Critical issues in special education technology research: What do we know? What do we need to know?

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The potential of technology for individuals with disabilities has long been recognized by the special education community. However, the rate of marketplace developments has far outstripped the research base documenting the effectiveness of specific applications of assistive and instructional technology. The purpose of this chapter is to summarize critical issues associated with six areas of special education technology: accessibility, assistive technology, professional development, instructional technology, service delivery, and legal / policy issues. Within each topical area, key works defining the current knowledge base will be summarized along with an analysis of important questions that deserve additional research. The implications of these analyses for defining future leadership and research agendas are noted.

Critical issues in special education technology research: What do we know? What do we need to know?

The fields of special education and rehabilitation have a long-standing interest in technology and the potential it holds for individuals with disabilities. Several detailed histories of the field of special education technology document the evolution of the discipline and highlight events and products that significantly impacted the use of technology by individuals with disabilities (Blackhurst, 1997; Blackhurst & Edyburn, 2000; Fein, 1996; Hannaford, 1993; Hauser & Malouf, 1996; Hobson, 1996; and U.S. Department of Education, 2000). A careful reading of the historical record suggests two powerful forces, innovation and policy, have operated in tandem throughout the twentieth century to advance the development, availability, and use of technology by people with disabilities.

Innovation

Innovation has largely occurred as a result of enterprising individuals and organizations as they created technological devices to augment human abilities. For example, the Audiophone Bone Conduction Amplifer was invented in 1874 and by 1900 the first electrical amplifying devices for individuals with hearing impairments was available. As radios made their way into American homes in the 1920s, in 1928 the American Foundation for the Blind distributed radios to blind citizens to provide them with access to information that previously was only available in print formats. Similarly, as the recording industry emerged in the 1930s in response to Edison's invention of the phonograph, talking books for the blind were produced on long-playing phonograph records as early as 1935. Fast forwarding to computer era we can observe that only a few years following the introduction of the first Apple computer in 1977, the Adaptive Firmware Card (AFC) was invented. The AFC allowed individuals with disabilities to operate the computer using a single-switch or with an alternative keyboard. The AFC

offered access to computer-based learning and productivity tools during the early days of the personal computing.

These few examples illustrate four historical patterns. First, the disability community has been quick to recognize the potential value of specific technological advances and capitalize on innovations by developing relevant applications for individuals with disabilities. Second, the lag between new technological advances and the availability of a specific disability application has been compressed during the twentieth century from over 20 years at the dawn of the century to only a few years at the end of the century. Third, while new technologies may initially be inaccessible to individuals with disabilities, modifications and innovative solutions routinely emerge to provide equal access. Finally, the disability community has demonstrated a consistent commitment to special education technology throughout the century.

Policy

The second powerful force influencing the advancement of special education technology in the twentieth century has been policy. Laws passed in the late nineteen century (i.e., 1879, P.L. 45-186 provided funds to the American Printing House for the Blind to produce Braille materials) and early 20th century (i.e., 1904, P.L. 58-171 promoted the circulation of reading matter among the blind) served to advance opportunities for individuals with disabilities who were perceived to be at a disadvantage in society. Over time, the disability community recognized the strategic value federal policy would serve for advancing the rights of individuals with disabilities.

Three specific legislative accomplishments benchmark the success of the disability rights policy agenda: 1973, P.L. 93-112 Rights of handicapped individuals in employment and educational institutions are guaranteed through Section 504 of the Rehabilitation Amendments; 1975, P.L. 94-142 Free appropriate public education and other procedural guarantees are mandated for all children with disabilities, and 1990, P.L. 101-336 passage of the Americans with Disabilities Act, landmark legislation

defining legal protections for individuals with disabilities, requiring employers to make reasonable accommodations, and mandating accessibility to public buildings. The accomplishments associated with this legislative agenda provided a context for political activism that contributed significantly to policy advances concerning technology in special education.

In the modern era, one of the first public policy documents to draw attention to the potential of technology was *Technology and Handicapped People* (U.S. Congress, Office of Technology Assessment, 1982). Readers were introduced to specialized technology tools, how they served a specific individual, and the impact these devices had on their lives. The real-life stories served as powerful illustrations of the potential of technology for individuals with disabilities. Success stories were an essential component of persuasive arguments that were advanced on the premise that public investment in research and development in the area of technology and disability could reap significant dividends in the form of improved communication skills, expanded mobility and independence, as well as an increase in the number of individuals gainfully employed and contributing to the tax base. Other marker events include passage of the Technology Related Assistance for Individuals with Disabilities Act (1988) which created a mechanism for each state to develop a responsive system for acquiring and training residents in their state on assistive technology and the 1997 reauthorization of IDEA which requires each IEP team to consider assistive technology when planning the educational program of each student with a disability.

Critical Issues in Special Education Technology Research

The dual impact of policy and innovation throughout the twentieth century created an expectation that the availability of technology and its use by individuals with disabilities would yield tremendous benefits. This expectation was formalized in the 1997 reauthorization of the Individuals with Disabilities Education Act (Public Law 105-17) through a requirement that technology consideration must be a routine part of

educational planning.

As the discipline of special education technology began to emerge during the 1980s and 1990s, research efforts became more notable. The organization of the Technology and Media (TAM) division of the Council for Exceptional Children in 1984 established the first membership organization where special educators with an interest in technology could affiliate. TAM is the publisher of one of the premier research journals for the discipline: *The Journal of Special Education Technology* (http://jset.unlv.edu). Another noteworthy influence during this period was work by the Office of Special Education Programs (OSEP), U.S. Department of Education. OSEP had established a specific grant program supporting research and development in technology, media, and materials for individuals with disabilities. With extensive input from consumers and professionals, OSEP facilitated the development of a research agenda to guide the federal grant process related to technology, media, and materials for students with disabilities (Schiller, 1993). Two subsequent reports describe the impact of the federal investment in special education technology research and development (Hauser & Malouf, 1996; U.S. Department of Education, 2000).

Considerable research on special education technology has been conducted during the past twenty years. Several literature reviews provide important historical snapshots concerning the effectiveness of specific technologies and interventions (Edyburn, 1995, 2000b, 2001a; Okolo, Bahr, & Rieth, 1993; Woodward & Cuban, 2001, Woodward & Rieth, 1997). Generally, we've learned that the issues associated with capturing the potential of technology are much more complex than we original thought. Despite a knowledge base that demonstrates the effective use of technology by individual and small groups of students, we have not been able to systematically capture the benefits of technology on a large scale. As a result, significant numbers of individuals with disabilities who could benefit from technology have yet to be introduced to the possibilities. Therefore, it may be important to revisit the notion of a

defining a technology research agenda (Pugach & Warger, 2001).

Early in the twenty-first century, a number of issues illustrate the need for concerted efforts to enlarge and systematize the research agenda concerning technology applications in special education. The following sections introduce an array of issues in six areas: accessibility, assistive technology, professional development, instructional technology, service delivery, and legal / policy issues, which currently impact the application of technology in special education. Within each topical area, key work summarizing the current knowledge base are identified. Emphasis will be placed on understanding the gaps in the current knowledge base in order to identify important questions that deserve additional research.

Accessibility

While recognizing the power and potential of technology, the special education community has also discovered that many technology products, as they come out of the box, are inaccessible for individuals with disabilities. The response to these design shortcomings has generally been two-fold: (a) create modifications that work around the problem, and (b) educate designers on universal design strategies that address the needs of individuals with disabilities while improving functionality for everyone.

What do know about accessibility?

Much of the early work in special education technology during the 1980s focused on adapting the computer to make it accessible for individuals with disabilities (Behrmann, 1988; Budhoff, Thormann, & Gras, 1984; Burkhart, 1980; Lewis, 1993). Today, over 20,000 assistive technology products are available (AbleData, 2000) that allow an individual with a special need to operate a computer using alternatives to the standard interface (keyboard, mouse, screen, printer) using tools like voice input, alternative keyboards, switches, and screen readers. However, the process of identifying, evaluating, and selecting assistive technology is often time-consuming and dependent upon specialized expertise provided by technology specialists, augmentative

communication specialists, and/or rehabilitation engineers.

As the Internet evolved, the extensive network of people involved in making computers accessible for individuals with disabilities, readily recognized that inadequate web design could disenfranchise the disability community. As a result, leaders were quick to call for design standards that would facilitate the use of assistive technologies like screen readers and enable users to personalize settings by over-riding default settings established by a designer (e.g., change the font size, alter the contrast between the text and the background). To a great extent, these efforts have been successful as a result of a multi-facted strategy to (a) impact web design standards (http://www.wai.org), (b) disseminate accessibility audit tools like Bobby (http://www.cast.org/bobby/), and (c) advance examples that illustrate good design is beneficial for everyone (Paciello, 2000; TRACE Center, 2001).

Some important breakthroughs in disability access computing occurred during the 1990s as a result of the research and development work of the TRACE Center at the University of Wisconsin-Madison. Recognizing the tremendous efforts required to retrofit assistive technology, the TRACE Center staff worked with computer manufacturers to include accessibility control panels within the system software on every computer. Hence, for selected types of impairments, accessibility is available on all computers by simply activating features in a control panel. This was a huge paradigm shift as it demonstrated that accommodations could be made proactively and without extensive specialized expertise. These initial efforts to improve access through better design contributed to what has come to be known as “universal design.” Principles of universal design challenge designers to plan for the full continuum of diversity so that everyone may use a product without additional modifications or adaptations.

Recently, the concepts of universal design and access to the general education curriculum have converged into what is referred to as “universal design for learning”

(Dolan, 2000; Orkwis & McLane, 1998; Rose, 2000; Rose, Sethuraman, & Meo, 2000). A leader in the area of universal design for learning has been the Center for Applied Special Technology (CAST). In 1999, CAST received a five-year grant from the Office of Special Education Programs to establish the Center for Accessing the General Education Curriculum (http://www.cast.org/naec/). In their view, universal design is a critical issue if students with disabilities are going to be able to access the general education curriculum. As part of their work, CAST sponsors the National Consortium on Universal Design for Learning (http://www.cast.org/udl/). The fundamental challenge is to design educational environments and instructional materials in ways that will be accessible to all students entering the classroom: students unable to manipulate the pages of a textbook, students unable to read at grade level, students whose first language is not English, etc.

What do we need to know about accessibility?

The issue of accessibility is a central one for special education. Current advocacy efforts have increased knowledge of the issues involved in physical and sensory access and new awareness is emerging concerning cognitive access. Designs which explicitly plan for diversity and thereby reduce or eliminate the need for reactive accommodations are a promising development. However, much more needs to be done. A research agenda in the area of accessibility may explore any number of questions: What percentage of accessibility problems can be addressed through improved awareness of existing solutions (i.e., activating control panels, purchasing off-the-shelf products) versus problems that require individual evaluation, custom solutions, or extensive consultation? How can protocols be used by individuals and organizations to conduct proactive, self-audits of the accessibility of a learning environment (i.e., computer lab, distance education system, cdrom-based learning materials)? Given products created using principles of universal design for learning theory, what impact do they have on students? teachers? learning outcomes? How can

technology be used to cognitively rescale information to make it accessible to individuals requiring more or less challenge?

Assistive Technology

Historically, the emphasis on technology for individuals with disabilities has been thought of as assistive technology, that is, extending the abilities of an individual in ways that provides physical access (i.e., wheelchairs, braces), and sensory access (i.e., Braille, closed captioning). Indeed, the legal definition of assistive technology is considerably broad:

> §300.5 Assistive technology device.
>
> As used in this part, Assistive technology device means any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability. (Authority: 20 U.S.C. 1401(1))

More recently, we've come to understand that additional attention must also be given to the use of technology for teaching and learning (Blackhurst & Lahm, 2000). In this chapter we'll use the term "special education technology" to cover both dimensions of assistive technology and instructional technology. Regardless of the specific application of technology, the general goal is always the same: to harness the potential of technology in ways that offer an individual with a disability increased opportunities for learning, productivity, and independence–opportunities that otherwise would not be available.

What do know about assistive technology?

Compared to most areas of special education technology, we know much about assistive technology. In one of the major works within the discipline, Cook and Hussey (1995) examine the context of human performance, disability, and assistive technology and provide theoretical and practical insights into the ways technology enhances performance. Research syntheses completed by Thorkildsen (1994) offer a historical

benchmark concerning the use of assistive technology, typically involving mobility and communication. Our understanding of assistive technology and specific disabilities has been increased through the work of Wehmeyer (1999) who examined mental retardation and Edyburn (2000a) who examined mild disabilities.

A number of studies contribute to the knowledge base concerning the acquisition and use of assistive technology. Todis and Walker (1993) and Todis (1996) helped us understand user perspectives on assistive technology. Research commissioned by United Cerebral Palsy (1999) offers insight into the technology needs of families and ways in which family centers can design programs and services to meet those needs. Parette and colleagues (Parette, 1999; Parette & Hourcade, 2000; Parette & Hourcade, 1997) have advanced a thoughtful series of inquiries into multicultural considerations and assistive technology. The state of assistive technology services in public schools has been examined by several research groups and contributes to an understanding of the variables impacting teacher support of students who use assistive technology (Derer, Polsgrove, & Rieth, 1996; Hutinger, Johanson, & Stoneburner, 1996; McGregor & Pachuski, 1996). Research by Raskind, Higgins, Slaff, & Shaw (1998) has provided a glimpse of assistive technology use at home by students with learning disabilities and has the potential to offer important insights about the relationship of home-school computing much like the earlier work of Giacquinta, Bauer, and Levin (1993).

An emerging topic of interest in the area of assistive technology focuses on issues involved in outcomes and quality. Smith (1996, 2000) has called attention to an array of measurement issues associated with understanding the impact of assistive technology. Zabala & Korsten (1999) have suggested that a series of changes can be expected when assistive technology is used effectively: quality, quantity, accuracy, rate, frequency, spontaneity, independence, and other. Their work offers an important starting point for creating a framework to document the effective use of assistive

technology. Another promising development comes from the work of the QIAT Consortium (http://www.qiat.org/) which has sought to operationally define quality indicators for assistive technology services (QIAT Consortium, 2001). Finally, the results of a national survey of assistive technology outcome practices has been published in a three-volume series by RESNA (1998) that offers a snapshot of current instruments, resources, and strategies for assessing assistive technology outcomes.

What do we need to know about assistive technology?

Significant gaps remain in what we know about assistive technology. For example, some questions that outline what we need to know, include: What is the current incidence of student use of assistive technology in schools? Are there key benchmarks to monitor concerning the equitable identification of need, selection, acquisition, and use of assistive technology? What impact does the use of assistive technology have on the academic performance of its users? Which current practices lead to effective and sustained use of assistive technology and which contribute to abandonment?

Professional Development

Teachers play a critical role in supporting students using assistive and instructional technology (McGregor & Pachuski, 1996; U.S. Congress, Office of Technology Assessment 1988, 1995). As a result, considerable effort has been devoted to (a) understanding what teachers need to know and be able to do, and (b) effective strategies for providing professional development to preservice and inservice teachers. Particularly troublesome is the fact that the need for extensive initial teacher preparation and on-going professional development in special education technology far exceeds our current ability to provide it.

What do know about professional development and technology?

Lahm (Lahm 1999, 2000) has reported on the efforts of the Technology and Media (TAM) Division of the Council for Exceptional Children to identify and validate

the technology competencies expected of beginning special education teachers, master teachers, and assistive technology specialists. This work has been used extensively by universities and inservice providers as they design coherent training sequences. Alternatively, programs like RESNA (http://www.resna.org) and CSUN (http://www.csun.edu/cod/) have established national certification programs to certify participants, upon completion, as assistive technology specialists. These two programs fill an important gap in leadership development for the discipline as a recent review of personnel preparation programs in assistive technology by RESNA (1998) identified only 21 programs in the United States that provided coursework leading to a certificate or degree in special education technology. In practice, this means that individuals desiring training in assistive technology will find less than one program for every two states in the country. To say that the pipeline preparing new special education technology specialists is severely constricted may be an understatement.

The literature also documents efforts to explore innovative uses of technology to enhance technology training for special education teachers. Edyburn (2001b) outlines a taxonomy of technology-based training approaches and supports. Feit (1999) describes the important paradigm shift involved in the creation of the Intellitools Learning Activities Exchange. This online component of their web site is a place where teachers can download instructional materials and software players to use adapted curriculum materials with their students before devoting the time and effort to learning how to modify or create original materials of their own. By completely inverting the training sequence, Intellitools has discovered they should reprioritize their efforts and yet, accomplish far more and reach many more teachers. The Special Needs Opportunities Windows (SNOW) project at the University of Toronto has demonstrated the value of distance education as an effective means of providing inservice professional development on special education technology (http://snow.utoronto.ca/coursereg.html). The use of distance education to

simultaneously help teachers learn about special education and gain important technology skills has also been explored by several groups of researchers (Blackhurst, Hales, & Lahm, 1998; Smith, Smith, & Boone, 2000).

The importance of self-directed learning for teachers and technology specialists cannot be overlooked. Professional organizations like TAM (http://www.tam.cec.org), RESNA (http://www.resna.org), and the newly formed Special Education Technology Special Interest Group (SETSIG) in the International Society of Technology in Education (ISTE) (http://www.iste.org) provide opportunities to join in membership with other professionals.

Resource organizations also play an important role in ongoing professional development given the variety of information products and services they provide (Closing the Gap, http://www.closingthegap.com; Center for Applied Special Technology, http://www.cast.org, Alliance for Technology Access, http://www.ataccess.org).

National special education technology conferences provide important opportunities for learning about new developments within the discipline. Major conferences include: ATIA (January, http://www.atia.org), TAM (January, http://www.tam.cec.org), CSUN (March, http://www.csun.edu/cod/), NECC (June, http://www.neccsite.org), and Closing the Gap (October, http://www.closingthegap.com).

A final component of self-directed learning involves using key publications within the discipline to stay current. The following publications are among the core journals of the discipline: Assistive Technology, Closing the Gap, Journal of Special Education Technology, Special Education Technology Practice, and Technology and Disability.

What do we need to know about professional development and technology?

Despite the extensive knowledge base informing the design and delivery of

professional development programs for teachers, a number of questions require additional study: What are the professional development habits of special education technology specialists? Which current professional development practices relative to technology and staff development can be documented as effective and which are known to have minimal impact? How much time should be devoted to maintaining current awareness and improving knowledge and skills in order for professionals to remain actively engaged in the knowledge base of the profession? What is the relationship between staff development concerning innovative applications of technology and student outcomes?

Instructional Technology

Much of the original work on microcomputer use in special education centered on drill and practice learning activities. Moving beyond this remedial application of technology required a transformation in thinking and professional practice (Russell, Corwin, Mokros, & Kapisovsky, 1989). Today, another transformation in thinking and professional practice is required as teachers and technology specialists must reconsider the role of technology in the inclusive classrooms, due to the fact that most students with disabilities spend a majority of their school day in general education classrooms. In response, the discipline of special education technology must place more emphasis on understanding and supporting the use of technology to enhance teaching and learning in additional to its traditional emphasis on assistive technology.

What do know about instructional technology?

Several analyses have summarized what is known about the effective use of technology by students with disabilities (Okolo, Bahr, & Rieth, 1993; Woodward & Rieth, 1997). Other insights concerning effective instructional technology practices may be gained from studies involving general education students (Fletcher-Finn & Gravatt, 1995; Roblyer, Castine, & King, 1988; Schacter & Fagnano, 1999; Sivin-Kachala, & Bialo, 2000, 1995). The evidence clearly suggests we know a lot about the use of technology to

enhance writing and problem solving and have many examples of how technology can facilitate student achievement through its attributes of innovation, feedback, and engagement.

Two trends presently impacting classroom instructional practice are standards-based instruction (McLaughlin, Nolet, Rhim, & Henderson, 1999) and high-stakes testing (Elliot, Erickson, Thurlow, & Shriner, 2000). As a result, teachers perceive a clear need to ask questions related to the educational outcomes regarding the materials they select and the instructional approaches they use. Several recent works have important implications for using technology to help students with disabilities achieve high academic standards: curriculum design strategies (Burke, Hagan, & Grossen, 1998), Grading modifications (Christensen & Vogel, 1998; Welch, 2000), cognitive credit cards (Edmunds, 1999), and validated instructional strategies (Sikorski, Niemiec, & Walberg, 1996). New accountability tools that help schools align standards, learning experiences, and technology in ways that document students' achievement of high academic standards are an important development (U.S. Department of Education, 1998).

The issue of technology integration is fundamental to understanding the use of technology to enhance instruction. The difficulties associated with technology integration are well documented: lack of teacher time; access to hardware, software and support; limited leadership, lack of of a common vision or rationale for technology use; limited training and support; and the impact of current assessment practices on defining what teachers must teach and that what students learn with technology may not be readily measured on standardized tests (U.S. Congress, Office of Technology Assessment, 1995).

Willis (1993) adds a number of other interesting dimensions of the problems teachers will confront when they try to integrate technology: curricular integration is a complex, difficult-to-learn process; many educators feel isolated and alone; time to experiment, explore, and study innovations is essential but rare in schools; top down

projects tend to fail over time; resentment and resistance destroys projects, ownership is critical to success; bottom-up projects tend to fail over time; administrative support is critical; nonexistent, inadequate, or inconsistent support is a major reason for failure; and theories of change are useful planning guides for change. Finally, experienced technology using teachers conclude--at least initially--most uses of computers make teaching more challenging and require more effort (U.S. Congress, Office of Technology Assessment, 1988, 1995). Individually, and collectively, the impact of these factors suggest the true complexity of the challenge associated with integrating technology into the curriculum.

What do we need to know about technology integration?

Despite significant work in the area of technology integration, a number of factors impact our ability to make integration happen on a systemic basis. Therefore, a number of questions are worthy of additional research: How does technology enhance teaching? How does technology enhance learning? When students use technology to enhance their productivity as a learner, what types of outcomes do they report? What role can technology play in facilitating the work of teachers to make modifications in curriculum, instruction, and/or assessment for students in general education settings? What types of measurement and reporting systems should document claims of the effectiveness of technology-based instructional interventions?

Service Delivery

Issues involved in the delivery of assistive technology services in schools are likely to gain additional attention in the future. At the present time, there is little evidence to suggest that assistive technology consideration is happening as required by law. As a result, in the near future we are likely to see new emphasis on service delivery systems equivalent to child find (screening for assistive technology needs) and prereferral interventions (equipping classrooms with common devices that have been demonstrated to help students thereby reducing the need for extensive assistive

technology evaluations).

What do know about special education technology service delivery systems?

In a new review of the literature on special education technology service delivery systems, Ludlow (2001) provides a comprehensive analysis of promises and pitfalls associated with technology and special education teacher education. This review fills a significant void on this topic.

In work that has important implications for both research and practice, Haines and Sanche (2000) reviewed four common assistive technology assessment models. Subsequently, they describe a normalization process used to standardize the models and terms, and sequence the components advanced by each theorist. The result is a synthesis of the four individual models into a coherent framework, "The AT CoPlanner Model," which they have implemented as a content module for the software product, "CoPlanner."

To-date, few alternatives (Anson, 1997) have emerged to a service delivery system that is labor intensive and requires specialized expertise not commonly found in every community. As a result, it can be surmised that the size of the underserved population is quite significant.

The lack of empirical data on special education technology service delivery methods requires the use of anecdotal observations to describe current practices:

- It is common practice to utilize a multidisciplinary team made up of teachers, technology specialists, occupational therapist, speech therapist, and physical therapist when conducting an assistive technology evaluation.
- Most individuals participating in an assistive technology team do so as a result of part-time release from their regular case / teaching load.
- Most assistive technology evaluations involve an in-depth evaluation that, in many respects, mirrors the special education referral process, and therefore, is perhaps comparable in terms of cost, time involved, and

efficiency.

- There is little evidence to suggest that schools use any systemic screening process to identify students who potentially could benefit from assistive technology.
- Students who have access to assistive technology often do so as the result of advocacy efforts that challenge the system rather than through a systemic process that ensures that all students in need of devices have them.
- Of the many students who currently use assistive technology, the most common applications involve technologies that overcome physical challenges or enhance communication abilities.
- Most AT teams lament that the majority of their time is spent assessing new students for assistive technology needs rather than being engaged in on-going support and follow-up of current assistive technology-using students. Implicitly, the emphasis is on acquisition (i.e., shopping), rather than on implementation and assessment of outcomes.
- Per federal mandate, every IEP team is required to document their efforts to consider assistive technology. As it pertains to students with mild disabilities (LD, ED, MR), ages 6-21, this effects over 3.8 million students. Current assistive technology service delivery systems, developed to respond to the needs of students with low incidence disabilities, do not appear capable of being scaled-up to meet the needs of students with high incidence disabilities.

What do we need to know about special education technology service delivery systems?

Little research has been conducted on the service delivery systems used by schools and state education agencies to provide special education technology. As a result, there is much to be learned. Some questions that should be addressed in future

research studies, include: What organizational structures are used to organize assistive technology services in schools? How many certified assistive technology specialists are employed in public and private schools? full-time? part-time? What is the composition of assistive technology teams in public schools? How long does it take to assess the need for assistive technology, acquire devices, train, and implement?

Legal / Policy Issues

As noted at the beginning of this chapter, the field of special education technology has been profoundly influenced by the legislative action that sought to realize the potential of technology for persons with disabilities. As a result, it has become increasingly important that policy studies become part of the research agenda for the discipline.

What do know about legal / policy issues?

The issue of assistive technology consideration is a rather recent development. Its origin can be traced to the Individuals with Disabilities Education Act Amendments of 1997 (Public Law 105-17) which contained a requirement for the Individual Education Program (I.E.P.) teams to consider assistive technology in the development of an IEP: "The IEP Team shall--(v) consider whether the child requires assistive technology devices and services." [Section 614 (d)(3)(B) Consideration of Special Factors.]

Whereas some observers believe this language reflects a new federal policy, Golden (1998) argues that it simply formalizes a previous responsibility:

> "The IDEA requires schools to provide AT if it is needed for a student to receive a free appropriate publication education (FAPE). FAPE can include a variety of services such as special education, related services, supplementary aids and services, program modifications or support for school personnel. AT, just like other components of FAPE, must be provided at no cost to parents. The specific IDEA requirement for schools to provide AT is as follows:
>
> > 300.308 Assistive Technology
> > Each public agency shall ensure that assistive technology devices or assistive technology services or both, as those terms are defined in 300.5 - 300.6 are made available to a child with a disability if required as part of a child's (a) Special education under 300.17; (b) Related

> services under 300.16; or (c) Supplementary aids and services under 300.550(b)(2).” (p. 4)

Golden’s analysis highlights a critical issue: Free Appropriate Public Education (FAPE). Schools are required to provide assistive technology for students that need such tools, if they are necessary, for the student’s participation in and benefit from a free appropriate public education (Etscheidt & Bartlett, 1999; Huefner, 2000). The historical implications of this requirement are unquestioned in the context of mobility (i.e., a powered wheelchair) and communication (i.e., an augmentative communication system). However, the requirement covers all disabilities and therefore issues like the following have emerged: “Jimmy’s handwriting is not legible, therefore he needs a laptop computer.” While such a claim and solution may indeed be certified by an I.E.P. team, the budgetary implications of this mandate, when applied to a high incidence population, has created an environment where administrators are reluctant to approve requests for assistive technology for students with mild disabilities given the fact that they have 50 students like Jimmy within their building (Edyburn, 2000a). Of course, interventions other than a laptop computer may also be appropriate.

Has technology been considered? A guide for IEP teams (Chambers, 1997) is an acknowledged key resource on the topic of assistive technology consideration. This book is an outcome of the author’s research which involved a delphi study of assistive technology experts and focus groups with trainers and consumers of assistive technology services in response to her observation that the 1997 reauthorization of IDEA required that assistive technology be considered, but the legislation offered no guidelines on how to implement the requirement. A valuable component of Chamber’s work is a flow chart of questions that should be asked and answered, by an I.E.P team. As a result of engaging in the process, she argues that teams will automatically generate the documentation of their assistive technology consideration efforts on behalf of a child.

What do we need to know about legal / policy issues?

As school districts seek to implement assistive technology on a systemic basic, a recent analysis by Golden (1999) provides benchmark estimates of the percentage of students by disability category that could potential benefit from assistive technology. These expectance figures should be confirmed or modified through research as an important policy tool that spurs action for reaching the underserved.

New research on service delivery models needs to examine alternatives to current models and examine universal access for all who could benefit. Obviously, funding is still a problem. Additional questions worthy of exploration include: Do all students who could potentially benefit from assistive technology have access to appropriate devices and services? Given a shortage of specialized personnel and the size of the high incidence disability population, what types of assistive technology interventions can be shown to be effective for students with mild disabilities? How might toolkits with these interventions be distributed and used as a pre-referral intervention? What factors should be considered when evaluating a due process claim concerning the need for assistive technology? What types of decision aids can be shown to improve decision making relative to the consideration, selection, and use of assistive technology?

Concluding Comments

Despite the impact of two powerful forces throughout the twentieth century, innovation and policy, and the success in demonstrating that a technological device or intervention works for an individual or a small group, the field of special education technology has struggled with the "scaling-up challenge." That is, how do we reach all the individuals that could potentially benefit from using technology? The gap between the potential of technology and current practice has been a source of frustration to many parents, professionals, and policy makers. Ideally, research should advance solutions to the difficulties associated with the "scaling up challenge."

As future leadership and research agendas are developed, consideration should be given to three aspects of using research to enhance decision-making concerning special education technology. Clearly, more research on the effective use of technology is urgently needed. Indeed, many more products are currently available in the marketplace, and are finding their ways into schools, than products with a record of research-validated evidence of effectiveness. Second, significant attention must be devoted to ensuring that research results are relevant. Many large multi-year projects currently take two to three years to collect data, two additional years to have the results published, and end up describing the effectiveness of products that are no longer available or have been updated through several revision cycles. Finally, increased emphasis on action research models and procedures may ultimately provide schools with the necessary data-based decision-making tools. Given the pace of change in the marketplace and the rate of adoption, action research can serve to assess the efficacy of innovative applications of special education technology in a timely and relevant manner.

The purpose of this chapter has been to provide a context for understanding the persistent effort of the profession to identify, implement, and evaluate applications of technology that serve to amplify and enhance communication, mobility, independence, and learning by individuals with disabilities. Critical issues associated with six areas of special education technology: accessibility, assistive technology, instructional technology, professional development, service delivery, and legal / policy issues, have been presented. Emphasis has been placed on summarizing key works and understanding the gaps in the current knowledge base in order to outline important questions that deserve further research. A list of the questions we need to know which have been advanced by the author are presented in Table 1. Readers are encouraged to consider the issues raised in this chapter as they define future leadership and research agendas and how their work may contribute important research findings to

understanding critical questions about the effective use of technology in special education.

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Table 1

Critical unanswered questions in special education technology research

Accessibility

- What percentage of accessibility problems can be addressed through improved awareness of existing solutions (i.e., activating control panels, purchasing off-the-shelf products) versus problems that require individual evaluation, custom solutions, or extensive consultation?
- How can protocols be used by individuals and organizations to conduct proactive, self-audits of the accessibility of a learning environment (i.e., computer lab, distance education system, cdrom-based learning materials)?
- Given products created using principles of universal design for learning theory, what impact do they have on students? teachers? learning outcomes?
- How can technology be used to cognitively rescale information to make it accessible to individuals requiring more or less challenge?

Assistive Technology

- What is the current incidence of student use of assistive technology in schools?
- Are there key benchmarks to monitor concerning the equitable identification of need, selection, acquisition, and use of assistive technology?
- What impact does the use of assistive technology have on the academic performance of its users?
- Which current practices lead to effective and sustained use of assistive technology and which contribute to abandonment?

Professional Development

- What are the professional development habits of special education technology specialists?
- Which current professional development practices relative to technology and staff

development can be documented as effective and which are known to have minimal impact?

- How much time should be devoted to maintaining current awareness and improving knowledge and skills in order for professionals to remain actively engaged in the knowledge base of the profession?
- What is the relationship between staff development concerning innovative applications of technology and student outcomes?

Instructional Technology

- How does technology enhance teaching? How does technology enhance learning?
- When students use technology to enhance their productivity as a learner, what types of outcomes do they report?
- What role can technology play in facilitating the work of teachers to make modifications in curriculum, instruction, and/or assessment for students in general education settings?
- What types of measurement and reporting systems should document claims of the effectiveness of technology-based instructional interventions?

Service Delivery

- What organizational structures are used to organize assistive technology services in schools?
- How many certified assistive technology specialists are employed in public and private schools? full-time? part-time?
- What is the composition of assistive technology teams in public schools?
- How long does it take to assess the need for assistive technology, acquire devices, train, and implement?

Legal/Policy Issues

- Do all students who could potentially benefit from assistive technology have

access to appropriate devices and services?

- Given a shortage of specialized personnel and the size of the high incidence disability population, what types of assistive technology interventions can be shown to be effective for students with mild disabilities? How might toolkits with these interventions be distributed and used as a pre-referral intervention?
- What factors should be considered when evaluating a due process claim concerning the need for assistive technology?
- What types of decision aids can be shown to improve decision making relative to the consideration, selection, and use of assistive technology?