Online Learning for K–12 Students: What Do We Know Now?

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Introduction to E-Learning

E-learning, also known as Internet-based hybrid learning or distance learning, is one of the most significant new learning technologies to emerge in the last 10 years. A growing body of research, program evaluation, theory, and policy analysis is documenting the rapid introduction of e-learning in postsecondary institutions in the United States and around the world.

As a response to this growing interest, North Central Regional Educational Laboratory (NCREL) is introducing the E-Learning Knowledge Base, which provides a review and synthesis of current literature on e-learning. In view of the increasing number of collaborative environments available to educators, and their growing potential for supporting online learning communities, NCREL is researching the effectiveness of various environments and strategies and synthesizing the results into procedural knowledge that the region's educators can use to apply online collaboration in the classroom and in professional development activities.

This review and synthesis of current literature on e-learning marks the beginning of a 5-year commitment to surveying and summarizing resources from this rapidly growing field. In particular, NCREL will make every effort to provide easy access to publications on e-learning policy and practice. Informing K–12 leaders and decision makers on the full range of issues concerning development and deployment of e-learning is considered a critical priority.

The deployment and diffusion of online learning in U.S. schools is becoming an almost irresistible force. Accordingly, it is now important to give careful, systematic consideration to details that will have lasting impacts on our educational system. Careful consideration must be given to all aspects of e-learning and online education that may impact the quality, efficiency, equity, and educational choices available to all America's students—regardless of age, race, religion, or socioeconomic standing—*anywhere, anytime.*

Today, developments in telecommunications link microcomputers in America's schools into local area networks (LANs) and expanding wide area networks (WANs), all tied together by the conduit that is provided by the Internet. According to the most recent report from the National Center for Educational Statistics, "By the Fall of 2000, almost all public schools in the United States had access to the Internet; 98 percent were connected" (Cattagni & Farris, 2000). Computer-aided learning (CAL) on mainframes has seemingly become a ubiquitous, new version of computer-based learning, being delivered anywhere, anytime via the global Internet.

The evolution of Internet use in K–12 schools and postsecondary institutions is having a profound impact on the evolution of computer use and the curricular integration of new learning technologies (Valdez et al., 2000). The Internet itself is a communications channel offering the potential for communication and collaboration. Online courses provide a significant and influential medium through which standards-based teaching and learning, online collaboration, and acculturation to evolving norms for participation in virtual communities are quickly becoming realities.

The NCREL E-Learning Knowledge Base grew from an initial review of both print and online literature from a wide variety of disciplinary sources. During the course of the literature search, it became increasingly obvious that a wealth of this material was available as full-text versions through URLs on the World Wide Web. It appears that because of the unique nature of work in e-learning, the best literature may very well be available in online forms.

The number of high-quality online e-learning resources available on the World Wide Web is apparently so large that the research team decided to refocus NCREL's resources and time on creating an interactive knowledge base consisting entirely of full-text online resources. Also, references are made to a limited number of important print sources here and in five other introductory narratives prefacing major categorical sections that divide the knowledge base.

Theoretical Framework

The underlying structure of the NCREL E-Learning Knowledge Base is based on the notion that two types of dynamic structures may account for the relative effectiveness of learning outcomes resulting from human interactions with technology systems. These two types of dynamic structures are discussed by Kemmis, Atkin, and Wright (1977) as "d-structures" (what is learned) and functional or "f-structures" (dimensions of the online learning environment constraining and conditioning learning opportunity and learning outcomes).

The Kemmis conception of "f-structures" is reminiscent of philosophical notions about thought forms, like Platonic ideals or John Dewey's pragmatism and the correspondence theory of truth. Dewey (1995) argues that true ideas are ones that agree or correspond to an observed and objectively verifiable scientific reality. Interpreted either ideally or pragmatically, "f-structures" are apparently "black-box" phenomena that only exist in the mind. As such, "f-structures" are not externally observable or verifiable and have little apparent value for increasing understanding of learning that may or may not result from human interactions with technology systems.

However, the conception of functional or "f-structures" is elaborated by Kemmis, et al. (1977), who offer a powerful schema useful for understanding human learning (with or without technology systems) and for gaining a much clearer understanding of environmental factors that influence the effectiveness and shape the outcomes of computer-aided learning (CAL).

Kemmis et al. (1977) discuss four general classes of "f-structures" that frame the learning process enabling computer-aided learning. These are:

1. Subject-matter “f-structures”
2. Pedagogical “f-structures”
3. Operating system “f-structures”
4. Milieu “f-structures”

Although the research behind this precedent-setting, 3-year, national study of computer-aided learning in the UK looked at interactions between students and distributed terminals on mainframe computers in the mid–1970s, the parallelism with today’s online learning delivery systems and e-learning is striking. Today, in place of mainframes accessed through terminals (often over great distance via the telephone networks), we use vast distributed systems consisting of networked microcomputers serving as terminals that load and run online learning programs from Web servers situated (often at great distance) on the global Internet.

Only minor changes are required to modify the terminology describing the four classes of “f-structures” to bring this important contribution to learning theory in line with today’s technology systems. The conception of computer operating systems is easily broadened to describe complex technology systems, consisting of software, hardware, and human components. The four classes of “f-structures” were modified to become the five dimensions of this E-Learning Knowledge Base:

1. Introduction to E-Learning
2. Curriculum and Standards-Based Content
3. Teaching and Learning
4. Instructional Technology Systems
5. Milieu: Cultural and Organizational Context

The foundation of the NCREL E-Learning Knowledge Base is a searchable, online annotated review of literature containing more than 350 active URLs linking directly to their full-text sources. (Visit the E-learning Knowledge Base Web site to access this review.) These online resources vary in scope and complexity from single, article-length publications published in a growing number of high-quality online publications to complex Web sites that house content roughly equivalent to a published journal or book.

The five dimensions of the knowledge base are links to the corresponding five sections in the Web site. Each section begins with an introductory narrative that contributes to the review and synthesis of the available print and online information resources on e-learning.

The e-learning synthesis and its deployment on NCREL’s Educational Technology Resources Online (NETRO) Web site are designed to invite visitors to access and review the written and online resources in a way that suits each person’s individual need-to-know. Users can explore the resources in the Web site using any order or strategy that helps them address their questions about e-learning. E-learning is changing rapidly, and the site will be changing with it. New resources will be added periodically, and the preliminary conclusions offered by NCREL’s synthesis may change as important new studies and policy documents are released for publication. The knowledge base is growing rapidly, so users are encouraged to come back often to check for new resources and modifications.

Curriculum and Standards-Based Content

Curriculum Standards

The most critical component of all learning systems is curriculum content based on formal academic standards that have been developed and approved by regional, state, and professional governing and accrediting agencies. According to a significant, newly released report by the National Association of State Boards of Education (2001):

> Nearly every state has now developed academic standards that detail “what students should know and be able to do” by the time they graduate from school. As hoped for when the standards and reform movement got underway, it is increasingly clear that standards and aligned assessments are indeed having a profound effect on what happens in classrooms.

Whether the delivery systems use traditional, face-to-face instruction or highly sophisticated online learning environments, engaging content based on standards-based curriculum can provide the most effective learning environments for students of all ages, races, religions, and socioeconomic levels. The majority of K–12 teachers and students with building or classroom access to microcomputers and the Internet already may be using the Internet as a resource and using simple mechanisms to enable online collaboration (e.g., e-mail or simple online forums).

However, use of fully online courses in K–12 classrooms and schools may not yet be a common instructional practice. In addition, the information currently available about e-learning is based almost solely on research conducted in higher-educational institutions and international education. Only a very limited corpus of K–12 educational research is currently available to guide the development and initial implementation of online e-learning in K–12 schools.

Curricular Integration of Instructional Technologies

Plugging In

When it comes to the basics of implementing engaged learning and classroom curricular integration of the newest high-speed telecommunication technologies, new initiatives bringing e-learning into K–12 schools gain much from what we have already learned about computers in the schools. Previous instructional technologies include computer-assisted instruction (e.g., drill and practice), tutorials, simulations, the use of productivity tools, integrated learning systems, and early use of the Internet as an information resource.

NCREL's *Plugging In: Choosing and Using Educational Technology* was one of the first research-based efforts that addressed the use of microcomputers in K–12 settings and that advocated the use of microcomputers to support engaged learning. Jones, Valdez, Nowakowski, and Rasmussen (1995) present engaged learning as a research-based instructional improvement strategy aimed at improving academic achievement:

> First, there is strong evidence that the traditional models of learning, traditional definitions of technology effectiveness, and traditional models of cost effectiveness of technology don't work. In place of these old assumptions, researchers are positing new ways of looking at learning that promote:
>
> - Engaged, meaningful learning and collaboration involving challenging and real-life tasks; and
> - Technology as a tool for learning and collaboration (p. 5).

Phase I: Print Automation

Research on use of early microcomputers in classrooms was summarized a few years later by an NCREL meta-analysis examining the effectiveness of computer use in schools. The findings suggested that classrooms in which computers were used to support instruction usually showed gains in student achievement as measured by standardized achievement tests (Valdez et al., 2000).

Findings went on to report that the effectiveness of computer-assisted instruction (CAI) often varied by content area and by the skill being taught. CAI fared better if it was delivered in a content area with a well-defined subject. Factual information from discipline-based subjects was well suited for judging the recall and recognition responses used in the drill and practice software that was common to early use of microcomputers in K–12 schools (Valdez et al., 2000).

Phase II: Expansion of Learning Opportunities

As microcomputer/software systems became cheaper and more powerful, new technologies emerged and computer use in the schools grew both in numbers and with regard to the cognitive complexity of instructional computing. Computers became tools for learner-centered practices rather than content delivery systems. Improvements in graphics displays, faster processors, increased memory, additional storage capacity, and some early telecommunications applications began moving instructional computing from largely isolated activities to applications that involved working in groups.

Teachers increasingly began emphasizing authentic and project-based learning activities. Assignments often were tailored for individuals or collaborative groups, and assessment was based on outcomes that could be scored based on both content and execution. Students processed and manipulated information in interactive hypertext and hypermedia formats. New technology tools amplified, extended, and enhanced human cognition.

Learning Technologies and Higher-Order Skills

With this increasing expansion of learning opportunities, powerful new software provided rapid access to human resources, materials, and information. Students were able to acquire, synthesize, and reconstruct information as unique project-based outcomes. Studies documenting the impact of these more sophisticated technology systems showed increased teacher-student interaction, cooperative learning, and—most important—problem solving, inquiry, and problem-based learning.

Research on technology and learning finally showed evidence that use of these new learning technologies in the schools could demonstrate a positive impact on higher-order thinking skills and cognitive abilities. Appropriately deployed technologies could support exploration and help students obtain achievable goals, form and test hypotheses, and discover new knowledge. These constructivist applications of technologies apparently support developing higher-order thinking skills that can help students strive and succeed with real, open-ended questions, such as those that they will have to face, address, and conquer during their adult lives (Valdez et al., 2000).

Phase III: Data-Driven Virtual Learning
Nearly in parallel with the earliest evidence indicating that constructivist learning activities in technology-rich learning environments promote higher-order skills, new developments in telecommunications and networking technologies matured and became increasingly central to supporting the use of microcomputers in K–12 schools. Online communications, sometimes called computer-mediated communications (CMC), was a generic term that described a variety of systems that enabled communications using computers connected using modems and plain old telephone service (POTS).

Early CMC included telecommunications applications such as e-mail, newsgroups, and e-mail lists. Approximately 30 years ago, the Internet broke over us all like a tidal wave, and both the 20th Century and the world's civilization changed forever. Building on any Internet connection that became available, universities, colleges, and K–12 public schools all across the country began to network their schools and get connected to the Internet. Today, data-driven virtual learning is emerging along with a shift in classroom dynamics resulting from the advent of increasingly constructivist approaches to teaching and learning and the revolutionary changes in computer-mediated technologies that followed the evolution of the Internet (Valdez et al., 2000).

Digital Age Literacy

Classroom and online communications patterns previously present in classroom discourse are being replaced by a wider locus of control, moving responsibility for initiation of interaction from the teacher to the students themselves. In today's connected classrooms and schools, interactive constructivist teaching practices, supported by computers and the Internet, increasingly allow and support the customization of content to meet individual student needs. The advent of these powerful new technologies in our schools and communities, and essential changes in the ways that we all communicate and work, are redefining what it means to be a literate person. This redefining has dramatically changed what today's students need to know and be able to do to succeed in the new Digital Age.

Today, the greatest challenges faced by educators concern redefining literacy in terms of the new skills and competencies that will be relevant to a more international and increasingly technological society. An important and difficult part of this task is to understand the relationship of these new 21st-Century skills with more traditional academic standards. To accomplish this understanding, it is important to recognize the need for assessment standards and strategies that will efficiently measure the new Digital Age proficiencies in the context of traditional academic standards and their continuing importance in today's evolving and increasingly global culture (Lemke, 2001).

Teaching and Learning

A shift in our definitions of teaching and learning is a critical factor required to enable the transition to Digital Age literacy and 21st-Century skills as the goals and objectives for public education in the new Millennium. The integration of new and powerful technologies in our schools and increasing emphasis on higher-order skills in curriculum content will not bring about the broad changes required without essentially changing the ways teachers and learners work together.

The work of the teacher is to plan and execute a series of interactions between students and subject matter. The decision-based rules governing interactions between teachers and students are commonly referred to as pedagogy. These interactions are based on underlying assumptions about the nature of the learning process. In general, the teacher plans a series of interactions to control the way the students come into contact with the subject matter.

By doing so, the teacher generally expects to make the key concepts and ideas more accessible to the students. Traditional designs for classroom instruction are commonly concerned with sequencing materials, moving from rule to example (or vice versa), prompting strategies, task analysis, learning hierarchies, the use of drill and practice patterns with key content, and, finally, tests measuring the accurate recall of key content. This static and generally linear interaction model characterizes most traditional classroom instruction. It is teacher centered and promotes a high degree of accountability for the recall and recognition of facts and demonstration of behaviorally stated competencies and skills that constitute most of the traditional, discipline-based curriculum. However, it allows for little of the exploration, reconstruction, and creation of authentic work products that are emerging as the new bases for literacy in today's classrooms and other learning environments.

E-Moderation and E-Moderators

The interaction models that are considered characteristic of today's technology-rich learning environments and the increasing emphasis on synthesis and application of knowledge to authentic tasks and project-based student work most often are described as being student centered. Students often work independently as individuals or in groups. The teacher's role changes from being the primary source for knowledge and direction to become something more like a facilitator of learning or (speaking metaphorically) a kind of ringmaster in a circus of learning events.

An important educational institution that was a pioneer in developing pedagogy suitable for supporting highly individualized distance learning with adults is the Open University (OU) in the United Kingdom. With the advent of computer-mediated communication (CMC), the individualized learning that characterized the OU work, providing highly individualized tutorials over distance, evolved into a new interactive and online variation that has come to be known as e-moderation (Salmon, 2000).

According to Salmon, "A moderator is a person who presides over a meeting. An e-moderator presides over an electronic online meeting or conference, though not in quite the same way as a moderator does" (p. 3).

Within operations characterizing distance education in the Open University, course authors seldom actually serve as teachers with the courses they create. Authors are subject-matter experts who have training and expertise to prepare print, audio, and video materials for courses. Tutors, who may know something about subject matter but also have different training and experience suitable for working with students, actually teach the courses. E-moderators can be described as highly specialized tutors who work with students in learning situations where interactions are sustained primarily through computer-mediated communication (Salmon, 2000).

Computer-Mediated Communication

An explicit, five-part model is used to guide tutor/student interaction in Open University online courses. The model may be summarized as follows (Salmon, 2000):

1. Access and Motivation (These are prerequisite competencies for online participation.)

2. Online Socialization (Participants establish online identities and networking with other participants.)

3. Information Exchange (Participants exchange information with the e-moderator and with one another.)

4. Knowledge Construction (Course-related discussions occur; interaction becomes more collaborative.)

5. Development (Participants reflect and examine benefits from the system of interactions that help them achieve personal or course-related goals, explore how to integrate CMC into other learning, and reflect on the learning process.)

In Open University online courses, it is the role of the e-moderator to guide student participants through an online learning experience where course content serves as a conceptual basis for continuing online interaction and discussions. The skills required to sustain this online interaction define the work of the e-moderator (Salmon, 2000).

Online Teaching and Learning

The most critical skill for successful e-moderators or online instructors is the ability to encourage and sustain a high degree of participation on the part of the students. Interactions should focus on the defined subject matter and should involve lots of opportunities to learn through exchanges of information with the instructor and with the other students.

This situation requires that the online instructor or e-moderator follow the five steps, as outlined above. The skills required to be an effective online teacher are nearly identical to those needed to become an effective online learner, with one possible exception. Effective online instructors or e-moderators have a significant responsibility to learn the strengths and weaknesses of individual students so that they can individually encourage and direct participation. In other words, the most effective online instructors and e-moderators tailor the information exchanges and interactions by individuals and groups to individualize instruction in order to optimize the learning experience for each student (Kearsley, 2000).

Salmon (2000) recognizes four issues as being critical to sustaining appropriate levels of interaction and to helping online students achieve successful outcomes:

- Appropriate numbers of online participants
- The use of online time
- Time and complexity
- The development of online communities

Opinions vary regarding the optimal number of students in an online course. Generally speaking, estimates run about on a par with similar estimates regarding optimal class size for traditional “face-to-face” classes. Use of time also follows norms governing the use of time that are nearly identical to traditional instruction, with the possible difference that interaction among students is encouraged rather than discouraged.

The conception of time in online instruction is different from that of time in traditional instruction for a number of interesting reasons. First, class can hypothetically go on 24 hours a day, 7 days per week. To make things even more interesting for online instructors, interactions with particular individual students often are serialized or truncated by the delivery of e-mail or random factors governing when individuals do or do not go online to work. This almost chaotic randomness of online interactions is one of the distinctive elements that most participants become accustomed to over time.

The subject of building online communities is extensively addressed in the growing body of knowledge concerning online learning. The formation of learning communities seems to be an extension of online interactions and online networks into the domain of face-to-face human contact. In fact, a possibly important characteristic that varies in some online courses is whether or not face-to-face class meetings are planned or required part of the course. Although some situations involving geographic distance between students may make face-to-face contact very difficult or impossible, many researchers looking at online learning in higher education settings believe that hybrid courses (which use a combination of online and real face-to-face human contact) have better student retention and arguably better student learning outcomes (Kearsley, 2000).

Assessment of Online Learning

The assessment of student outcomes associated with online learning is controversial and important. Teachers and institutions are justifiably concerned that student performance is accountable and that institutional standards are upheld, with grade inflation kept to a minimum. The one way that assessment of online work differs from traditional assignments is that online learning often provides an objective way that participation can be measured and factored into student grades.

In effect, by recording keystrokes and by time-stamping records of online events, instructors can have a data record of every individual transaction or interaction of every student enrolled in an online course or class. If the course's software creates an event log made available to instructors in a way that can be interpreted without overwhelming them with raw information, a student's participation can be objectively taken into account when assessing student performance and assigning the grade. This activity can be as simple as requiring each student to post one original message in a mail list and respond meaningfully to two messages posted by others. On the other hand, some online courses have elaborate management systems that keep a detailed transaction record of every instance where students log in and do work in an online learning environment. Some course platforms create what amounts to an automated student portfolio documenting the complete online participation and the work products of every student.

A recurring subject discussed by both critics and friends of online learning is cheating. The question usually goes something like this: "How do you know that the responses on the screen come from the actual student, not some substitute?" In general, this concern is less significant in longer online courses when instructors have an opportunity to become familiar with students' communication styles and written products. One of the frequent arguments for hybrid courses (combinations of online and face-to-face instruction) is that by meeting the students in person, instructors are more likely to successfully distinguish and identify work products created by sources other than the students enrolled (Kearsley, 2000).

Instructional Technology Systems

The systems of hard and soft technologies that enable and support online learning are incredibly complex and technically sophisticated. The possible variations on computer workstations and servers, the various available (and often competing) operating systems, and the complexities of local area networks (LANs), wide area networks (WANs), and the ubiquitous Internet (or World Wide Web) make it nearly impossible for any single online instructor to be able to individually troubleshoot or successfully diagnose and advise students when they occasionally encounter software or hardware glitches and malfunctions.

The powerful new instructional technologies like e-learning continue to create new possibilities for innovative instructional delivery systems and creative learning outcomes. Along with these new technologies comes the possibility of increasing access to educational opportunity for disadvantaged segments of our nation's learning community. These developments support an increased acceptance of a more eclectic definition of instructional technology. Of possible competing definitions for instructional technology, one of the most liberal is Reiser's (1987) eclectic definition: "The combination of these concepts in the broad context of education and society yields synergistic outcomes—behaviors which are not predictable based on the parts alone—but outcomes with extra energy which is created by the unique interrelation of the parts" (p. 41).

Working definitions of e-learning and the broad definition of technology in education will probably continue to change and evolve in the foreseeable future. The application of new technologies to improve teaching and learning will necessarily follow the ongoing invention and development of new hard and soft technologies. Technology innovations seemingly evolve so rapidly that investments in infrastructure and professional development risk obsolescence before the anticipated benefits of upgrades and improvements can be realized. The pace of change has become so extreme that we may even risk destabilizing the very learning environments we all work to support. However, it is important to remember that people—real human beings—are also an important part of technology systems. In particular, support personnel are a critically important part of distance learning systems. Research on the effectiveness of distance learning in higher education has shown that the availability of properly credentialed and effective support technicians is one of the most important factors differentiating between effective courses demonstrating a high rate of completion and courses where a high percentage of students beginning an online course never finish and withdraw or just never come back (Kearsley, 2000).

Infrastructure factors affecting online instruction are generally identical to those affecting all complex learning technology systems. NCREL's (2001) *enGauge* Framework offers the following indicators of success regarding robust access—anywhere, anytime:

- Technology Resources
- Connectivity
- Technical Support

- Technology-Ready Facilities
- Virtual Learning Opportunities
- Administrative Processes and Operations

Platforms and Networks

NCREL's (2001) *enGauge* Web site goes on to detail the following topics important to hardware platforms and network connectivity:

Technology Resources

- Equipment and digital resources are strategically deployed and sufficient to meet the needs of learners and educators.

- Thoughtful assessments are conducted to assess the organization's capacity for integrating technology into the curriculum, adapting to new learning environments, and systematically upgrading equipment.

Connectivity

- The telecommunications infrastructure provides appropriate, robust communication from every learning setting.

- Current and future bandwidth issues are routinely considered.

- Access extends beyond the school day and the school facility.

Practitioners of distance learning frequently face questions regarding the technical adequacy of computer platforms and the complaint that there is never enough bandwidth available to permit the newest state-of-the-art technologies to be used to support online learning. To avoid the zero-sum choice, ongoing redefinition of technical adequacy should include room to permit the compromises needed to achieve a balance among all the factors conditioning the quality, efficiency, equity, and choices guiding the implementation of K–12 distance learning.

Available E-Learning Options

One of the most interesting choices facing K–12 school districts that may be considering the use of online learning as some part of an organized instructional program (probably at the high school level) is whether to: (1) license or purchase use of commercially developed, course-equivalent online courses from software vendors, or (2) initiate software development projects using master teachers as subject-matter experts who participate in designing, developing, and implementing locally created online courses.

In effect, this second alternative follows along lines that are similar to the role played by lecturers who participated in developing correspondence courses and other varieties of distance education in the U.K.'s Open University and in many U.S. colleges and universities. Most of the online courses presently being offered in higher-education institutions in the United States were developed along these lines by participating faculty members from the respective departmental faculty members.

Based on experiences by those developing e-learning courses in America's higher-education institutions, there is a growing body of research and other publications on aspects of policy and practice relevant to undertaking the local development of online learning and course-equivalent learning environments. K–12 technology leadership and teachers considering undertaking the acquisition or development of online learning would be well advised to study this growing literature and apply some of the lessons already learned in higher education.

In particular, work done by the Southern Regional Education Board (SREB) established the SREB Distance Learning Policy Laboratory, which seeks to reduce or eliminate existing or potential policy barriers to distance learning activities in three broad areas: access, quality, and cost. SREB (1999) lists the laboratory's objectives as follows:

- Assessing educational policy issues that are identified as barriers.
- Establishing policy baselines of current practices, procedures, and strategies.
- Assisting states and institutions as they develop ways to use technology to improve quality, expand access, and reduce costs.
- Establishing trial or pilot efforts with state partners to test new distance learning approaches or strategies.
- Promoting state-level policy changes via existing SREB organizational arrangements and agreements.
- Developing and testing agreements among institutions and states.
- Utilizing the regional platform to serve as a clearinghouse for states and institutions to discuss policy issues and concerns.
- Measuring the implementation of policy changes in the SREB states and widely disseminating the results.

In particular, the Distance Learning Policy Laboratory has determined that there are a number of major barriers to distance learning. K–12 educational leadership and faculty considering roles developing courses in virtual high school or participating in the local development of online high school courses would be well advised to consider the following topics outlined by SREB (1999):

- Finance issues, including traditional funding models and budget allocation practices.
- Faculty issues, including faculty assessment, skill development, reward structures, and intellectual property issues.
- Student issues, including credit transfer, credit banking, and student services for the distance learner.
- Tuition differentials between in- and out-of-state students.
- Quality assurance.
- Financial aid for distance learners.
- Reaching underserved populations.
- Coherence and values in distance learning.

Designing Effective Online Learning Environments

Concerns about how to design effective online learning environments always run close behind all the distance learning policy issues raised by groups like SREB. Instructional design is an extensive and important domain of theory and research-based practice pursued by instructional design specialists all over the world. In the United States, as Knirk and Gustafson (1986) note, the growth and general acceptance of instructional systems design within the education community is often viewed as a historical byproduct of decisions concerning the design of adult learning made in the late 1960s by the U.S. Army Combat Arms Training Board at Fort Benning, Georgia, and the Center for Instructional Technology at Florida State University.

When U.S. Army training programs were reviewed in the late 1960s, the Army's training specialists thought that by following the principals of instructional design they could dramatically increase the efficiency of military training. They believed the result would be a more efficient and better disciplined fighting force. The resulting document is the Interservice Procedures for Instructional Systems Development (IPISD). The Interservice model starts with an in-depth analysis of the job to be performed and a detailed account defining the scope and sequence for all the subtasks required to accurately and efficiently train another person to do the same job. The intrinsic aspects of human interface design are a serious concern of today's military training commands (Navy Center for Applied Research in Artificial Intelligence, 1999).

As Plotnick (1997) reports,

> In "Survey of Instructional Development Models, Third Edition," Gustafson & Branch (1997) define instructional development (ID) in terms of four major activities.
>
> - Analysis of the setting and learner needs;
> - Design of a set of specifications for an effective, efficient, and relevant learner environment;
> - Development of all learner and management materials; and
> - Evaluation of the results of the development both formatively and summatively.

In contrast, classroom instructional development models are of interest primarily to professional educators who accept as a given that their role is to teach, and that their students require some form of instruction. Teachers usually view an instructional design model as a general road map to follow. Generally, a classroom instructional design model outlines only a few functions, and typically provides a plan or flow chart organizing instructional events for a unified series of related instructional events (Plotnick, 1997).

Since the 1960s, there has been an evident tension between instructional design theorists who advocate use of a more rigorous instructional systems design process and educators who have expressed their belief that the model is too labor intensive to have practical value as a model for planning and conducting routine classroom instruction (Gordon & Zemke, 2000).

The complexities of instructional design can be greatly simplified (Hemphill, 2000) by reducing the elements of traditional design to the following basic principles outlined by Kemmis et al. (1977):

Frequency of Interaction: Increasing the frequency of interactions between the learner and online lesson-learning materials generally increases a student's engagement and retention of content.

Complexity of Interaction: Interactions with an online learning environment vary in complexity and sophistication and generally fall into the following six categories:

- Simple recognition (true/false or yes/no).
- Recall (fill-in, free recall, or matching).
- Comprehension (multiple choice, substitution, paraphrase, or short answer).
- Problem solving (simulations or modeling).
- Knowledge construction (project-based outcomes, research, or products from creative activity).

Feedback Content and Quality: Online courses should offer students substantial feedback on all tests and work products. Online feedback provided in the online learning environment can be simple judgments indicating correct or incorrect answers, or can be complex responses that include diagnosis and/or remediation. Diagnostic or remedial online feedback promotes generally better outcomes than simpler feedback signaling that a response is simply right or wrong.

Balancing Comprehension and Significance: Information provided onscreen in the learning environment can be either easy or difficult to comprehend based on its density and complexity. In general, screens displaying too much information (text or graphics) can be difficult or confusing to read or interpret. However, information that is overly simplified may be perceived by the reader to be trivial or even irrelevant.

Achieving a reasonable balance between excessive complexity and trivial simplicity seemingly has more in common with judgments about aesthetic worth that might be applied by artists and artisans than it does with any kind of objective science. In the last analysis, design and implementation of online learning may well be something that is learned most effectively through practice and guided experience, following an apprenticeship model like the one followed traditionally by guild members and skilled artisans. Whatever it takes, it seems certain that the production of high-quality online courses will remain an important concern of educational leaders and teacher technologists in K–12 schools into the foreseeable future.

Milieu: Cultural and Organizational Context

Milieu factors and the sociocultural dimensions of technological innovation and change are often the most paradoxical, bewildering, and fascinating dimensions of technological change and innovation. Collingridge (1980) supports his case by clarifying two conditions necessary for avoiding the undesired consequences of a technology: "It must be known that a technology has, or will have, harmful effects, and it must be possible to change the technology in some way to avoid the effects" (p. 16).

Regrettably, one or both conditions are frequently lacking, and attempts to control technology seldom succeed. Collingridge expresses this by articulating a dilemma that seriously threatens our ability to control technology. This dilemma of control is clearly stated by Collingridge (1980) as follows:

> Attempting to control a technology is difficult, and not rarely impossible, because during its early stages, when it can be controlled, not enough can be known about its harmful social consequences to warrant controlling its development; but by the time these consequences are apparent, control has become costly and slow (p. 19).

This dilemma of control is not unlike some of the problems facing e-learning pioneers who are hard at work creating the first virtual high schools. Presently, there are estimates on the numbers of state-sanctioned virtual high school projects in approximately 14 states.

A study commissioned by the Distance Learning Resource Network at WestEd offers an analysis of trends based on an online survey of state-approved or regionally accredited schools conducted from July through August 2001. A peer group of 44 virtual schools was identified and surveyed using e-mail and telephone follow-up to reach a response rate of 75 percent [N=33]. Highlights of this study (Clark, 2001) are as follows:

- The trend from conversion of virtual high schools to virtual K–12 schools continues.
- The most-reported tuition was $300 per semester, but prices varied greatly.
- Calculus AB was the online AP course offered most by the schools.

Based on data from this survey, as many as 40,000 to 50,000 students may be enrolled in state-sanctioned online high-school courses in the current school year (2001–2002). Following the logic of Collingridge's dilemma of control, this number may not be large enough to see any substantial evidence, other than collateral, possibly destabilizing, outcomes for our nation's educational system. In fact, at the second annual Center for Internet Technology in Education (CiTE) Virtual High School Symposium held in October 2001, there was little evidence that any of the groups involved is very interested in slowing down the rate of growth shown by individual projects to allow more flexibility for possible course corrections later.

An active and growing group of "first-comers" to the virtual high school movement presently exhibits most of the characteristics attributed to successful virtual communities. Rheingold (1998), who created of one of the first major Internet communities, defines virtual communities as social aggregations that emerge when enough people carry on public discussions long enough and with sufficient human feeling to form webs of personal relationships in cyberspace.

Strong affinities and an ethos emphasizing mutual support were evident among virtual high school first-comers at the CiTE Virtual High School Symposium. Although the group is relatively small in numbers, participants are enthusiastic and optimistic about prospects for the immediate future. This growing and active online community of practice clearly displays characteristics associated with the important and final Development Phase in the Open University five-part model for the development of computer-mediated communication: Participants reflect and examine benefits from the system of interactions that help them achieve personal or course-related goals, explore how to integrate CMC into other learning, and generally reflect on the learning process (Salmon, 2000).

Another subject of discussion among attendees at the conference was netiquette, or practices that promote developing and enforcing acceptable standards for online discourse. Civil discourse is at the very heart of developing and nurturing group membership and a sense of belonging in any cultural or social group, whether it is virtual or face-to-face.

Rinaldi (1998) elaborates her views on and provides a mature and well-established set of standards to guide the conduct of online interactions in both social and educational forums:

> The Internet is rapidly developing its own unique culture formed by a diverse group of people of various religions, nationalities, genders, and experiences. The Internet, commonly referred to as "Cyberspace," is a worldwide melting pot of opinions and ideas. The people using the resources on the Internet have been known to call themselves "netizens" (network citizens) which qualifies them into a whole different social and cultural evolution of a new community of people.

Rinaldi goes on to advocate the development and maintenance of uniform standards for netiquette governing the civility of all online interactions.

Another ongoing issue discussed by symposium attendees in planned sessions and in informal discussions involved the evolution of a consensus among the practitioners regarding critical policy issues that the online learning community is currently facing. In his keynote address, John Bailey, then the special assistant to the undersecretary, shared the following general beliefs about technology, which he believes are needed to successfully achieve beneficial outcomes regarding e-learning (Bailey, 2001):

> In order for us to make any progress on technology in education and e-learning, we need to change our minds about five beliefs how we approach education and technology:
>
> 1. We need to move beyond the notion that education is about school buildings, school days, and classrooms. For us to move forward with not just e-learning, but learning in general, we must accept the reality that education can now be delivered to students wherever they are located.
>
> 2. Schools need to become education centers. With distance education, schools become access points to a whole range of educational opportunities. Until schools recognize that their mission is fundamentally changing as a result of e-learning, we're only going to make incremental progress toward this important objective.
>
> 3. Every educational program is a technology opportunity and every technology program is an educational opportunity. While our investment in technology does help schools purchase computers and networks, it is also fundamentally about purchasing math courses and additional online resources and distance education classes for their students. It isn't about the boxes and the wires. It is about teaching and learning. It is the instructional content and its applications that should drive technology, not the other way around.

4. Online assessment, particularly online assessment with e-learning technologies, is one of the next generation "killer applications" that is waiting for us out there. When online assessment results are tied into e-learning systems, the potential benefits become very significant. The result should be more effective use of class time and a system of education that isn't based on mass production, but is instead based on mass customization.

5. Finally, together as industry and as government, we need to be relentless in measuring and assessing the impact that technology has on education and on academic achievement. We need evidence that teaching and learning are improved as the result of technology. Using technology to teach using traditional methods will only lead to traditional results.

In final analysis, online learning or e-learning isn't about digital technologies any more than classroom teaching is about blackboards. E-learning should be about creating and deploying technology systems that enable constructive human interaction and support the improvement of *all* teaching and learning. Computers and other technologies will certainly play an increasing role. A desirable goal may be that *every* student has and routinely uses his or her own notebook computer. Books and other more traditional technologies will also continue to be important, along with telephones, satellites, compressed videos, and audio and VHS tape. Today's newest technologies, like e-learning, are destined to become tomorrow's stable and established media that will become commonplace for people in all walks of life and throughout our global, cultural, political, and economic systems.

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