast television is considered prohibitive (Garrido, 1991). Numerous texts and didactic guides are published yearly by the National University for Distance Education (NUDE) located in Spain. In addition to the print material, Spain and Latin America now supplement the printed material with a series of daily radio broadcasts from Radio Nacional de Espana. Spain and Latin America are not alone in their widespread use of print material, Garrido's article also includes Venezuela, which only recently instituted, on a limited basis, both television and audiocassette delivery systems to supplement text-based instruction. Costa Rica has a similar program in operation (Garrison, 1990). While many countries must rely on print to disseminate instruction, Turkey and other developing countries with large communication infrastructures already in place use broadcast television (McIsaac, 1990). As distance education increases worldwide, the need for continued modern delivery systems will continue (Winn, 1990).

Much of the literature originating in the United States, though not in other countries, discusses the advancement of technology to facilitate the delivery of distance education. Computer-assisted learning (CAL) (see 12.23) and computer conferencing (see Chapter 14) lead the list for the number of articles. One reason may be that CAL and computer conferencing have allowed a shift from individualized, selfdirected learning to collaborative learning (Lauzon & Moore, 1989). Additionally, Lauzon and Moore report that CAL meets the diverse needs and characteristics of adult learners by providing the opportunity for the learner to control and pace the instruction. Qualitative research by Cheng, Lehman, and Armstrong (1991) supports the effectiveness of CAL and reports CAL to be "an effective teletraining device for academic institutions" (p. 63). Abrioux (1991), however, sees CAL as a somewhat questionable technological application. His research on language acquisition foreshadowed a need for student-to-student and student-to-instructor interaction. Abrioux also questions the cost effectiveness of CAL in terms of student achievement. While CAL was once viewed as one student working with material presented by one computer, advances in technology have allowed linkage of many computers and many students. This linkage is often entitled *computer conferencing.*

In their discussion of computer conferencing, Davie and Wells (1991) support the need for interaction. They describe one of computer conferencing's most frequently cited characteristics as being its many-to-many capability. Computer conferencing is an ideal communication tool for bridging time and space among those who share similar interests. Lauzon and Moore (1989) note that computer conferencing is "effective in removing the barriers of time and space as constraints on communication" (p. 40). Their article goes on to describe "on-line communities that will be instrumental in the realization of a 'learning society' by transforming current distance education systems into on-line educational communities" (p. 40). Harasim (1990) observes that because of the democratic openness of the computer conference environment, all students have an equal opportunity to contribute. Although the majority of literature on computer conferencing is positive, Harasim continues her response to computer conferencing by pointing out several opposing features. She reports that class members have difficulty reading the computer screens and following a variety of on-line, visual cues. She also cautions that distance educators should review the amount of material students are required to read both on and off the computer screen. While these comments are precautionary and important to both students and instructors in distance education, an overall view of the literature indicates that the positive benefits of CAL and computer conferencing appear to outweigh the disadvantages.

A second technology often cited in current literature is interactive television with two-way audio and two-way video capabilities. Although the majority of literature reviewed interactive projects within the United States, Collis (1991) reports from the DELTA Project (Developing European Learning Through Technological Advance) that nearly all of the countries involved expressed a need for modern interactive technology in Europe's future distance education projects. A further comment calls for teamwork and interaction. "The learning system should be capable of supporting team work in the classroom or between learners at different locations, enabling work material to be exchanged between and displayed at other locations (von Stachelsky, 1991, p. 9). Canada has joined the United States and the countries involved with the DELTA Project in selecting interactive television technology because of its interactive modality for students and instructors (Helm, 1989). The term *interaction* in the literature does not exclusively refer to a two-way technologically mediated exchange. Cost factors, coupled with lack of access to the necessary components of interactive television, have led several institutions to give "interactive" a less mechanically oriented definition. The Ontario Institute for Studies in Education (Harasim, 1990), Nova University (Scigliano, Joslyn & Levin, 1989), and the Dutch Open University (Meurs & Bouhuijs, 1989) all facilitate interaction by combining face-to-face meetings with computer-assisted learning (Davie & Wells, 1991). Regardless of how interaction is defined, its importance cannot be underesti-

mated, especially in the realm of distance education (Harasim, 1990).

Television, another often cited technology, is becoming a widely used medium due to the availability of satellites, both in Europe and China. China's satellite television-based multimedia education system is the largest in the world (Gao, 1991). Gao continues by stating that, with a population of 1.2 billion people, Chinese satellite television is the only technology capable of reaching so many people and meeting their educational needs. Germany's academic Society for Adult Further Education based in Stuttgart also uses satellite television to disseminate instruction throughout Germany (Hawkridge, 1991).

Technologies come in many packages, says Garrison (1989), but each must be scrutinized for its effect on the achievement of the learner, for its costs, and for the environmental conditions necessary for its implementation. Administrators of distance education should not attend exclusively to the issues related to technology. Research is needed to identify how technology interacts with students and how it affects teaching and learning.

Areas of interest to researchers in distance education have been categorized in a variety of ways. The International Centre for Distance Learning (ICDL) at the British Open University, the largest single database of distance learning literature, has divided topics in distance education into theory, student psychology and motivation, administration and support, curriculum development, teaching materials and resources, and institutions and staff.

13.6.3 Research and Students

Although studies focusing on learners have received attention in the literature (18%), it is largely descriptive. Research-based articles, however, can be found in works by Tovar (1989), Wilkinson and Sherman (1990), and Baynton (1992). Aslanian and Brickell's (1988) qualitative research offers a very extensive profile of the distance education student in America. Their findings are congruent with international programs, although the international research is generally empirical. Nearly one-fourth of the literature reviewed about students calls for student-instructor interaction in order to decrease anxiety and increase motivation. The need for interaction is additionally associated with the selection and implementation of specific media within the distance education course.

As a form of nontraditional education, distance education serves mainly adults, and those adult students possess unique needs, motivations, goals, and self-concepts. In a qualitative study with 1,000 adults, Aslanian and Brickell (1988) developed a profile of an adult distance education learner. They found that, in general, the students are married (61%), female (58%), part-time students (80%), employed full time (71%), and paying for their own schooling (60%).

Of the adults surveyed, 75% were between the ages of 25 and 44 years of age. Apt and Enert (1983) compiled student characteristics at six open-learning programs and found similar results. International results were found to be congruent in work done by Van Enckevort, Harry, Marin, and Schultz (1987) at four European distance education universities. Administration, instructors, and curriculum designers must take the needs of the adult student population into account when proposing theoretical and andragogically based instruction designed for distance education programs (Verduin & Clark, 1991).

The adult student generally enters the learning environment, whether traditional or distant, with a high degree of motivation (Ehrman, 1990). Knowles's (1984) learner-focused theory of andragogy suggests that much intentional learning activity of adults is motivated by their desire to move from their current level of proficiency to a new, higher level. Verduin and Clark (1991) agree with both Knowles and Ehrman: "Discrepancies between adults' current level and desired proficiency level directly affect motivation and achievement in both learning activities and life roles" (p. 25).

Although adults possess a high degree of motivation, the technology associated with distance education, coupled with the distance separating the student and instructor, leads to high degrees of anxiety. Anxiety in learning has occasionally been described as helpful, but more often treated in terms of its negative affects (Aggasiz, 1971). A negative view of anxiety comes from Darke (1988), who believes that anxiety can debilitate cognitive processing. The importance of student anxiety cannot be underestimated in facilitating two-way interaction between students and instructors in the distance education setting. The painful anxieties that learners experience in any instructional setting tend to be exacerbated when that learning is mediated by technology (Garrison, 1989).

Other distance education researchers (Keegan, 1988; Lewis, 1988) have questioned the need for too much student/instructor interaction. They see a large amount of interaction as inhibiting the independence of the learner. Although distance education is premised on creating the potential for greater independence for the learner, it is often "just as confining and inflexible as other forms of education" (Lewis, 1988, p.9). Sewart (1987) suggests that distance education students, perhaps, have greater freedom, but with that freedom comes responsibilities. Freedom demands that the student make a number of important decisions that would normally be made for him:

> It is an interesting and perhaps sometimes infuriating paradox; this provision of flexibility to cater for individuals needs inevitably results in increasing complexity of administrative and organizational procedures which may present the student with problems (Sewart, 1987, p. 168).

13.6.4 Instruction and Learner Support

The issue of learner support has received wide attention in distance education. The research, however, has been varied and inconclusive. After examining 107 articles to determine whether there were predictors of successful student support, Dillon and Blanchard (1991) conclude that the reported research was mixed. They propose a model to examine the support needs of the distance student, related to institutional characteristics, course content, and the technology. In a study analyzing learner support services in a statewide distance education system, Dillon, Gunawardena, and Parker (1992) outline the function and effectiveness of one learner support system and make recommendations for examining student program interactions. Feasley (1991) comments that although research on student support falls largely into the evaluation category, there are some very useful case studies and institutional surveys such as reports issued by FernUniversitat and National Home Study Council which summarize statistics about student services for a number of institutions, Wright (1991) comments that the largest number of studies related to student support have been conducted outside the United States with large distance education programs. The student support activities reported are preenrollment 'activities and tutorial services, as well as counseling and advising services.

In addition to student support, several ethical and administrative issues related to students are repeated in the current literature as well. The mediation of technology coupled with the distance between instructor and student poses questions related to admission, counseling, and retention. Reed and Sork (1990) provide evidence that admission criteria and intake systems should take into account the unique demands of the adult learner (i.e., motivation, anxiety, interactions, and learning style). Nelson (1988) states that admission requirements should consider the effects of the individual's cognitive styles, as these often affect student achievement in programs characterized by mediated communications and limited personal contact.

Combined with the institutions' responsibilities related to admissions procedures is the responsibility of counseling students into and out of programs where the learner and advisor are physically separated (Reed & Sork, 1990). Herein two issues arise. First, the nearly impossible task of understanding the life situation of the learner when distance and time interfere with communication makes counseling a difficult task at best. Second, the monetary requirements of the distance education institution and the well-being of the student who may or may not be advised into a distance education environment must be considered. Reed and Sork (1990) observe that students counseled out of distance education represent a loss of revenue. Counseling in a traditional setting requires expertise in a number of psychological and academic areas. However, counseling from a distance is a highly complex process that calls for a variety of methods, materi-

als, and a knowledge of adult learner characteristics (Verduin & Clark, 1991).

The recent literature has offered various profiles of the distance education student. Counseling professionals should review the research on student needs and develop new methodologies for assisting students at a distance. Additional research is called for in all areas of student interaction with the learning environment.

13.6.4.1.   Learning and Characteristics of Learners. The study of learning and characteristics of learners engages the largest number of researchers and includes studies of learning styles, attitudes, personality, locus of control, motivation, and attrition. Included are general studies about cognition and metacognition, as well as specific studies related to the particular needs of the distance learner. Many studies have been single-group evaluations, few with randomization of subjects or programmatic investigations. Some exploratory research has involved a small number of participants in short interventions. Although these efforts yield interesting insights, they have not helped solve the problem of isolating and testing variables that might predict academic success. Often, experimental studies use thin descriptions and do not provide deep contextual information. Similarly, descriptive studies often lack generalizability and are not qualitatively rich.

Research reports that do appear in the literature are often inconclusive. Reports in the literature suggest that some combination of cognitive style, personality characteristics, and self-expectations can be predictors of success in distance education programs. It appears that those students who are most successful in distance learning situations tend to be independent, autonomous learners who prefer to control their own learning situations.

Characteristics besides independence which appear to be predictors of success are high self-expectations and self-confidence (Laube, 1992), academic accomplishment (Coggins, 1988; Dille & Mexack, 1991), and external locus of control (Baynton, 1992). Another motivation that reportedly influences academic persistence is the desire to improve employment possibilities (von Prummer, 1990). Research findings suggest that it is the combination of personal (such as learning style), environmental, and social factors that must be taken into account when predicting academic success in distance learning programs.

Verduin and Clark (1991) examined learning styles within the distance education setting and reviewed the research done on learning styles by Canfield in 1983. Canfield developed a learning style inventory that conceptualized learning styles as composed of preferred conditions, content, mode, and expectancy scores. Verduin and Clark (1991) believe this information can be helpful to educators in planning courses for students who will receive the instruction from a distance. They indicate that an understanding of how individual learn-

ers approach learning may make it possible for the distance educator to see a pattern of learning styles and plan or adjust course presentations accordingly. They conclude by saying that adults may or may not learn more easily when the style of presentation matches the students' learning style, but when the two do match, the students report being more satisfied with the course.

Perhaps the most interesting work in cognition appears outside the traditional confines of the distance education literature. Research that examines the interaction of learners and delivery media is currently being conducted with multimedia. These studies examine learning and problem solving in asynchronous, virtual environments in which the learner is encouraged to progress and interact with learning materials in a very individual way. In the Jasper experiment (see 12.3.2.2), for example, math problems are anchored in authentic real-world situations portrayed on videodisc (Van Haneghan, Barron, Young, Williams, Vye & Bransford, 1992). It was hypothesized that the attributes of videodisc, which allow the portrayal of rich audio and visual images of a problem situation, would enhance the problem-solving abilities of learners. Research results showed significant gains for the video-based group over the text-based group, not only in solving the original Jasper problems but also in identifying and solving similar and related problems. The rich video-based format context was found to simulate a real-world context for problem solving (Van Haneghan et al., 1992). In a similar vein, the Young Children's literacy project uses a Vygotsky scaffolding approach to support the construction of mental model-building skills for listening and storytelling (Cognition & Technology Group at Vanderbilt, 1991). Programs like Jasper and the Young Children's literacy project provide robust sensory environments for developing metacognitive strategies and participating in critical thinking. These cognitive approaches to teaching abstract thinking skills have found fertile ground in the design and development of multimedia programs.

Individualized instruction delivered in multimedia settings has begun to blur the distinction between distance education and traditional education. The use of computer technologies to enhance thinking has generated interest in all areas of the curriculum. Researchers are examining ways to decontextualize classroom learning by anchoring and situating problems to be solved as real-life events (Brown, Collins & Duguid, 1989). Collaborative interactions between learner and technology have caused cognitive psychologists to reexamine the effects of computer technology on intellectual performance. Salomon, Perkins, and Globerson (1991) call on educators to investigate the learning activities that new technologies promote. They argue that it is this collaborative cognitive processing between intelligent technology and learner which may have the potential for affecting human intellectual performance.

The authors make the distinction between effects *with* technology, in which the learner enters into a partnership in which the technology assumes part of the intellectual burden of processing information (calculator), and effects of technology (see 24.3.5) and related transfer of skills. The former role of technology is what has been referred to by Pea (1993) as *distributed cognition* (see 24.3.8). The distributed model of cognition has its roots in the cultural-historical tradition and is reflected in the work of Luria (1979) and Vygotsky (1978). This view of the distribution of cognition from a cultural-historical perspective maintains that learning is not an individual process but is part of a larger activity that involves the teacher, pupil, and cultural artifacts of the classroom. Knowledge does not reside with an individual alone but is distributed among the tools and artifacts of the culture. The technologies of today have created graphic interfaces that offer symbiotic and virtual environments distributed between human and machine.

One example of such a symbiotic environment is a computer conference network called the WELL. It is a ""virtual community" where people meet, converse, and socialize. This '"digital watering hole for information-age hunters and gatherers" has developed into a unique social and communication phenomenon (Rheingold, 1993). It functions as cafe, beauty shop, town square, pub, lecture hall, and library. In short, it is a network of communications in cyberspace, a true virtual community. The social and cultural ramifications of this type of community, which functions in cognitive and social space rather than geographic space, has vast implications for research in distance education,

These new learning environments are distance learning settings, and they prompt researchers to ask further questions: How do these environments enhance cognitive activities? Which personal learning-style factors are important to consider in designing interactive materials for effective instruction? Can we predict which program elements are likely to enhance student learning?

13.6.5 Course Design and Communications

A number of research studies have been conducted around the issues of designing course material for distance education. A brief review of the literature reveals that the most frequently expressed concern in courses designed for distance learners has to do with providing the learner with adequate feedback (Howard, 1987; McCleary & Eagan, 1989). Learner feedback is listed as one of the five most important considerations in course design and instruction, and it is identified by Howard as the most significant component in his model for effective course design.

Other major issues that relate to course design are effective instructional design, selection of appropriate media based on instructional needs, basic evaluation, and programmatic research. There appears to be little reported systematic research in this area because of the time and costs involved in

conducting such large-scale projects. McCleary and Egan (1989) examined course design and found that their second and third courses received higher ratings as a result of improving three elements of course design, one of which was feedback. In a review of the research, Dwyer (1991) proposes the use of instructional consistency/congruency paradigms when designing distance education materials in order to pair content of material with level of learners' ability. Others suggest models combining cognitive complexity, intellectual activity, and forms of instruction for integrating the use of technology in course delivery.

Although consideration is given in the literature to elements of course design such as interactivity, student support, media selection, instructional design issues, and feedback, little research has been reported other than evaluative studies. Few are generalizable to global situations. Although course design is a primary component of large-scale international distance education programs, little attention has been paid to the underlying social and cultural assumptions within which such instruction is designed. Critical theorists have examined how teaching materials and classroom practices reflect social assumptions of validity, authority, and empowerment. Although the thread of critical theory (see Chapter 9) has woven its way through the fabric of the literature in education, nowhere is it more important to examine educational assumptions underlying course design than in distance education.

Courses designed for distance delivery often cost thousands of dollars to produce and reach hundreds of thousands of students. Not only are hidden curricula in the classroom well documented, there is a growing body of evidence in the literature which critically analyzes the impact of social norms on the production of educational media. In their book, Ellsworth and What ley (1990) examine the ways in which particular historical and social perspectives combine to produce images in educational media that serve the interests of a particular social and historical interpretation of values. Distance learning materials are designed to rely heavily on visual materials to maintain student interest. Film, video, and still photography should no longer be viewed as neutral carriers of information. In a seminal book of readings, Hlynka and Belland (1991) explore critical inquiry in the field of educational technology as a third paradigm, equally as important as the qualitative and quantitative perspectives. This collection of essays encourages instructional designers to examine issues in educational media and technology using paradigms drawn from the humanities and social sciences and sociology and anthropology.

The examination of issues concerning the use of technology is especially important when designing courses for distance education. There are six factors that are particularly critical and need to be considered. In order to distinguish the characteristics of the communications technologies currently being used in distance education, it is necessary to adopt a

classification system, although any classification system may not remain current for very long with the constant development of new technologies.

13.6.5.1. Media and Course Design. Several classification models have been developed to describe the technologies used in distance education (Barker, Frisbie & Patrick, 1989; Bates, 1991; Johansen, Martin, Mittman & Saffo, 1991). In a recent attempt to classify the media used in distance education, Bates (1993) notes that there should be two distinctions. The first is that it is important to make a distinction between '"media" and "technology." Media are the forms of communication associated with particular ways of representing knowledge. Therefore, each medium has its unique way of presenting knowledge and organizing it, which is reflected in particular formats or styles of presentation. Bates (1993) notes that in distance education, the most important four media are text, audio, television, and computing. Each medium, however, can usually be carried by more than one technology. For example, the audio medium can be carried by audiocassettes, radio, and telephone, while the television medium can be carried by broadcasting, videocassettes, videodiscs, cable, satellite, fiber optics, ITFS, and microwave. In other words, a variety of different technologies may be used to deliver one medium. The second distinction is the one between primarily one-way and primarily two-way technologies. One-way technologies, such as radio and broadcast television, do not provide opportunities for interaction, while two-way technologies, such as videoconferencing or interactive television, allow for interaction between learners and instructors and among learners themselves.

For the purpose of this chapter, we would like to expand on a definition adopted by Willen (1988), who noted that where distance teaching and learning are concerned, three characteristics have proved critical to the optimization of the study situation: (a) the ability of the medium to reach all learners, or provide access; (b) the flexibility of the medium; and (c) the two-way communication capability of the medium. We feel that it is necessary to expand these three characteristics to include three others: the symbolic characteristics of the medium, the social presence conveyed by the medium, and the human-machine interface for a particular technology. Whatever classification system is used to describe the technologies, we feel that six important characteristics need to be kept in mind in the adoption and use of these technologies for distance education:

1. Delivery and access: the way in which the technology distributes the learning material to distance learners and the location to which it is distributed—homes, places of work, or local study centers. Student access to technologies in order to participate in the learning process is an important consideration.

2. Control: the extent to which the learner has control over the medium (the extent to which the medium provides flexibility in allowing the students to use it at a time and place and in a manner which suits them best). For example, the advantage of using videocassettes over broadcast television is that students can exercise '"control" over the programming by using the stop, rewind, replay, and fast-forward features to proceed at their own pace. Videocassettes are also a very flexible medium allowing students to use the cassettes at a time that is suitable to them.

3. Interaction: the degree to which the technology permits interaction (two-way communication) between the teacher and the student, and among students. Technologies utilized for distance education can be classified as one-way transmission, or two-way interactive technologies. One-way transmission media include printed texts and materials, radio programs, open broadcast or cablecast television programs, and audiocassettes and videocassettes. Technologies that permit two-way interaction can be classified as either synchronous (real-time communication) or asynchronous (time-delayed communication) systems (see 14.2.3). Audio teleconferencing, audiographics teleconferencing, video teleconferencing, interactive television, and real-time computer chatting—when two or more computers are linked so that participants can talk to each other at the same time—are synchronous technologies that permit real-time, two-way communication. Computer-mediated communications (CMC)—including electronic mail (e-mail), bulletin boards, and computer conferencing—when used in a time-delayed fashion, are asynchronous technologies that permit two-way communication (see Chapter 14).

4. Symbolic (or audiovisual) characteristics of the medium: Salomon (1979) distinguishes between three kinds of symbol systems; iconic, digital, and analog. Iconic systems use pictorial representation; digital systems convey meaning by written language, musical notation, and mathematical symbols; and analog systems are made up of continuous elements that nevertheless have reorganized meaning and forms, such as voice quality, performed music, and dance. Television, for example, uses all three coding systems to convey a message. Salomon (1979) observes that it is the symbol system that a medium embodies rather than its other characteristics that may relate more directly to cognition and learning. "A code can activate a skill, it can short-circuit it, or it can overtly supplant it" (Salomon, 1979, p. 134).

5. The social presence created by the medium: Telecommunication systems, even two-way video and audio systems that permit the transmission of facial expressions and gestures, create social climates that are very different from the traditional classroom. Short et al. (1976) define social presence as the '"degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships (p. 65). This means the degree to which a person is perceived as a "real person" in mediated communication. They define social presence as a quality of the me-

dium itself, and hypothesize that communications media vary in their degree of social presence, and that these variations are important in determining the way individuals interact. The capacity of the medium to transmit information about facial expression, direction of looking, posture, dress, and nonverbal vocal cues, all contribute to the degree of social presence of a communications medium. Two concepts associated with social presence are ""intimacy" and "'immediacy." Short et al. (1976) suggest that the social presence of the communications medium contributes to the level of intimacy, which depends on factors such as physical distance, eye contact, smiling, and personal topics of conversation. They observe that the use of television rather than audio-only communication makes for greater intimacy, other things being equal. Immediacy is a measure of the psychological distance that a communicator puts between himself or herself and the object of his or her communication. A person can convey immediacy or nonimmediacy nonverbally (physical proximity, formality of dress, and facial expression) as well as verbally. Therefore, social presence can be conveyed both by the medium—video can convey a higher degree of social presence than audio—and by the people who are involved in using the medium for interaction—instructors who humanize the classroom climate may convey a higher degree of social presence than those who do not. A recent study (Gunawardena, Campbell Gibson, Cochenour, Dean, Dillon, Hessmiller et al., 1994) examines the concept of social presence in distance education and analyzes student perceptions of two media: audio-graphics and computer conferencing.

6.   Human-machine interface for a particular technology that takes into consideration how the equipment interfaces with the end users: The learner must interact with the interface or the technological medium in order to interact with the content, instructor, and other learners. This may include an activity, such as pushing the press-to-talk bar on some microphones, or learning to use a graphics tablet to communicate graphically in an audio-graphics system. With the rapid growth of new telecommunications technologies, ergonomics (design of human-machine interfaces) has become an important area of research and development within the broader area of research related to human factors. The kinds of interfaces the technology employs has implications for the kind of training or orientation that both teachers and students must receive in order to be competent users of the medium.

When selecting technologies for a distance learning program, or when designing instruction for distance learning, these six factors need to be kept in mind. They are not entities in and of themselves but interact with each other to make up the total environment in which a specific medium operates. Figure 13-2 indicates this interaction.

The evolution of geographic space into cyberspace has profound implications for communication, instruction, and the design of the instructional message.

13.6.5.2. Course Design and the International Market. Issues that examine course design in distance education cross geographic boundaries. Courses that are produced in North America are exported across the world. There is a widespread belief that Western technologies, particularly the computer, are culturally neutral and can be used to modernize traditional societies. When distance education programs are delivered to developing countries, cultural differences are often dealt with by simply translating the existing software, or by writing new software in the local language. What remains is still instruction based on a set of cultural assumptions emphasizing the view that Western technology and science represent the most advanced stage in cultural evolution. This rationalist, secularist, and individualist philosophy remains at the tacit level and suggests that, for any country, true modernization relies on the scientific method and the adoption of culture-free technology. The imported technology boasts capabilities based on assumptions that are frequently in direct opposition to traditions and social practices in the local culture.

Critical theorists (see Chapter 9), and others, have engaged in the debate over obvious discrepancies between the ideal Western view of life and the reality of deteriorating social fabric, loss of traditional values, high crime and drug rates, and other visible social ills. The Western view of modernization and progress have not been universally accepted as ideal. However, by embracing new communication technologies, non-Western countries are buying into a new set of cultural assumptions. The danger is that this may occur at the cost of their own indigenous traditions.

UNESCO has argued that when urban, individualistic images of life are part of the cultural agendas of Western media, people in developing countries will aspire to these to be modern. The long-term effects of technological innovations on cultural traditions have not yet been well docu-
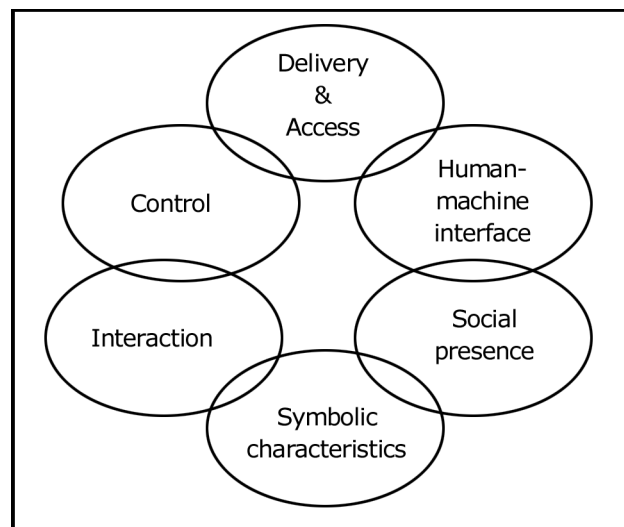

Figure 13-2. Factors impacting selection and use of distance education technologies.

mented. It may be that, in racing to embrace modernism and technological innovations, social and traditional patterns of life will be altered to the extent that local traditions may be irrevocably changed. The cultural values of individualism, secularism, and feminism are not all recognized as desirable in other cultures that place higher values on religion, group efforts, and well-defined gender roles (McIsaac, 1993). Course materials designed with a particular cultural bias embedded in the instruction may have a negative effect on learning.

Moral issues surrounding loss of local culture can result from wholesale importation of foreign values. At the minimum, educators engaged in technology transfer should analyze local social customs and consider those customs, whenever possible. Such social conventions as extended hospitality, differing perceptions of time, and the perceived importance of the technology project can all affect the credibility of the program and, ultimately, its success (McIsaac & Koymen, 1988).

Course designers should first determine the underlying assumptions conveyed by the educational message being designed. Designers should consider the social and political setting in which the lessons will be used. They should determine whether the instructional design model has implicit cultural and social bias. And, finally, tacit messages and hidden agendas should be examined and eliminated wherever possible so that course materials do not reflect particular ideological points of view. Distance education research in course design should include programs of social research that explore the effects of technological innovations on cultural traditions.

13.6.6 Issues Related to Teaching

Studies that examine teaching in distance education address the developing role of the instructor, the need for decreasing resistance as traditional educators begin to use distance delivery systems, and, finally, faculty attitude toward the use of technology. Altered roles for faculty who teach in distance education settings is a common thread found throughout the literature. Sammons (1989) sees a need for definition of the role of teacher. He stresses that without this definition, prepackaged, mass distribution of education will result. Holmberg's (1989) theory of guided didactic conversation suggests that a relationship exists between the faculty's role in the conversation and student performance. Smith's (1991) qualitative study places students' involvement at the center of the foundation for distance education teaching activities. The extent to which faculty roles are modified by the distance education environment is related to how the technology is used (Dillon & Walsh, 1992).

Some educators express concern that the use of packaged television courses creates negative consequences for mediated instruction. Sammons (1989) notes that the teaching role is an interactive, social process and questions whether

presenting a telecourse or mass producing learning material for presentation at a distance is teaching. Peters (1983) lends an organizational perspective in his comparison of distance teaching to an industrial enterprise. He reports on the mass production of learning materials, mechanization, automation, quality control, and other operational activities. According to Peters, the teacher need not teach in a personal, face-to-face mode but rather should provide cost-effective instruction that can reach large numbers of students.

The emergence of increasingly student-centered learning activities of the 1970s, facilitated by technology in the 1980s, is contributing to an evolution of the role of faculty in the 1990s (Beaudoin, 1990). In particular, the increase in distance education enrollment will profoundly impact faculty members' instructional roles. Rather than transmit information in person, many faculty will have to make the adjustment to monitoring and facilitating the work of geographically distant learners (Bates, 1991). Faculty accustomed to the more conventional teaching roles will be required to accommodate new skills and assume expanding roles (Kember & Murphy, 1990).

This role shift from the European model of teacher as the exclusive source of information to one of facilitator is a difficult and threatening situation for most teachers. The role of teacher is not becoming obsolete but instead is being transformed (Beaudoin, 1990). Educators, and in particular those in distance educational environments, must be proficient at both delivery of content and the operation of the technology. Beaudoin goes on to point out that the teacher's role in the 90s is becoming one of facilitator and bridge between student and the learning source (i.e., computer, television).

With new technologies being capable of delivering instruction, teachers are entering into a partnership with the technology. Garrison (1989) notes that while the teacher must be aware of the external aspects of learning, those related to the technology, it is the internal cognitive aspects of the learning experience that remain in the hands of the teacher. Ramsden (1988) sees the role of the distance education instructor as including the challenge of dialogue and interaction. "'Machines,' Ramsden says, '"transmit information as if it were an unquestionable truth" (p. 52). The teacher's role, which must include dialogue, is to challenge the seemingly unquestionable truths and to elicit meaning for the student.

Dillon and Walsh (1992) see a lack of research focus on the role adaptations of faculty, and they recommend future research on this topic. In their review of current literature, Dillon and Walsh found only 24 of 225 articles on faculty roles. Research by Garrison (1990) indicates that educators are resistant to adaptation and to introduction of technology into previously designed classes. The literature suggests that faculty attitudes improve as experience with distance education increases, and as faculty become more familiar with the technology. Taylor and White (1991) support this idea in their findings of positive attitudes from faculty who have com-

pleted the first distance education class, but their study also indicates a faculty preference for face-to-face traditional teaching. The reason most often cited in their qualitative study is lack of student interaction. Additionally, Taylor and White found through interviews and surveys that faculty agree that distance teaching is not appropriate for all content areas or for all students.

There is a lack of training opportunity in distance education which could help faculty overcome anxieties about technology and might improve teacher attitudes. Most teacher in-service programs that deal with technology teach how to operate equipment, with little attention paid to the more important aspects of how to incorporate technology into instruction. Virtually none addresses the concept and practice of distance education as a unique enterprise with different techniques of instruction from the traditional classroom.

In addition to conducting research on the emerging roles of faculty involved in distance education activities, studies are needed to examine faculty attitudes. Many teachers have a natural concern that technology will replace them in the classroom. It is important, says Hawkridge (1991), for teachers in training to be stimulated to a positive attitude toward technology as a means of enhancing the quality of the human interaction, and not to see technology as a dehumanizing influence. Hawkridge is joined by other researchers who call for future study in the area of instructor role development. As technology becomes a means for future educational delivery, a new view of the profession of teaching may need to be developed.

13.6.7 Policy and Management

State and national policies on the use of telecommunication technologies for distance education have been slow to develop in the United States. Many other countries have had well-developed national plans for the implementation of distance education delivery systems over large geographic areas. Countries in which education is centralized at the national level are often those with the largest distance education enterprises. Countries in Asia, the Middle East, Latin America, and Europe which have national policies for the development of distance education often use communication infrastructures that are already in place to deliver massive programs over broadcast media (McIsaac, Murphy & Demiray, 1988). As is the case with the area of learner support, the literature in theory and policy management is concerned largely with institutional evaluation studies that are extremely useful to countries looking for prototype models for establishing large-scale programs, but the literature does not offer testable hypotheses or rich, detailed qualitative analyses. These international evaluation reports of large-scale distance education projects raise issues of national educational priorities, funding sources, and policy determination.

In the United States, the most significant early study to be done on a large scale was Linking for Learning (Office of Technology Assessment, 1989). This report was the first to examine national and state telecommunication initiatives and make recommendations for a plan of action, based on needs of state and local schools. Because distance education in the United States is not supported by a central educational authority as in other countries, development of national and state policy is slower in developing. Key policy issues now receiving attention include: funding, equal access to high-quality education, effectiveness of educational systems, licensing of distance education programs, and equal access to delivery systems (Dirr, 1991). Donaldson (1991) calls for application of organization theory to issues of management and administration in distance education.

Finally, we might ask what conclusions we can draw from the collection of research studies in this rapidly growing area. It seems evident that research has been conducted from many perspectives and in many disciplines. As the body of research studies grows, methods such as meta-analysis can help us analyze the growing body of information. Meta-analysis, the application of qualitative and quantitative procedures for the purpose of integrating, synthesizing, and analyzing various studies, would be particularly useful (McIsaac, 1990). Sophason and Prescott (1988) believe that single studies cannot expect to provide definitive answers to theoretical questions. Instead, a method such as metaanalysis is needed to identify underlying trends and principles emerging from the research.

13.7 INTERNATIONAL ISSUES

Distance learning delivery systems, particularly those that rely on telecommunications, have benefited from the economic growth of the industry. In 1990 alone, telecommunication equipment and services accounted for $350 billion and employed 2.8 million workers. The communication industry in OECD countries has recently become an extremely profitable and competitive business with public telecommunication operators developing new integrated services digital networks (ISDNs) and satellite services. It is predicted that the increased development of high-definition television (HDTV) and mobile communications will be matched with increased deregulation and privatization of networks, increasing competition and lowering costs.

In many countries, although the existing communication infrastructure is old and dysfunctional, newer technologies are developing which will provide for the flow of information to the majority of the population through distance education delivery systems (McIsaac, 1992). This is particularly true in the newly emerging eastern European countries where previous communication suppliers were sparse or nonexistent. In these situations, the newer cellular radio technologies, which can handle a greater number of users than previous fixed-link networks, may provide the answer. Such mobile technologies can be put in place with less cost than wired

networks and, in addition, occupy a very small spectrum of the radio frequencies.

Although the future of new technological developments promises increased accessibility to information at low cost, this access is not without its own pitfalls. Economic power remains largely within the hands of developed countries. From an economic point of view, some disadvantages include the selection of a costly technological solution when a simpler and existing technology might suffice. Technology that must be used over long physical distances with primitive and unreliable electricity and telephone services is not in the best interest of the developing country. The most important consideration for the majority of developing countries is economic independence. It is in many of the economically developing countries that the largest distance learning projects are undertaken. A top educational priority for many such countries is to improve the cost effectiveness of education and to provide training and jobs for the general population. Researchers across the globe are calling for the establishment of national priorities for research in areas such as distance education (Jegede, 1993).

Research-based distance education programs face a number of obstacles around the world. The lack of financial resources available for conducting adequate needs assessment in many countries, particularly prior to embarking on a massive distance education plan, is a common problem (McIsaac, 1990). In many cases, investing money in research is perceived to be unnecessary and a drain from areas in which the money is needed. Time is an additional problem, since programs are often mandated with very little start-up time. In the interest of expedience, an existing distance learning program from another country may be used and revised, but many times this does not adequately answer the needs of the specific population.

One solution to the lack of adequate resources available locally has traditionally been the donation of time and expertise by international organizations to help in developing project goals and objectives. The criticism of this approach is that visiting experts seldom have adequate time to become completely familiar with the economic, social, and political factors influencing the success of the project. A second, and more appropriate solution, has been to train local experts to research, design, and implement sound distance learning programs based on the needs of the particular economy.

Distance education and its related delivery systems are often called upon to support national educational priorities and the current political system. One goal of education, particularly in developing countries, is to support the political organization of the country and to develop good citizens. Distance education programs that endorse this priority will have greater chance for success. National political philosophies and priorities are found reflected in the diversity of distance education programs around the world. These programs conform to prevailing political, social, and economic values. Research, particularly of the applied variety, is essential to avoid the trial-and-error approach that costs international distance education projects millions of dollars.

13.8 SUMMARY AND RECOMMENDATIONS

Distance education programs will continue to grow both in the United States and abroad. One of the reasons for this growth is related to the ever-growing global need for an educated workforce, combined with financial constraints of established educational systems. Distance education offers life-long learning potential to working adults and will play a significant part in educating societies around the world. Distance education will become of far greater importance in the United States in the years ahead because it is so cost efficient and because it allows for independent learning by working adults. If society is to cope with this growing need for an educated workforce, distance education must continue to make its place in the educational community.

Although distance education has been difficult to establish in a number of European countries, influential networks are being established to facilitate future growth. The European Association of Distance Teaching Universities (EADTU) has combined with Eurostep (which organizes educational television across Europe using satellite) and the Budapest Platform (providing satellite television to central and eastern countries) to develop a system of distance education programs throughout Europe. Distance education programs will become major components facilitating economic progress throughout the world.

Future research should focus on establishing theoretical frameworks as a basis for research and should examine the interactions of technology with teaching and learning. Researchers should address issues of achievement, motivation, attrition, and control.

Distance education is no longer viewed as a marginal educational activity. Instead, it is regarded internationally as a viable and cost effective way of providing individualized instruction. Recent developments in technology are erasing the lines between traditional and distance learners as more students have the opportunity to work with multimedia designed for individual and interactive learning. Print once was the primary method of instructional delivery but is now taking a backseat to modern interactive technologies.

The content of future research should:

• Move beyond media comparison studies.

• Examine the characteristics of the distance learner and investigate the collaborative effects of media attributes and cognition.

• Explore the relationship between media and the socio-

cultural construction of knowledge.

- Identify course design elements effective in interactive learning systems.

- Contribute to a shared international research database.

- Examine the cultural effects of technology and course-ware transfer in distance education programs.

Research methodologies should:

- Avoid microanalyses.

- Progress beyond early descriptive studies.

- Generate a substantive research base by conducting longitudinal and collaborative studies.

- Identify and develop appropriate conceptual frameworks from related disciplines such as cognitive psychology, social learning theory, critical theory, communication theory, and social science theories.

- Conduct thorough qualitative studies that identify the combination of personal, social, and educational elements that create a successful environment for the independent learner.

- Combine qualitative and experimental methodologies, where appropriate, to enrich research findings.

Technology may be driving the rapid rise in popularity of distance education, but it is the well-designed instructional situation that allows the learner to interact with the technology in the construction of knowledge. It is the effective interaction of instructor, student, and delivery system that affords distance education its prominence within the educational community. Distance education can offer the opportunity for a research-based, practical, integration of technology, instruction and instructor creating a successful educational package .

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