A Comprehensive Look at Distance Education in the K–12 Context

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Abstract

This review provides a comprehensive examination of the literature surrounding the current state of K–12 distance education. The growth in K–12 distance education follows in the footsteps of expanded learning opportunities at all levels of public education and training in corporate environments. Implementation has been accomplished with a limited research base, often drawing from studies in adult distance education and policies adapted from traditional learning environments. This review of literature provides an overview of the field of distance education with a focus on the research conducted in K–12 distance education environments. (Keywords: Distance education, distance learning, virtual schools, cyber-schools, K–12.)

Adult distance education is not a new phenomenon, but in recent years a growing number of distance programs have been aimed at primary and secondary school students. National policy initiatives focused on expanding educational opportunities for all students (Hassel & Terrell, 2004; U. S. Department of Education, 2004; Web-based Education Commission, 2000), funding shortages, overcrowded brick and mortar facilities (Fulton, 2002; Clark, 2001), and exploration of alternative routes for education (Collins, 2001; Herring, 2004) are just a few examples of the forces fueling the expansion of K–12 distance education programs and schools.

This article presents a comprehensive examination of the literature surrounding the current state of K–12 distance education. Despite the noted lack of quality studies in distance education in general (Bernard, Abrami, Lou, & Borokhovski, 2004; Phipps & Merisotis, 1999), the research base in K–12 distance education continues to expand and includes both comparative studies and studies that attempt to identify the factors associated with instructional quality and effectiveness.

In conducting this review, a general search of the literature was performed in numerous databases, journals, Web sites, and bibliographic resources using the descriptors: distance learning, online learning, Web-based instruction, distance education, online education, interactions, virtual K–12, virtual program, virtual school, e-learning, cyber school, and cyber charter. Electronic searches were conducted in the LILI-D, ERIC, Wilson Education, and EBSCO databases. In addition, a systematic search of the journals specifically related to distance education and/or educational research was also conducted. These included *Review of Educational Research, Distance Learning, International Journal of Distance Education, American Journal of Distance Education, Educational Technology, Jour-*

nal of Asynchronous Learning Networks, *Educational Technology and Society*, and *Open Learning*. More than 20 national and state Web sites relating to distance learning and/or virtual schools were searched, including the U.S. Department of Education and The National Center for Education Statistics Web sites.

OVERVIEW OF THE FIELD

Distance education, distance learning, e-learning, Web-based instruction, virtual schools, and online learning are all terms used interchangeably to describe this broad, somewhat confusing, and constantly changing field of nontraditional instruction (Carnevale, 2001; Saba, 2005). Although distance education has been defined from a variety of perspectives (Kaplan-Leiderson, n.d.; National Center for Educational Statistics, 1999), perhaps the most comprehensive definition is that offered in a published monograph by The Association for Educational Communications and Technology (Schlosser & Simonson, 2002). They define distance education as:

> Institution-based, formal education where the learning group is separated, and where interactive telecommunications systems are used to connect learners, resources, and instructors. (p. 1)

According to Schlosser and Simonson, four main components are critical to this definition. First, in order to differentiate distance education from self study, distance education must be institutionally based. Second, there must be a separation of teacher and learner in terms of geography, time, and knowledge of the concepts to be taught. Thirdly, some form of interactive telecommunications must be available for learners to interact with each other, with the resources of instruction, and with the teacher. In this case, telecommunications is defined as "communicating at a distance" (p. 2) and does not necessarily mean the use of electronic media but can also include non-electronic forms of communication such as the postal system. The final concept stresses the inclusion of instructional environments and resources that facilitate learning experiences and promote learning.

The means by which distance education is accomplished are varied and may include video conferencing, audio conferencing, Web-based communications, or any combination of electronic communication and management tools (Rural School and Community Trust and the State Technology Directors Association, 2003). In addition to the variety in types of media tools used, the instruction may be delivered synchronously, with students and teachers communicating in real time, asynchronously, with students working at different times, or any combination of the two, often with the inclusion of phone conversations, online chats, or face-to-face meetings. Distance education programs may also be self-paced, structured to fit into the traditional academic calendar, or fall anywhere in between.

As in adult distance education programs, K–12 distance education exists on a continuum from traditional "home study" or text-based correspondence programs to programs that utilize the full potential of technology-mediated instruction. Distance education programs targeting grade levels K–12, often referred to as "virtual schools" or "cyber schools," are operated by a variety of entities that may include states, school districts, charter schools, consortia, higher

education institutions, for-profit companies, or nonprofit organizations (Fulton & Kober, 2002). Researchers have attempted to define the multiple methods in which distance education programs may be organized within traditional state and local educational systems.

Watson, Winograd, and Kalmon (2004) have identified five basic types of online programs that exist across two dimensions. One dimension concerns how the program operates within the state's educational hierarchy, such as statewide, multi-district or single district. The other concerns whether the program operates as a cyber school where students are enrolled and garner credits and diplomas, or provides supplemental online courses to students who are enrolled in another school. Table 1 (below) outlines five types of online programs (Watson et al., 2004).

Table 1: Five Types of K–12 Online Programs

Type	Description
Statewide supplemental programs	Students take individual courses but are enrolled in a physical school or cyber school within the state. These programs are authorized by the state and overseen by state education governing agencies.
District-level supplemental programs	Are typically operated by autonomous districts and are typically not tracked by state agencies.
Single-district cyber schools	Provide an alternative to the traditional face-to-face school environment and are offered by individual districts for students within that district.
Multi-district cyber schools	Are operated within individual school districts but enroll students from other school districts within the state. This represents the largest growth sector in K–12 online learning.
Cyber charters	Are chartered within a single district but can draw students from across the state. In many cases they are connected in some way to commercial curriculum providers.

In addition to defining potential organizational schemes for K–12 distance education programs, descriptive, anecdotal, and survey evidence identifies a broad population of students served by this nontraditional form of education. Distance education programs can serve entire populations of students that traditional classrooms do not by providing increased opportunity through choice, tutoring, and supplemental services to: students who live in remote areas, students in home school settings, those who are hospitalized or homebound for health reasons, professional athletes, students who are incarcerated, students who need flexible schedules for employment, or students who want to enrich their education, move at their own pace, or experience learning that fits their particular learning style (Bogden, 2003; Chaney, 2001; Patrick, 2004). Virtual schooling provides flexibility to meet scheduling demands, offers an opportunity for students to take courses over holiday or summer breaks, and can provide

remediation and tutoring on demand (Fulton & Kober, 2002; Rural School and Community Trust et al., 2003; Setzer & Lewis, 2005).

In 2001, it was estimated that 14 states had "a planned or operational state-sanctioned, state-level virtual school in place" (Clark, 2001, p. 1), with an estimated enrollment of 40,000–50,000 K–12 students. A 2003 report by the Education Commission of the States (Long, 2004) estimated 60 cyber charter schools in 13 states for the 2002–2003 school year, a number that was double that of the previous year. The estimated enrollment for that year was 100,000 students (National Association of State Boards of Education [NASBE], 2002). Although exact numbers are difficult to determine, a more recent report estimates that virtually every state now has some form of cyber-school operating within its boundaries (Long, 2004).

Despite the potential for expansion of distance education programs at all levels, several factors have been identified that may limit growth. These include:

> course development and/or purchasing costs; limited technological infrastructure to support distance education; concerns about course quality; restrictive federal, state, or local laws or policies; concerns about receiving funding based on student attendance for distance education courses; or some other reason. (Setzer & Lewis, 2005, p. 15)

In addition to the impediments identified in the NCES study, factors associated with equity, access, and accountability have also been identified (Fulton & Kober, 2002; Watson et al., 2004). Policy initiatives at all levels and by a variety of entities and organizations continue to address these issues and will be discussed in detail below.

POLICY

Leading the way in efforts to promote a change in traditional views of education in the K–12 environment is the National Education Technology Plan published by the U. S. Department of Education: *Toward a New Golden Age in American Education: How the Internet, the Law and Today's Students are Revolutionizing Expectations* (2004). The plan proposes seven main objectives to assist schools in implementing systematic change: (1) strengthen leadership, (2) consider innovative budgeting, (3) improve teacher training, (4) support e-learning and virtual schools, (5) encourage broadband access, (6) move toward digital content, and (7) improve achievement through student data management. Particularly relevant for this report is the plan's emphasis on e-learning as one of the key issues facing federal, state, and local education agencies. Their recommendations for states, districts, and schools include:

- Provide every student access to e-learning.
- Enable every teacher to participate in e-learning training.
- Encourage the use of e-learning options to meet the No Child Left Behind requirements for highly qualified teachers, supplemental services and parental choice.
- Explore creative ways to fund e-learning opportunities.
- Develop quality measures and accreditation standards for e-learning that mirror those required for course credit. (p. 42)

The emphasis on virtual schools in the National Education Technology Plan is no coincidence. Under the No Child Left Behind (NCLB) Act (U.S. Department of Education, 2001), virtual schools are considered a legitimate option for school choice: "A virtual school can be among schools to which eligible students are offered the opportunity to transfer as long as that school is a public elementary or secondary school as defined by state law" (U.S. Department of Education, 2004, p. 13). In fact, virtual schools may present the only option for districts that lack the resources necessary to meet the school choice requirements of NCLB with traditional brick and mortar classrooms (Hassel & Terrell, 2004). The current and predicted trend in online course enrollment seems to underscore this need.

Implementing these and other similar recommendations has been the topic of numerous state-level, local-level, and organizational policy briefs, initiatives, and existing distance education program evaluations (Freedman, Darrow, & Watson, 2002; Fulton & Kober, 2002; NASBE, 2001; National School Boards Association, 2002) But, researchers from the NCREL (Watson et al., 2004) concluded from empirical data as well as anecdotal evidence that only a few states have established policies in place for the development of K–12 online learning programs. Further, they found that in most cases, online learning is little understood by policymakers. The result is the application of existing policies—policies that address the needs of physical schools—to online programs, which may not fit well and thus may not be in the best interests of students. They urge states to "develop appropriate mechanisms to provide a framework of sustainability and value that will enable online education to flourish and to meet the diverse needs of students" (Watson et al., 2004, p. 7).

Many of the issues addressed in the preceding policy guidelines have been driven by evaluations of fully developed programs already in place. Perhaps the earliest and most widely known K–12 online education programs are the Florida Virtual School, a statewide program, and the Virtual High School, created by the Hudson, Massachusetts Public Schools and the Concord Consortium, a collaborative endeavor between 125 high schools across the United States (Clair, 2002; Freedman et al., 2002). Although these programs and other states with mature K–12 online education programs offer comprehensive program evaluations, they offer little guidance in the way of standardized policy development. Of the 11 states included in the first NCREL study (Watson et al., 2004), California and Minnesota had developed the most extensive policies regarding online education.

A subsequent report, published by NCREL in 2005, further elaborates on the findings in the initial report by examining state level policy and practice in all 50 states (Watson, 2005). In this update, the author concludes that "about 50 percent of all states have one or both of: (a) a statewide online learning program with developed policies and practices; (b) state-level policies that govern online learning programs across the state" (p. 120). In addition to these general conclusions, several recommendations are offered. First, although no single state has an ideal set of policies, those policies that have been developed can serve as examples for other states. Second, basic research examining the effectiveness

of online learning and the costs associated with it is needed in order to inform policy decisions. Associated with this recommendation is the call for common measures across states and programs to benefit research and policy, and the use of data gathered from several states with reporting requirements already in existence to inform future policy decisions. Third, although there has been and continues to be an informal sharing of ideas and best practices, there has been no formal attempt to document best practices across programs.

These reports and others underscore the need for the creation of a central body to facilitate the standardization of online education through the sharing of information regarding policies and practices. The North American Council for Online Learning (NACOL) (2005), founded in September 2003, is the result of efforts by those involved in the early development of virtual schools and the need for communication and interaction among them. NACOL represents the interests of administrators, practitioners, and students involved in online learning. Major initiatives include: conducting research to enhance K–12 online learning, encouraging collaboration among stakeholders, and promoting the success and effectiveness of online learning. In addition, one of the strategic objectives of NACOL is the creation and management of a K–12 online learning knowledge base that contains current, accurate information about online learning in the United States, Canada, and Mexico. As an example, NACOL currently lists more than 144 online schools or programs in its online learning database. The Southern Regional Education Board (SREB) (2005) has also taken on the role of disseminator of information related to effective online learning practice and policy. As part of their Educational Technology Cooperative, the newly developed Online Learning Task Group is one example of their efforts to develop and improve implementation of quality e-learning programs in the K–12 context.

K–12 DISTANCE EDUCATION RESEARCH

Although research in the areas relative to general technology and Internet use in schools is fairly abundant, a paucity of research exists when examining high school students enrolled in virtual schools, and the research base is smaller still when the population of students is furthered narrowed to the elementary grades. In an attempt to present a complete picture of research in this field, studies for this review were drawn from a variety of resources, including refereed journals, conference proceedings, government reports, dissertations, unpublished studies, and reports from public and private organizations. With such little available research, and the intent of an exhaustive and evaluative review, only strictly anecdotal studies were deemed inappropriate for inclusion.

Unlike early research that focused more heavily on distance technologies that involved audio and video conferencing (Downs & Moller, 1999), current research focuses more closely on Web-based technologies, delivery systems, and the specific attributes of those systems and their relationship with student learning outcomes. In this review, research was categorized into two broad categories: (1) Comparative studies examining student performance in distance education versus student performance in traditional, face-to-face classrooms and (2) studies examining the qualities and characteristics of the teaching/learning experi-

ence. This category was further narrowed into the areas of learner characteristics, learner supports, and affective learning domains.

Comparative Studies

As with the research in adult distance education, the starting point for most studies in K–12 distance education is an analysis of student achievement relative to traditional face-to-face instruction (Cavanaugh, 2001). Media comparison studies in K–12 distance education appear to support the same "no significant difference phenomenon" reported in adult studies (Phipps & Merisotis, 1999; Russell, 1999). Analysis in this area is particularly difficult due to a lack of consistent experimental comparative methodologies that control for a multitude of confounding variables. Studies in this area are also often challenged with issues of small sample size, dissimilar comparison groups, and differences in instructor experience and training (Kozma et al., 2000; Mills, 2003).

McLeod, Hughes, Brown, Choi, and Maeda (2005) attempted to limit these challenges by controlling for student demographics and academic characteristics in their study examining academic performance of students enrolled in Algebra I classes in three virtual schools and two face-to-face schools in three different states. Six teachers and 81 students participated in the study. The findings indicated that virtual students outperformed students in traditional face-to-face classes. Particularly noteworthy about their findings is that students in the face-to-face classes were much more likely to be in a college preparatory program than virtual students, and virtual students were more likely to be enrolled in the math course because of a previous failure. Unfortunately, a number of additional variables, such as early dropout and voluntary testing in the virtual school, raise questions concerning the causality of the findings.

Fortunately, two meta-analyses exist that may assist in generating a better understanding of the findings of research studies that have examined student achievement through comparative studies (Cavanaugh, 2001; Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004). Meta-analysis is an appropriate methodology because it allows comparison of different studies by computing an effect size for each study, as well as investigation into the relationship among study features and outcomes. According to Krathwohl (1998), "a meta-analysis can plot the nature of causal relation, show how it is affected by other variables, and determine where evidence is needed for more complete understanding" (p. 152).

In a meta-analysis conducted in 2001, Cavanaugh analyzed the effect sizes of 19 experimental and quasi-experimental studies (n = 929) examining student academic achievement in K–12 interactive distance education settings in the research from 1980–1998. The findings indicated higher effect sizes consistently reported in distance education environments characterized by smaller sized groups, shorter duration, and distance education that was used to supplement or support traditional classroom instruction rather than as the primary mode of instruction. The significance of the findings have been called into question, however, because at the time the initial meta-analysis was conducted, the K–12 virtual environment was so new that no achievement data from students in fully online programs were available (Blomeyer, 2002).

A subsequent meta-analysis published in 2004 by Cavanaugh, Gillan, Kromrey, Hess, and Blomeyer examined 116 effect sizes on nearly 40 factors from 14 Web-delivered K–12 distance programs between 1999 and 2004. Using only studies that fit the definition of scientifically-based research as defined by the U.S. Department of Education in its call for evidence-based program decisions through the No Child Left Behind Act of 2001 (U.S. Department of Education, 2001), 14 studies with 116 outcomes were examined (N = 7,561 students).

The findings from this study support previous findings of adult online education programs that suggest there is no significant difference between courses delivered online and those delivered in traditional face-to-face classrooms (Phipps & Merisotis, 1999). The researchers concluded, "As distance education is currently practiced, educators and other stakeholders can reasonably expect learning in a well-designed distance education environment to be equivalent to learning in a well-designed classroom environment" (Cavanaugh et al., 2004, p. 20).

In addition to the findings, the report contains extensive recommendations for future research, policy, and practice. The authors encourage policy makers and evaluators to move beyond questioning whether distance education is as effective as traditional face-to-face instruction and begin to evaluate the specific characteristics of effective distance education programs in the K–12 arena. Following in the footsteps of the national call to action for those in the adult distance education field (Web-based Education Commission, 2000), the authors of this report call for the use of comprehensive program evaluation planning to lead the way for quality research agendas in K–12. It is the authors' contention that the detailed collection and reporting of data can only begin when common goals are identified by policy makers and evaluators.

The recommendation by Cavanaugh et al. to redirect research efforts has been echoed by others in the field. Roblyer and Knezek (2003) suggest that comparative studies tend to be one dimensional in their design, focusing only on the delivery medium (the use of technology vs. no technology) rather than the multidimensional aspects of teaching practice and the learning process. These arguments are also supported by research in adult distance education. Sener (2005) and Bernard et al. (2004) argue that even when significant differences are found, they are more likely to be attributable to factors unrelated to delivery mode, such as instructor experience and quality, or variations among student cohorts. Indeed, Bernard et al. also found differences in results based on methodological features used. For example, studies that involved researcher-made tests favored distance learning over face-to-face, while studies using teacher-made tests favored face-to-face classrooms over distance learning. Calculated effect sizes favored distance learning while estimated effect sizes favored the classroom. Although none of the effect sizes in his meta-analysis were significant, the differences illuminate the larger problem of confounding variables inherent is this type of research.

The undeniable fact is that some students succeed in the virtual educational environment and some fail just as they do in traditional classroom environments. The key lies in understanding the critical components in an educational context that promote and encourage student success, not the media that was

used to deliver the instruction (Clark, 1994; Gunawardena & McIsaac, 2004). Blomeyer (2002) suggests

> 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. (p. 19)

Critical Components in Teaching and Learning

Building upon the findings of comparative studies are a variety of studies that examine the qualities of both the learning experience and teaching practice in online environments. Although the majority of comparative studies may present only a one-dimensional approach, the studies in this realm are an attempt to address the criticisms mentioned above—the failure of most comparative studies to take into account the complex systems in which distance education operates. Rather than comparing, these studies attempt to identify the important variables that create successful and effective online learning environments and make real efforts to transform learning experiences and teaching practices. Research in this section of the review has been categorized into studies that examine three areas: (1) Learner characteristics, (2) learner supports, and (3) affective learning domains.

Learner Characteristics

The relationship between personal variables, (i.e., learning style, self-esteem beliefs, demographics, etc.), and success is the focus of studies in this area. We have learned from adult research that many factors coexist and may be responsible for promoting student success in distance education environments. For example, greater learner autonomy and student responsibility are characteristics often found in successful distance education students (Fjortoft, 1995; Morris & Wu, 2005; Parker, 1999). In examining distance education studies, however, Cavanaugh et al. (2004) warn that it is important to differentiate between adult learners and learners in K–12 classroom settings. Young learners may present fundamentally different characteristics than their adult counterparts. In addition, although most adults have developed these characteristics to some extent, younger students need to acquire necessary skills through careful instruction.

What are the characteristics of the typical distance education student? Accurate statistical data of younger students participating in distance education is difficult to locate. In his evaluation of a Midwestern virtual high school, Mills (2003) examined frequency counts of 2,600 online student enrollments and found that the typical online student was just as likely to be male as female, and was an A or B student who was either a junior or senior. Roblyer and Marshall (2003) found that of the students who participated in their study of the Concord Consortium's Virtual High School Project (N = 135), about half were female, most were 16–17 years old, and 70% identified themselves as white. What seems to be more important than specific demographic descriptors are learner attributes that may indicate a student's potential success or failure in dis-

tance education environments. Most reports examining characteristics of online students hypothesize that a combination of factors may contribute to student success. As with comparative research, the research examining student characteristics consists mainly of studies that are descriptive and anecdotal in nature.

Studies that examine reasons for participating in distance education may offer insight into the relationship between motivation and student success. Students across studies appear to enroll in online courses for similar reasons. Convenience, flexibility in scheduling, credit recovery, accelerated learning opportunities, conflict avoidance, and the ability to take courses not offered at a local school are just some of the reasons identified in the research (Mills, 2003; Tunison & Noonan, 2001) Research also indicates that factors such as student attributes and their choice of course delivery method may also influence motivation (Roblyer, 1999; Tunison & Noonan, 2001). Hypothesizing that there is a relationship between student attributes, motivation, and success, Roblyer and Marshall (2003) used the results from an educational success instrument to predict student success in online courses ($n = 94$). Success was defined as passing with a grade in the course of A, B, or C ($n = 73$). Students who withdrew or received a D or F in the course were not included in the passing group ($n = 21$). Seventy items within four major factors thought to be related to successful behavior in online environments were constructed and presented as a survey to students enrolled in virtual high school courses. Descriminant analysis of the 70 items indicated that the instrument was successful at predicting student success with 100% confidence, or failure with 95% confidence.

The first factor in the prediction instrument, achievement and self-esteem beliefs, revolves around the degree of locus of control and self-efficacy beliefs that students have. This factor is important to the success of students because of the degree of self-motivation necessary to complete work in an online environment. The second factor, responsibility and risk taking, centers on the degree of individual initiative and taking responsibility for one's actions. The third factor, technology skills and access, assesses how skilled students are in using technology and their degree of access to the technology. The final factor, organization and self-regulation, centers on study skills and the necessity to approach tasks in an organized way. Qualitative data in the form of instructor input was also examined and corresponded to each of the factors mentioned above, with the exception that good parental support was mentioned by teachers as contributing to good work habits. In addition to these factors, the researchers also examined personal characteristics of students (i.e. grade level, age, job status) and their relationship with student success or failure. The only statistical difference occurred when the number of hours spent in outside school jobs was examined ($t = 2.73$, $p < .01$). Not surprisingly, students who are successful spend fewer hours working in jobs outside of the school environment.

One finding illustrates the potential of distance education and motivation in the development of learner autonomy. Tunison and Noonan (2001) examined online high schools students' first experiences in an online course. They looked at the demographics and perceptions of learner experiences of 126 students enrolled in courses offered through a virtual school created as an alternative school

within an existing district in a mid-sized Canadian city. The researchers reported an emergent theme of student appreciation for the feeling of empowerment and freedom in the direction of their learning.

> The most common student response to the question of benefits of a virtual school course was their appreciation of the autonomy and freedom. Although most students identified the teacher as the ultimate source of information, many students enjoyed the opportunity to work on their own and to figure out things for themselves without having to wait for their teacher to tell them what to do. (p. 503)

In addition to this finding, students reported appreciating most the fact that they could work ahead and at their own pace and the opportunity to develop new skills. Finally, students stated benefits in their interpersonal relationships. Students also reported disadvantages in taking an online course. Time management was an issue, as were technology problems. Although in general the researchers concluded that students enjoyed their online experience, they did point out the need for student supports as a major challenge to online instruction.

Learner Supports

Learner attributes appear to play a role in the success of students in distance education, but what about meeting the needs of students who may lack those qualities? In addition, even if students are highly motivated and self-directed, in a distance education environment they can still find the experience isolating, difficult, and discouraging. In adult research, instructional support, technical support, services that promote a sense of community, and the design of the learning environment have all been found to influence student success (LaPadula, 2003; McLoughlin, 2002). What components of this type have been found to affect student outcomes in the K–12 arena? Unfortunately, in this review of the research, very few studies were found that address the specific needs of K–12 students in the form of student supports. The few studies that were located tend to be descriptive in nature and function as an initial inquiry.

Similar to the Tunison and Noonan study discussed above, a study conducted by Frid (2001) concluded, in the descriptive study referenced previously, that experiences in a distance education environment can actually improve learner autonomy and independence but also indicates the importance of student supports. In this case, the amount of engagement by the adult supervisor seemed to influence the amount of and quality of participation by students. Participants included 28 students ranging in grade level from two to seven and in age from 7–12 years old, living in four different Australian territories or states. Participants who did not have an adult supervisor either did not finish the course or exhibited a marked decrease in the amount and quality of participation. Finally, interactions with peers appeared to have an effect on the results; when evidence of interaction with peers was apparent, students were more likely to persist with a challenging problem.

Weiner (2003) examined information gathered through surveys and interviews in a qualitative, descriptive case study that revealed students' attitudes to-

wards learning, motivational issues, academic achievements, and strengths and weaknesses of Web-based instruction. In summarizing the results she reports,

> The research findings confirmed that a high degree of student-teacher interaction, including feedback and summaries to the students, are a necessity in the virtual classroom, otherwise students felt ignored, lonely and lost in their courses. (p. 49)

The role of the teacher has been the topic of a significant number of adult distance education studies as well as studies associated with traditional K–12 classroom environments. Several studies indicate the most influential factor in student success or failure in traditional environments, even when accounting for minority and socio-economic status (SES), may be teacher quality (Ascher & Fruchter, 2001; Darling Hammond, 2000; Sanders & Rivers, 1996). Not surprisingly, it has also been posited that teacher quality plays a significant role in distance education outcomes (Cavanaugh et al, 2004). Indeed, one of the motivational influences for the development of distance education programs in K–12 education is the notion of increased access to highly qualified teachers.

Hughes, McLeod, Brown, Maeda, & Choi (2005) examined student perceptions of the learning environment in a comparison study of an online high school algebra class and a face-to-face course and the relationship not only with student outcomes but with teacher professional development (face-to-face students, n = 85; online students, n = 31). Major findings indicated first that students in the traditional class perceived significantly higher cooperation, student cohesiveness, and involvement than their virtual counterparts. Secondly, students in the virtual class perceived significantly more teacher support than students in the face-to-face class. Although the authors cautioned against generalizations because of the "small sample size in the sample (n = 7)," it is important to note that there was a significant relationship between the number of professional development experience hours and three of the student support components (p. 35). There was a significant relationship between the number of hours of professional development in mathematical content and perceived involvement (r = 0.872), between teaching mathematics and perceived teacher support (0.852), and between teaching technologies and perceived student cohesiveness (-0.819). Once again, however, this study is plagued by unanswered questions. For example, an examination across locations indicates significant variation in cohesiveness across virtual schools. Because of the lack of descriptive information regarding course structure and learning activities, it is impossible to make inferences about the nature of this variation.

Advocates of computer-based learning have traditionally advocated a shift in the theoretical foundations of pedagogical practice from that of behaviorist teacher-centered instruction to more student-centered constructivist approaches (Herring, 2004; Hill, Wiley, Nelson, & Han, 2004). At the heart of this shift is a change in the way we view the role of the teacher.

> 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. (Blomeyer, 2002, p. 8)

Herring (2004) examined the issues surrounding this shift in teaching practices. In a Delphi study conducted using the Web, a panel of experts in university positions from 13 states was asked to identify core constructivist-based experiences or elements necessary for their implementation in distance education settings. The result is a list of pedagogical guiding practices for curriculum and professional development activities that promote the tenets of constructivist learning environments. Perhaps a more important outcome from this study was an acknowledgment of the primary role of the instructional process in distance education rather than a focus on operational issues such as time management, classroom management, interaction, and delivery mechanisms.

Although in theory we may know what to do, it is more difficult in practice to implement. McLoughlin (2002) provided insight into how the core principles of effective instruction espoused by constructivist tenets may be implemented in a distance education setting through a detailed examination of scaffolding and associated technological tools. "Effective support would need to include the encouragement of reflective thinking, provision of social support for dialogue, interaction and extension of ideas with feedback from peers and mentors on emerging issues" (p. 152).

There is general agreement that distance education presents an opportunity to move toward a restructuring of education, but this move requires a shift in the role of the teacher (Vornberg & Maris, 2003). In reality, however, there are often barriers to implementation that may include: inadequate professional development, lack of time for development of course content, problems with the technology, and resistance to change.

There is some evidence that once barriers are removed, there is a potential for change and positive outcomes for students (Collins, 2001).

Affective Learning Domains

Related to student supports and instructional quality and effectiveness is a body of research that has investigated the realm of affective learning domains and their effects on student performance, satisfaction, and retention in distance education environments. One of the greatest concerns surrounding distance education may be the lack of social interaction and the potential harm this may cause, especially to younger students The perception of student isolation in the virtual environment is often seen as one drawback of this form of education (Fulton, 2002). Improvements in distance education technologies that assist in providing enhanced opportunities for interaction, such as threaded discussion boards and real-time audio and video communication tools, are examples of our perceived need to replicate classroom interactions as closely as possible. For this

reason, social dimensions and affective learning domains continue to generate interest in both traditional and virtual learning environments. Of particular interest is research that examines student performance through the lens of the theories of transactional distance, interaction, and social presence.

The research provides evidence that interaction in distance courses involves a complex array of variables: social, instructional, and technological. Interaction also plays a role in social presence, and Wolcott (1996) confirmed that psychological distance is a problem inherent in most distance courses. Moore (1989) posited that distance is not a matter of geography but rather psychology, and although geographical or physical distance may be increased in distance education settings, its effect can be decreased. He suggested that the interchange within a distance education context is characterized by three different types of learner interactions: learner-to-content (appropriateness of the course material and delivery vehicle considering the objectives and learners), learner-to-instructor (types of communication and feedback, access and support, etc.), and learner-to-learner (types of communication and feedback, support systems, and procedures for dialogue, etc.). Hillman, Willis, and Gunawardena (1994) add an additional mode of interaction related directly to distance education; learner-to-interface, where interaction is related to user access to and competency with the specific technology employed.

In online courses, there are often a variety of interaction types. Current computer-mediated communications (CMC) research identifies two broad categories of communication: synchronous (real-time) and asynchronous (delayed-time) (Romiszowski & Mason, 2004). Typical distance education synchronous communication tools would include the telephone, instant messaging or chat tools, and virtual classroom tools that allow file sharing, audio, and even video communications. Asynchronous communications encompass those technologies that typically involve a delay in when a message has been sent and when it has been read. Letter writing, fax, e-mail, and threaded discussions are all examples of asynchronous communications.

Preventing dropout behavior is a critical concern of online programs. As with online programs that serve adult populations, K–12 virtual schools and programs have relatively high dropout and failure rates; as much as 50% in some cases (Carr, 2000; Roblyer & Elbaum, 2000; Simpson, 2004). Studies of interactivity involving adults enrolled in online courses reveal that students have a real need to make connections with their instructor and their peers and research consistently supports the concept that faculty-to-student and student-to-student interactions are important components in student satisfaction and student retention (Downs & Moller, 1999; Kuh & Hu, 2001; Muirhead, 2001; Picciano, 2002; Stein, Wanstreet, Calvin, Overtoom, & Wheaton, 2005; Stith & Fitz, 1994). But does the same hold true for younger students?

The research concerning persistence of at-risk youth tends to support this notion. Lee and Burkham (2001) examined a variety of factors associated with persistence and concluded that although other factors such as curriculum and school size are important, the most important factor in student satisfaction and persistence may have more to do with the social organization of the school than

with any other factor. In short, students who experience consistent, positive relationships with their teachers were less likely to drop out. Students who don't experience these kinds of positive relationships often become disconnected and drop out (Zweig, 2003). Although no research could be located that addresses this relationship in the context of distance education in K–12, there is no reason to believe that the findings would not be consistent across instructional modalities. Passey (2000) suggests the basis for implementing distance education in K–12 should reflect the need to strengthen social supports rather than "providing a cost-effective solution which lowers levels of social interaction" (p. 48). Unfortunately, there is very little research examining the relationship between K–12 interaction that directly relates to student performance, satisfaction, and retention in a distance education context.

An internal evaluation of a virtual high school in Illinois, with a retention rate of more than 95%, does highlight the importance of interaction to some extent. Using interview transcripts, classroom documents, memos, and survey results, evaluators were able to establish that the qualities most responsible for success could be attributed in part to high quality materials and frequent teacher-student interaction (Vrasidas & Zembylas, 2003).

Studies are also beginning to appear that attempt to evaluate some of the latest computer-mediated communication tools for evidence of the quantity and quality of interactivity. Through observations and interviews of one teacher and 20 high school students using a Web-based synchronous tool, researchers examined the types of interactions occurring within and among the teachers and students participating in six separate class observations (Murphy & Coffin, 2003). Although each of the three types of interactions described by Moore (1989) and the fourth interaction described by Hillman et al. (1994) occurred with use of this tool, no data were gathered examining the relationship between interaction and student achievement or satisfaction.

The relationship between interaction and student achievement is less supported in the adult research base as well (Simonson, Smaldino, Albright, & Zvacek, 2006) but there are indications in adult studies that the use of interactive, asynchronous tools such as discussion boards may be linked with higher achievement (Kawachi, 2003) and the development of higher-order thinking skills (Meyer, 2003). Lapadat (2002) argues that the text-based, nonlinear characteristics of threaded discussions may provide increased opportunities for reflection and sense-making based on constructivist cognitive foundations. In essence, this type of communication allows students to "write one's way into understanding" (p. 27). No research could be found in the K–12 context that directly addresses this issue but there may be indications of a relationship between student-to-student interaction and learning. Frid (2001) concluded, in the descriptive study referenced previously, that increased interaction influenced motivation and engagement in activities that resulted in increased student persistence with a challenging problem.

Roblyer and Wiencke (2003) asserted that identifying observable behaviors with interactive qualities is essential in studying the effect of interaction. They have formulated a rubric designed to assess the interactive qualities of online

courses. Preliminary results from a formative evaluation suggest the rubric was shown to exhibit usefulness in defining and clarifying expected interactive performance. Hirumi (2002) also suggests using an approach grounded in learning theory in developing interactive experiences and provides explicit guidelines for doing so.

Research in the social dimensions of distance education is complex and a comprehensive evaluation of the field is beyond the scope of this review. Simonson et al. (2006) summarize that, "although interaction seems intuitively important to the learning experience, interaction should not be added without real purpose" (p. 81). Additionally, "Focusing on building collaboration and group interaction may be more important than focusing on individual participation" (p. 81). The limited research base and the descriptive nature of existing research in the K–12 realm makes it difficult to present even a basic summary. Obviously, more research is needed to determine the relationship between the affective domains of distance education and student performance and whether the use of asynchronous and synchronous technology tools may lead to enhanced learning, but it can be surmised that ineffective practices used in traditional classrooms will also be ineffective in distance education. Translating a lecture course to the Web, for example, will likely not generate the interest and motivation in students that a highly interactive course might. In addition, care must be given when generalizing adult research to the K–12 student population. As stated earlier, younger students need to be provided guidance in developing characteristics of successful distance students. Common sense would dictate that this applies to the social domains as well. Enhanced computer-mediated communication tools cannot substitute for well-designed instruction and opportunities to engage in purposeful, interactive learning activities.

CONCLUSION

The current state of distance education research, in general, has been described as one of confusion (Saba, 2005). It is apparent from this review that research in the realm of K–12 distance education is following closely in the footsteps of adult distance education. The research is limited and many of the studies reviewed in this report provide only limited insight into the complexities of the field. Some of the blame for this has been placed on the doorstep of the research community for a lack of a theoretical rationale for most distance education research as well as a lack of adequate training for new researchers in the field (Bernard et al., 2004; Saba, 2005). The complex nature of the field only adds to the confusion.

One thing we do know is that the effectiveness of distance education appears to have more to do with who is teaching, who is learning, and how that learning is accomplished, and less to do with the medium. At the very least, work such as that by Roblyer and Marshall (2003) and Simpson (2004) should continue and expand on prediction instruments and methodologies that assist in identifying those students who are less likely to succeed. Simpson suggests collecting demographic data on student cohorts, linking results to achievement/completion data, and performing logistic regression analysis on the results of

a previous student cohort to assist in predicting the future cohort results. This would require a concerted effort to collect, organize, and manage data on students. His current efforts attain 65% accuracy in predicting whether students will pass or fail and efforts are under way to improve this accuracy rating.

The Kozma et al. (2000) study is also a good example of a program evaluation that has followed this lead and taken a more comprehensive view of the potential factors responsible for student success in distance education. While painting a more comprehensive picture, this study also illustrates the difficulties in isolating complex interactions that occur in both face-to-face and distance education environments. The development of valid and reliable tools designed to identify expected behaviors associated with interactivity, such as the rubric developed by Roblyer and Wiencke (2003), will likely assist in this process, as will the work by Hirumi (2002) into guiding principles of interactive experiences through the lenses of learning theory and instructional design.

Technology in and of itself may have no special powers to improve learning, but it has been argued that distance technologies could offer more powerful learning opportunities than their face-to-face counterparts when embedded with instruction that addresses the cognitive and social processes of knowledge construction (Kozma, 1991). Quality research in this area would not only expand our knowledge of distance education but would be a valuable contribution to the knowledge base of existing research into teaching and learning in general.

The question of the effectiveness of student supports is critical in the K–12 context, especially when considering the alternative nature of the educational experience and the proclivity for its attractiveness to at-risk student populations. The characteristics identified as successful with at-risk students—instructional environments that are self-paced, personalized, utilize diverse instructional methods, and are facilitated by competent, caring adults (Barr & Parrett, 2001)—are the very characteristics that have been lauded in distance education circles. Research examining the relationship between student supports and at-risk student needs in relation to distance education is essential in answering questions about the benefits or drawbacks of distance education not only for this special population of students but for all students.

We can only expect the myriad aspects of distance education to become more complex as technological improvements are made in such areas as speech processing, gaming, 3D simulations, and automated speech translations. This continued expansion of distance education opportunities for primary and secondary students, particularly distance education that uses Internet or Web-based technologies, warrants a comprehensive examination of the needs and issues facing national, state, and local education agencies, policymakers, and researchers. In addition, responsibilities cannot be examined from just a proprietary or centralized perspective. The advances that are made encourage and influence education policy and practice on a global scale (Lin, 2003).

The results of this investigation are useful in that they provide a frame of reference from which to view this complex and rapidly evolving field. A summary of the findings suggest a need to:

- Improve the quality of research that examines the critical components of learning directly related to younger learners.
- Continue and expand on the development of prediction instructions that help identify successful learner attributes.
- Develop organized student evaluation systems to facilitate consistent data collection.
- Investigate the relationship between student supports and at-risk student needs in relation to distance education.
- Investigate the social and cognitive aspects of distance education and the effect on knowledge construction.
- Develop valid and reliable tools for identifying interactive qualities in course design and instruction.

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