Assistive Technology
Outcomes and Benefits

A joint publication of the Assistive Technology Industry Association (ATIA) and the Special Education Assistive Technology (SEAT) Center

Volume8, Number 1
Fall 2012

Focused Issue: The Role of Higher Education in the Prepartion of Education Professionals to Use Assistive Technology

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Special Education Assistive Technology Center at Illinois State University and Assistive Technology Industry Association

ISSN 1938-7261

Assistive Technology Outcomes and Benefits

The Role of Higher Education in Preparing Education Professionals to Use Assistive Technology

Fall 2012 Focused Issue

Assistive Technology Outcomes and Benefits (ATOB) is a collaborative peer-reviewed publication of the Assistive Technology Industry Association (ATIA) and the Special Education Assistive Technology (SEAT) Center at Illinois State University..

Editing policies of this special issue are based on the *Publication Manual of the American Psychological Association* (5th ed.). The content presented herein does not reflect the position or policy of ATIA or the SEAT Center and no official endorsement should be inferred.

Assistive Technology Outcomes and Benefits

Editorial Policy

Assistive Technology Outcomes and Benefits is a peer-reviewed, cross-disability, transdisciplinary journal that publishes articles related to the *benefits* and *outcomes* of assistive technology (AT) across the lifespan. The journal's purposes are to (a) foster communication among vendors, AT Specialists, AT Consultants and other professionals that work in the field of AT, family members, and consumers with disabilities; (b) facilitate dialogue regarding effective AT practices; and (c) help practitioners, consumers, and family members advocate for effective AT practices.

Assistive Technology Outcomes and Benefits (ATOB) invites submission of manuscripts adhering to the format of the *Publication Manual of the American Psychological Association* (5th ed.) and which address a broad range of topics related to *outcomes and benefits* of AT devices and services. Manuscripts may include (a) findings of original scientific research, including group studies and single subject designs; (b) marketing research conducted relevant to specific devices having broad interest across disciplines and disabilities; (c) technical notes regarding AT product development findings; (d) qualitative studies, such as focus group and structured interview findings with consumers and their families regarding AT service delivery and associated outcomes and benefits; and (e) project/program descriptions in which AT outcomes and benefits have been documented.

ATOB will include a broad spectrum of papers on topics specifically dealing with AT outcomes and benefits issues, in (but NOT limited to) the following areas:

- Early Childhood and School-Age Populations
- Research and Product Development
- Outcomes Research
- Transitions
- Employment
- Innovative Program Descriptions
- Government Policy

Regardless of primary focus of any submission, primary consideration will be given by the journal to manuscripts presenting quantifiable results.

Types of articles that are appropriate include:

Applied/Clinical Research. This category includes original work presented with careful attention to experimental design, objective data analysis, and reference to the literature.

Case Studies. This category includes studies that involve only one or a few subjects or an informal protocol. Publication is justified if the results are potentially significant and have broad appeal to a cross-disciplinary audience.

Design. This category includes descriptions of conceptual or physical design of new AT models, techniques, or devices.

Marketing Research. This category includes industry-based research related to specific AT devices and/or services.

Project/Program Description. This category includes descriptions of grant projects, private foundation activities, institutes, and centers having specific goals, objectives, and outcomes related to AT outcomes and benefits.

In all categories, authors MUST include a section titled Outcomes and Benefits containing a discussion related to outcomes and benefits of the AT devices/services addressed in the article.

For specific manuscript preparation guidelines, contributors should refer to the Guidelines for Authors at http://atia.org/

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- Government Policy
- Research and Development
- Low Incidence Populations

Submission Categories

Articles may be submitted under two categories—*Voices from the Field* and *Voices from the Industry*.

Voices from the Field

Articles submitted under this category should come from professionals who are involved in some aspect of AT service delivery with persons having disabilities, or from family members and/or consumers with disabilities.

Voices from the Industry

Articles submitted under this category should come from professionals involved in developing and marketing specific AT devices and services.

Within each of these two categories, authors have a range of options for the type of manuscript submitted. Regardless of the type of article submitted, primary consideration will be given by the journal to work that has *quantifiable results*.

Types of articles that are appropriate include:

Applied/Clinical Research. This category includes original work presented with careful attention to experimental design, objective data analysis, and reference to the literature.

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A Farewell to the Readership and the Assistive Technology (AT) Field

In 2002, the idea of a journal focusing on AT outcomes was being considered while I was a faculty member at Southeast Missouri State University. In a conversation with Dave Edyburn at that time, it was suggested that the potential existed for a partnership with the Assistive Technology Industry Association (ATIA) to create just such a journal. Subsequent discussions with David Dikter, Executive Director of ATIA, supported by my appointment as Kara Peters Endowed Chair in Assistive Technology at Illinois State University culminated in a partnership to launch our unique journal, *Assistive Technology Outcomes and Benefits* (ATOB). Published annually since Fall, 2004, and archived in ERIC and Ebsco Host, our early goal was to create a revenue-generating, cross-disciplinary, peer-reviewed journal that provided a forum for the dissemination of outcomes and benefits generated by AT scientific and marketing research, manufacturers' product development activities, and AT projects/programs. In the early years of the journal's production, it was envisioned that a sustainable model could be achieved to support the publication process. However, over time the increasing preferences for and expectation of an open access publishing model became the expectation, and, while such a model is laudable from a consumer perspective, the current approach to publishing ATOB is no longer feasible. I have immensely enjoyed this service commitment to our field as Founding Editor of ATOB, and extend a personal thanks to my colleague, Dr. Brian Wojcik, who has served as Production Manager since the first issue was published in 2004. Appreciation is also expressed to David Dikter and Caroline Van Howe, our partners in the ATOB adventure, for their support and encouragement over the years. Finally, the many members of our distinguished panel of ATOB reviewers are extended a heart-felt word of thanks for their diligence in reviewing manuscripts for both our regular issues of the journal and our Special Issues. As our field continues to evolve, we hope that our efforts with ATOB will be remembered as a historical marker, and we wish all our readership continued success in their respective endeavors to help individuals with disabilities through use of AT.

Howard P. Parette, Ed.D., Editor

The Role of Higher Education in Preparing Education Professionals to Use Assistive Technology

Jeffrey P. Bakken
Bradley University

Howard P. Parette, Jr.
Illinois State University

In both 2005 and 2006, Assistive Technology Outcomes and Benefits (ATOB) published articles based on issues addressed at two AT Outcomes Summits, attended by higher education professionals, assistive technology (AT) manufacturers, AT consultants, public school AT Specialists, representatives of national AT organizations, and concerned citizens from the private sector (Parette, Peterson-Karlan, & Wojcik, 2005; Parette, Peterson-Karlan, Smith, Gray, & Silver-Pacuilla, 2006). In both venues, the issue of preservice preparation of future education professionals to consider and use AT with children with disabilities was addressed. The thinking of many of these participants was succinctly summarized by Cindy Okolo:

> I think we are doing a really lousy job with pre-service teachers and any kind of impact we can have or anybody else can have on pre-service teacher preparation—ways of making information more readily available to people who are teaching…teachers, so that they can get this into pre-service classes…is really important. (Parette et al., 2006, p. 23)

Without effective preservice preparation of future education professionals to both consider and use AT, they may continue to rely on an 'expert model' in which a 'funneling' effect occurs (i.e., experts sharing only a narrow set of AT knowledge and skills with which they are familiar to a target audience; Parette, Peterson-Karlan, & Wojcik, 2005). The net result of funneling is "diminishing the knowledge base of large groups of individuals…and reinforcing the continuing reliance of entities and individuals in the service system on experts" (Parette et al., 2005, p. 16). A better approach to this ongoing reliance on an expert model is to develop a broad AT knowledge base and skills at the preservice level, but the challenge remains as to how such preparation may be accomplished.

Numerous authorities for more than a decade have called attention to the need for effective preservice preparation of education professionals (Anderson & Petch-Hogan, 2001; Bausch & Hasselbring, 2004; Bell & Judge, 2010; Edyburn & Gardner, 1999; Michaels & McDermott, 2003; Judge & Simms, 2009; Van Laarhoven & Conderman, 2011; Wojcik, Stachochiak, Van Laarhoven, & Parette, 2009). This is certainly problematic from the perspective of future special education professionals, but is an issue for general education professionals who typically serve children with disabilities in their classroom settings (Andrews, 2002; Kamens, Loprete, & Slostad, 2003; Pugach, 2005).

These issues prompted a focus of this issue of ATOB on the role of higher education in preparing future education professionals to consider and use AT in today's school settings. Four articles are reported, covering such diverse topics as the status of both undergraduate and graduate personnel preparation in AT service delivery, format for the delivery of instruction, lessons learned in integrating AT knowledge and skills into a curriculum, and specific service delivery to post-secondary students with learning disabilities.

In the first article, "Status of Assistive Technology Instruction in University Personnel Preparation Programs," Margaret E. Bausch and Melinda J. Ault describe a national study that was implemented to gauge the extent to which personnel preparation programs believe they prepare their graduates to implement AT in their future roles. Participants from 231 institutions of higher education (IHE) completed the survey. Results focused on the amount of AT instruction received and the AT devices that they were able to use. Also discussed are major barriers to including AT in their curriculum to students with disabilities. Based on the data suggestions are made for promising practices that could benefit other IHEs that are providing or wanting to provide AT coursework.

In the second article, "Web-based Resources an Effective Means for Increasing Knowledge in Higher Education?" Carrie A. Courtad presents findings from a study examining the impact of a Web-based resource on preservice general education teachers' knowledge regarding assistive technology in the general education classroom. Ninety-nine participants enrolled in general education content courses participated in the study. Five different conditions were assessed involving various aspects of a Web-based resource as compared to traditional lecture. Results investigated the use of a Web-based resource with a graded assignment versus a more traditional lecture. The use of Web-based resources in undergraduate coursework is also discussed.

In the third article, "Integrating Assistive Technology into Teacher Education Programs: Trials, Tribulations, and Lessons Learned," Toni Van Laarhoven, Dennis D. Munk, Lynette K. Chandler, Leslie Zurita, and Kathleen Lynch discuss an approach to integrating AT into a preservice program and describe several stages in the integration of assistive technology (AT) into and across the curriculum of a teacher education program. This multi-year initiative included several projects and strategies that differentially affected the abilities of faculty to integrate training and evaluation in using AT in their coursework. Different strategies are explained and described that increase faculty familiarity and comfort with AT.

In the final article, "The Efficacy of Assistive Technology on Reading Comprehension for Postsecondary Students with Learning Disabilities," Kim K. Floyd and Sharon Judge focus on use of a specific technology used to support post-secondary students with reading disabilities. The authors work with six postsecondary students with LD. A multiple baseline across participants design was employed and they examined the effects of AT, specifically the ClassMate Reader, on reading comprehension. Data are analyzed to discern participant performance with and without the device, social fidelity, and acceptability.

We hope that this issue of ATOB provides direction for future preservice personnel preparation with regard to AT knowledge and skills and how that preparation is translated into outcomes and benefits—both for education professionals and students with disabilities who are impacted by effective AT preservice experiences. We express our appreciation to the many reviewers who assisted us with the peer review process for papers submitted for consideration in this issue. We realize that the number of articles presented is small, but we hope that you will agree that the articles present useful information to guide our discipline. We have high hopes that this issue will lead to others doing more research in this area.

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Status of Assistive Technology Instruction in University Personnel Preparation Programs

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Abstract: The reauthorization of IDEA mandates that students with a disability must be considered for assistive technology (AT). However, in order to implement the mandate, teachers and related service personnel must be knowledgeable about many aspects of AT. The purpose of this study was to gauge the extent to which personnel preparation programs believe they prepare their graduates to implement AT in their future roles. Participants from 231 institutions of higher education (IHEs) completed the survey. Results indicate that the majority of the respondents provided some AT instruction but had a *limited number* or *no* AT devices available to them. Participants also indicated the major barriers to including AT in their curriculum; however, of value are the suggestions for promising practices that could benefit other IHEs that are providing or wanting to provide AT coursework. Ideas for practice are categorized and include collaboration strategies, college initiatives, student assignments, and alternate instruction.

Keywords: Assistive technology, Higher education, Promising practices, Assistive technology coursework

Many students with disabilities need AT to receive a free and appropriate public education (FAPE). The Individuals with Disabilities Education Improvement Act (IDEA, 2004) states that an AT device is defined as "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 [20 U.S.C.1401§602(1)]. IDEA also states that each Individualized Education Program (IEP) team must consider whether a child needs AT devices or services and that AT devices and services must be documented in a child's IEP as a part of special education, related services, and/or supplementary aids or services [§1414(d)(3)(B)(v)].

As a result of these federal legislation mandates, advancing technologies, and the competencies of the professionals in schools, students have mastered skills that they would have never been able to attain before the availability of AT. Researchers and teachers working in school settings have demonstrated the effectiveness of assistive and instructional technologies in teaching a wide variety of functional and academic core contents skills to students of different ages and ability levels across a wide variety of environments (Dell, Newton, & Petroff, 2011).

To take full advantage of the success that can be achieved by students using AT, it is crucial that professionals working in schools develop the technology competencies to implement the mandates of IDEA and adequately serve their students (Michaels & McDermott, 2003). For example, the Council for Exceptional Children (2009) has developed professional content standards for initial level special educators. Technology knowledge and skills are included in the standards under (a)

Standard 6: Communication (i.e., using assistive and augmentative communication strategies); (b) Standard 7: Instructional planning (i.e., planning and managing for technology, implementing instructional and AT, using technologies for students with exceptional learning needs); and (c) Standard 8: Assessment (i.e., using technology in conducting assessments). More advanced knowledge and skills are defined for advanced level special educators as well as special education technology specialists.

Elementary and secondary schools need to employ teachers who have mastered these technology standards and are trained in the appropriate selection, use, and implementation of AT devices to comply with federal, state, and local policies (Bausch & Hasselbring, 2004). If training is not provided at the preservice level, school districts will be responsible for providing professional development training or offering outreach classes for teachers and other staff. Training will most likely be required for teachers, school psychologists, administrators, occupational therapists (OTs), physical therapists (PTs), and speech/language pathologists (SLPs) because they may be responsible for administrating the policies or implementing the use of AT as described in IEPs. For example, district and school administrators need to know how to establish AT policies or guidelines, supervise the implementation of those policies, and evaluate their respective program. OTs, PTs, and SLPs need to work closely with general education and special education teachers to assure proper implementation of specific AT devices, monitor AT use, and evaluate AT effectiveness.

Training for direct service professionals in these AT competencies falls to undergraduate programs, and, at the advanced level, to graduate programs. The importance and need to integrate technology competencies into teacher preparation curricula has been noted for many years (Edyburn & Gardner, 1999; Lahm & Nickels, 1999; Parette, Peterson-Karlan, Smith, Gray, & Silver-Pacuilla, 2006; Parette, Peterson-Karlan, & Wojcik, 2005); however, teacher candidates graduating with inadequate technology knowledge and skills continues to be an area of concern (Anderson & Petch-Hogan, 2001; Parette et al., 2006; Van Laarhoven & Conderman, 2011). To illustrate, Lee and Vega (2005) surveyed 154 special education personnel from a rural county in California, 91% of whom were teachers. When asked about the adequacy of the AT training they received in their teacher preparation programs, only a fourth of the respondents indicated that their pre-service AT training had been adequate. In addition, Bell, Cihak, and Judge (2010) surveyed 123 special education teachers enrolled in an alternative certification program and found that gaining skills in AT was particularly difficult for this population of students. They indicated there was a positive correlation between the teachers' knowledge and use of AT and their confidence with AT, emphasizing the importance of providing AT experiences and instruction to special educators.

The inadequacy of AT training also has been noted by researchers and IHEs themselves. For example, Judge and Simms (2009) analyzed the documents from special education teacher preparation programs in the U.S. They studied a stratified sample of 162 special education preparation programs from urban, suburban, and rural areas. They found that AT coursework was required in only about 33% of undergraduate special education licensure programs, 28% of initial post baccalaureate licensure programs, and 25% of master's degree programs. They also found that AT coursework was required more frequently in programs for teachers of students with moderate to severe disabilities when compared to other special education certification programs. Michaels and McDermott (2003) surveyed 143 graduate special education program coordinators about the current state of AT practice in their institutions and what they would consider to be ideal. A statistically significant mismatch was found between the current state of practice and perceived ideal practices in the graduate program. Qualitatively, respondents indicated barriers to achieving ideal practice were a lack of (a) time and funding, (b) faculty knowledge and consistent AT focus, and (c) understanding of the need for AT for students with high incidence disabilities.

Despite reported inadequacies in teacher preparation programs, data indicate that training can make important changes in teachers' knowledge, skills, and dispositions. Lee and Vega (2005) found that the majority (71.9%) of special education personnel who had 40 hours of AT training indicated that AT was an important part of the daily routine of their students, while the majority (73.9%) of the respondents who had not had AT training indicated that AT was not an important part of this daily routine. In addition, Anderson and Petch-Hogan (2001) found that following participation in a technology-rich field placement experience, pre-service teachers reported they had improved skills in their use of AT, their knowledge of computers, their ability to evaluate software, their ability to facilitate instruction using technology, and their ability to develop a technology plan. Finally, Bell et al. (2010) noted that alternative certification teachers who had taken a previous AT course scored significantly higher on a Knowledge and Applied Use Scale than teachers who had not taken a course.

Given that IHEs are in a prime position to influence the AT training of personnel who will work directly to make important changes for students, it is crucial to understand how they are delivering AT instruction. The purpose of this study was to gauge the extent to which pre-service personnel preparation programs and graduate programs believe they prepare their graduates to implement AT in their future roles. The findings will be useful in planning AT offerings in pre-service teacher training programs and providing a rationale for providing training for the teachers and other staff already working in schools who have not been trained to implement the principles of AT.

Research Questions

The following general research questions were formulated to determine the status of AT instruction in pre-service and graduate personnel preparation programs in IHEs. More specific questions were addressed for the various types of personnel who are being prepared at IHEs.

1. To what extent are IHEs providing instruction to develop AT knowledge and skills among students who are preparing for careers in schools?
2. In what specific topic areas are AT instruction being provided in IHE curricula?
3. What are the barriers to implementation of instruction about AT in IHEs?
4. What promising practices are being implemented by personnel at IHEs to prepare school personnel to participate in AT activities in schools?

Method

Background

Survey research was conducted to determine the status of instruction about AT in programs preparing personnel to work in schools as part of the data collection process for the National Assistive Technology Research Institute (NATRI). This Institute was formed through a cooperative agreement with the Office of Special Education Programs (OSEP) to study the use of AT to improve the provision of a FAPE for children with disabilities. The project was conducted by the University of Kentucky in collaboration with several local, state, and regional education agencies, IHEs, and related national institutes and agencies that address AT topics. There were two main goals of the research institute: to examine factors related to the planning, development, implementation, and evaluation of AT services in schools; and to disseminate the findings of the research in ways that will assist school personnel to develop or improve AT policies and practices for students with disabilities. In order to accomplish the goals, seven research areas were defined for the project. They were to (a) investigate the status of AT use in schools and the role it provides in education; (b) examine the policies & procedures in the development and delivery of AT services; (c) study AT decision-making by IEP teams; (d) examine how AT is integrated in learning environments to facilitate instruction and access the curriculum; (e) investigate the effects of AT use on academic, social, functional performance of students; (f) identify the training and technical support needed by persons implementing AT; and (g) examine the extent to which IHEs are developing AT knowledge and skills (Lahm, Bausch, Hasselbring, & Blackhurst, 2001). The data for this paper were extrapolated from the research on IHEs.

Participants

Surveys were sent to the chairpersons of all special education (SPED), occupational therapy (OT), physical therapy (PT), and speech language pathology (SLP) departments at IHEs in the U.S. The list of names and contact information was purchased from MKTG Services in Wilmington, MA, the same service used by the Council for Exceptional Children. MKTG Services provided a list of SPED and SLP department chairs. A list of department chairs for OT and PT were not available, so two additional lists containing all faculty members in OT and PT at IHEs in the U.S. also were purchased from MKTG. Because a specific individual was not included, a search for the name of each department chair was conducted online by locating the name of the IHE provided on the MKTG Services list and identifying the name of the department chair listed on the official website of each IHE.

A total of 561 IHEs offering courses in special education were identified in the purchased list. However, when 84 duplicates, U.S. territories, and obvious errors (e.g., math department) were eliminated, 477 surveys were mailed to education programs. Those receiving the survey included department chairs from departments titled special education, special populations, and exceptional populations. At the risk of over-identification, departments with the generic title of *Department of Education* were also sent surveys. These departments were not omitted from participation in the study since conceivably all education courses, including special education, could be included in one department. Recipients of the survey were instructed to return the survey unanswered if their department did not offer one of the four targeted programs (i.e., SPED, OT, PT, or SLP).

MKTG Services also provided a list of 279 speech language and related departments (e.g., audiology, communication disorders, speech and hearing). Addresses of 31 institutions were eliminated, again because of noted errors (e.g., agriculture communication). However, Departments of Allied Health were included, once again at the risk of over-identification. A total of 248 surveys were mailed to department chairs of Allied Health and Communication Disorders.

Additionally, 336 department chairs of PT and 281 chairs of OT were identified from the separately purchased lists. The total number of surveys sent was 1,342.

Instrument

The questionnaire used in the national survey contained items designed to obtain descriptive data about the status of AT instruction at the IHE, how it was integrated into the curriculum, barriers that might exist for implementation of AT, and promising practices that may have implications for other IHE personnel. The authors developed a print-based questionnaire comprised of 13 multi-component questions. Survey items related to AT coursework and AT topics were developed based on the Quality Indicators of Assistive Technology (Zabala & Carl, 2005), a validated guide for providing quality AT services to students with disabilities. In addition to the authors, four AT faculty members at other institutes of higher education reviewed the survey for clarity. Following discussions with the reviewers, the authors made edits and revisions to the survey. The questionnaire contained a variety of items, including rating scales, checklists, discrete response objective items, and open-ended responses for both pre-service and graduate programs. Graded response and short answer questions sampled opinions in the following 13 topic areas: demographic information; degrees offered; current status of instruction; demonstration of competencies; availability of AT devices; availability of instructional materials; required and elective courses offered; specialization in AT; delivery formats (e.g., face-to-face, distance learning); delivery methods (e.g., lectures, demonstrations, hands-on); topics addressed; functional areas addressed; possible barriers to delivering instruction; and promising practices.

For the purpose of this paper, information from seven topic areas were examined: (a) current status of instruction, (b) demonstration of competencies, (c) availability of devices, (d) availability of instructional materials (e) specific topic areas addressed in courses, (f) barriers to offering AT instruction at the institution, and (g) promising practices in the program. The complete questionnaire is available from the first author upon request.

Procedures

All of the surveys were mailed to the institutions via the U.S. Postal Service. Each envelope contained one copy of the survey instrument and a self-addressed, postage paid envelope for the return of the questionnaire. Two weeks following the mailing of the surveys, a postcard was mailed to the individual at each institution thanking those who had completed the survey and reminding those who had not completed it to do so (Dillman, 2007). Participants also were given the opportunity to request another copy of the instrument if they had not received the questionnaire or had misplaced the original.

Data Analysis

The data were analyzed using both quantitative and qualitative methods. The quantitative data from the forced choice items were entered into the SPSS statistical software package and analyzed using descriptive statistics (i.e., frequencies, percentages). These data contributed to answering Research Questions 1-3.

The qualitative data contributed to answering Research Question 4 in which respondents wrote in promising practices. Themes were developed that emerged from the data and provided insight into practices being used in IHEs to overcome barriers to providing instruction in AT. These data were important to gather to provide more detail about what the objective data did not show, to explore additional explanations of the data, and to provide information to others who may want to replicate the practices described by the respondents (Glesne, 2006).

The qualitative analysis was an iterative process that occurred over time (Glesne, 2006). First, the first author read through all open responses in which the respondents wrote in a promising practice they thought was unique in their program. The author used open coding, categorized like responses, and developed themes (Dey, 2004; Strauss & Corbin, 1998). After the initial coding session, the author identified 16 categories. The author read the responses again and collapsed the 16 categories into more broad categories using a constant comparative method (Lincoln & Guba, 1985). This resulted in a reorganization of the codes that resulted in four broad themes. The second author then used these broad themes and independently read all the open-responses determining if the identified themes adequately captured all of the responses (Miles & Huberman, 1994). The first and second authors met to reach a consensus on any disagreements of the final themes and agreed the four themes adequately captured the reported data. They included (a) collaboration, (b) college initiatives, (c) student assignments, and (d) alternate instruction.

Results

Surveys were returned from 15 institutions as undeliverable and 26 were returned as not having one of the four programs (i.e., SPED, OT, PT, or SLP). A total of 231 surveys out of the 1301 valid surveys were returned for a return rate of 17.5%. Of the returned surveys, 30% (*n* = 69) were from SPED departments, 23% (*n* = 53) were from SLP departments, 23% (*n* = 52) from OT departments, 18% (*n* = 42) from PT departments, and 6% (*n* = 15) identified their department as *other* including generic classifications such as *allied health* and *education.*

Of those returning the survey, 70% (*n* = 161) were from public institutions, 29% (*n* = 67) from private colleges or universities, and 1% (*n* = 3) did not respond to the question. Additionally, 10% (*n* = 23) offered an associate's degrees, 52% (*n* = 121) offered a bachelor's degree, 70% (*n* = 161) offered a master's degree, 10% (*n* = 24) a specialist's degree, and 30% (*n* = 69) offered a doctoral degree in their field. The size of the institutions varied from fewer than 2,000 students to greater than 30,000 students (see Table 1).

Table 1
Enrollment Size of Institutions of Higher Education (*n* = 231)

Students	Institutions	
N	*n*	%
Less than 2,000	16	6.9
2,001 - 5,000	42	18.2
5,001 - 10,000	38	16.5
10,000 – 20,000	52	22.5
20,001 - 30,000	38	16.5
Greater than 30,000	15	6.5
No Response	30	13.0

Table 2
Graduate (*n* = 188) and Undergraduate (*n* = 136) AT Offerings at Institutions of Higher Education

Status of AT Instruction	Undergraduate		Graduate	
	n	%	*n*	%
No need to provide	2	1	2	1
Not providing with no plans to provide	10	7	1	1
Not providing but plans to provide	1	1	1	1
Not providing/ provided in other departments	6	4	3	2
Some instruction	89	65	104	55
Strong AT provisions	28	21	77	41

Current Status of Instruction in AT

In order to answer the first research question, "To what extent are IHEs providing instruction to develop AT knowledge and skills among students who are preparing for careers in schools?" data from four of the survey questions were analyzed including current program status, demonstration of competencies, availability of devices, and availability of instructional materials. One hundred thirty six responses were received at the undergraduate level and 188 responses were received for graduate programs. The majority of the respondents, 65% (*n* = 89) at the undergraduate level and 55% (*n* = 104) at the graduate level, indicated that they were providing *some* instruction in AT while 21% (*n* = 28) at the undergraduate level and 41% (*n* = 77) at the graduate level reported *strong* offerings in AT (see Table 2). When asked whether students had to demonstrate competencies, 142 responses were recorded for undergraduate programs and 192 were received for graduate programs. Of those responses, 47% (*n* = 66) of undergraduate programs and 25% (*n* = 47) of the graduate programs reported that students were not required to demonstrate competencies or were required to demonstrate a *few* competencies in AT. The undergraduate programs reported that students demonstrated AT competencies *some* of the time 42% (*n* = 59) while the graduate programs reported 54% (*n* = 104). Only 12% (*n* = 17) of undergraduate programs and 21% (*n* = 41) of graduate programs reported that students were required to demonstrate AT competencies to *a great extent*.

When asked about the availability of AT devices, 137 undergraduate programs and 191 graduate programs provided information. Over half (58%; *n* = 80) of undergraduate programs and about half (49%; *n* = 93) of graduate programs have access to *no* or a *limited number* of AT devices during their program while only 9% (*n* = 13) of programs at the undergraduate level and 12% (*n* = 22) at the graduate level have access to an *optimum* number of AT devices. Undergraduate and graduate programs reported an *adequate* number of devices 32% (*n* = 44) and 40% (*n* = 76) respectively.

Similarly, when asked about the availability of instructional materials related to AT, 140 graduate programs and 189 graduate programs responded. Of the programs, 52% (*n* = 72) of undergraduate and 40% (*n* = 75) of graduate reported *no* or *limited access* to instructional materials related to AT while only 7% (*n* = 10) of the undergraduate programs and 11% (*n* = 20) of the graduate programs indicated an optimum number of instructional materials. An *adequate* number of AT materials were reported 41% (*n* = 58) by undergraduate programs and 50% (*n* = 94) by graduate programs.

Topic Areas of Instruction at IHEs

When asked, "In what specific topic areas are you providing AT instruction?" respondents were asked to identify whether or not 20 different topics were addressed in their programs. The five most frequently topics addressed by all of the programs (including at the undergraduate level only, at the graduate level only, or at both the undergraduate and graduate levels) at an IHE were general awareness of AT devices (94%; *n* = 217), selecting AT devices (79%; *n* = 180), including AT in the IEP (76%; *n* = 175), teaching students how to use AT devices (76%; *n* = 175), and locating information about AT (72%; *n* = 167; see Table 3).

The most frequently addressed topics at the undergraduate level (including programs that reported the topic addressed at either the undergraduate level only or both the undergraduate and graduate levels) were general awareness of AT devices (52%; *n* = 121), including AT in the IEP (34%; *n* = 79), locating information about AT (34%; *n* = 78), teaching how to use AT devices (32%; *n* = 74), selecting AT devices (30%; *n* = 70), and making low tech devices (30%; *n* = 70).

The most frequently addressed topics at the graduate level (including programs that reported the topic addressed at either the graduate level only or both the undergraduate and graduate levels) were similar to the undergraduate most frequently addressed topics: general awareness of AT (75%; *n* = 173), selecting AT devices (67%; *n* = 155), AT in the IEP (65%; *n* = 149), and teaching how to use AT devices (62%; *n* = 142). Additionally, approximately 27% (*n* = 63; undergraduate) and 49% (*n* = 113; graduate) are instructing students in applying universal design for learning (UDL) principles to instruction; 25% (*n* = 59; undergraduate) and 55% (*n* = 128; graduate) of IHEs are training students in understanding AT legislation; and 22% (*n* = 50; undergraduate) and 49% (*n* = 114; graduate) are training students in selecting and using AT software.

Of note are the AT topics that were least often reported as being addressed in either the undergraduate or graduate programs at the IHEs. Nine of the topics were reported as not addressed by 50% or more of the respondents. The topics most frequently reported as not addressed by the responding IHEs were, evaluating district of school implementation of AT (81%; *n* = 187), coordinating AT services (66%; *n* = 152), using AT to provide appropriate accommodations, (61%; *n* = 141), evaluating AT service delivery (60%; *n* = 139), training service providers and parents to use AT devices (57%; *n* = 131), selecting and using instructional software (57%; *n* = 131), monitoring student performance (55%; *n* = 126), integrating AT into the curriculum (53%; *n* = 123), and funding AT (53%; *n* = 122).

Barriers to Offering AT Instruction

Study participants were asked, "What are the barriers to implementation of instruction about AT in IHEs?" and were asked to choose from nine possible choices and report other barriers they faced at their institution.

Table 3
Topic Areas Reported by Institutions of Higher Education (*n* = 231)

Topic Area	Not Addressed		Undergraduate Only		Graduate Only		Both U and G	
	n	%	*n*	%	*n*	%	*n*	%
General awareness of AT devices	14	6	44	19	96	42	77	33
Understanding AT legislation	86	37	17	7	86	37	42	18
Conducting AT assessments	86	37	17	7	98	42	30	13
Including AT in the IEP	56	24	26	11	96	42	53	23
Applying UDL principles to instruction	97	42	21	9	71	31	42	18
Selecting AT devices	51	21	25	11	110	48	45	19
Teaching how to use AT devices	56	24	33	14	101	44	41	18
Making low tech AT devices	86	37	28	12	75	32	42	18
Selecting and using tools/software to aid instruction	93	40	18	8	77	33	43	19
Training service providers/parents to use AT devices	131	57	8	3	79	34	13	6
Evaluating AT service delivery	139	60	7	3	68	29	17	7
Coordinating AT services	152	66	5	2	62	26	12	5
Locating information about AT	64	28	28	12	89	38	50	22
Using AT to provide accommodations	141	61	8	3	59	25	23	10
Integrating AT into the curriculum	123	53	12	5	58	25	38	16
Funding AT	122	53	9	4	78	33	22	10
Evaluating district or school implementation programs	187	81	1	0.4	37	16	6	3
Monitoring student performance	126	55	9	4	61	26	35	15
Selecting and using AT software	104	45	13	6	77	33	37	16
Selecting and using instructional software	131	57	7	3	58	25	35	15

Almost half (47%; *n* = 107) of respondents reported that lack of fiscal resources to purchase AT devices was a *significant* or *irresolvable* barrier (see Table 4). Similarly, lack of support staff (34%; *n* = 79), lack of lab and storage facilities (33%; *n* = 75), lack of faculty time to learn software and devices (31%; *n* = 72), and fear of the need to constantly update software and hardware (28%; *n* = 64) were reported as *significant* or *irresolvable* barriers.

Promising Practices

When asked, "What promising practices are being implemented by personnel at IHEs to prepare school personnel to participate in AT activities in schools?" approximately 44% (*n* = 101) of the respondents volunteered 114 promising practices used in their programs that they believed to be unique and useful for others to replicate. The authors categorized the responses into 4 categories: (a) collaboration, (b) college initiatives, (c) student assignments, and (d) alternate instruction using a constant comparative method (Lincoln & Guba, 1985).

Collaboration. The most often cited practice was that of collaboration. Collaboration activities took place with many partners including State Education Agencies, public schools, other departments within the university that offered coursework in a specific area of AT (e.g., seating in the physical therapy program, augmentative communication in the communication disorders program), other IHEs with a nearby campus, not-for-profit AT centers, local agencies providing services for individuals with disabilities, and transdisciplinary programs with related service (OT, PT, SLP) programs. The collaborators typically shared AT equipment and AT lab space.

College initiatives. Participants included examples of college-wide initiatives that increased opportunities for students to learn about AT. One university reported a college AT loan library run by faculty and students, another had the local AT center based on campus, another developed a model classroom showcasing technology for all learners, and one respondent reported having a traveling exhibit with presentations and equipment for use by faculty for demonstrations and use at professional meetings.

Student assignments. Respondents reported a variety of student assignments that allowed students to gain experiences in AT. Suggestions included fieldwork in schools and local agencies; AT assessment opportunities in school, home, and community environments; student-run AT fairs and expos; service learning projects with local AT centers or AT libraries; and exploration and evaluation of free AT software on the internet.

Alternate instruction. Respondents overwhelming reported ways to provide instruction about AT outside of their university setting. Field visits, distance-learning opportunities, courses at other IHEs, home visits, and off campus courses at local technology centers were some of the practices listed.

Discussion

AT coursework was being offered in all four disciplines surveyed (SPED, OT, PT, and SLP), at both public and private IHEs, and at both the undergraduate and graduate levels. IHEs apparently saw the need to offer coursework in AT as 86% (*n* = 117) of the undergraduate programs and 96% (*n* = 181) of the graduate programs included coursework about AT. However, even though institutions reported offering the AT courses, relatively few required students to demonstrate more than *some* AT competencies (12% undergraduate, *n* = 17; and 21% graduate programs, *n* = 41). Additionally, both undergraduate and graduate programs reported *no* or a *limited number* of AT devices for instructional purposes, 58% (*n* = 80) and 49% (*n* = 93) respectively, severely limiting the ability to provide comprehensive AT instruction and adequate hands-on instruction for their students.

These findings conflict with those reported by Judge and Simms (2009) in their document analysis of required AT coursework of special education preparation programs, in which it was reported that only 25-33% of undergraduate and graduate special education programs in their sample required AT coursework. The data in this study indicate much higher percentages of AT coursework being offered in programs. The discrepancy may be attributable to several factors. First, this study was a self-reporting survey while the Judge and Simms study was a document analysis. Second, this study surveyed OT, PT, SLP, and SPED programs while the Judge and Simms study only analyzed special education preparation programs. And third, this study asked respondents to report AT coursework *offered* in their programs, while the Judge and Simms study analyzed required AT coursework. However, the data from these studies are similar in that both indicate that teachers are leaving special education preparation programs without adequate preparation in AT.

More instruction occurred in graduate programs than in undergraduate programs, but overall there were relatively low percentages of inclusion of many of the topics in both the undergraduate and graduate programs. While 52% (n = 121) of undergraduate programs and 75% (n = 173) of graduate programs were offering information about general awareness of AT, few included information about integrating AT into the curriculum, monitoring and evaluating student performance, service delivery, or evaluating school AT implementation programs. Proficiency in each of these topics is vital for school personnel to implement high quality assistive technology services, and AT instruction at the higher education level must go beyond general awareness. Other studies (Abner & Lahm, 1998; Bausch, Ault, Evmenova, & Behrmann, 2007; Hutinger & Johanson, 2000) have reported similar findings in that service providers were not prepared to address these same topics.

It is concerning that only 65% (n = 89) of undergraduate programs had some AT instruction and only 21% (n = 28) had strong provisions. This could indicate that many people who are hired upon graduation are entering schools without the skills and knowledge to produce positive outcomes for students using technology. AT training must include a full range of instruction in AT competencies to prepare school personnel to provide high quality AT services from the consideration process through implementation (Bausch, Ault, & Hasselbring, 2006).

A number of barriers were reported that affected IHEs delivery of AT content including faculty and administrator attitudes; a fear of need for continuous upgrade of technology; and a lack of faculty knowledge, room in the curriculum, fiscal resources, facilities, time to learn new technology, and tech support. These findings support those in the Michaels and McDermott (2003) survey that also found that graduate special education program coordinators reported lack of time, funding, and faculty knowledge as barriers to ideal AT practice.

Limitations

There were several limitations to the study. First, a relatively low return rate was obtained. It may have been that distributing paper versions to be returned by mail contributed to this, whereas availability of an online version may have increased the response rate. Second, there was an over identification of IHEs offering the programs. Although a decision was made to attempt to garner information from all of the programs with generic departments, it is suspected that many did not offer the programs and the survey may have been ignored. This could have been another factor leading to the low return rate. Third, as with any self-report study, the accuracy of the information cannot be verified without follow-up with each program. Due to the lack of resources and time, this was not done for this study. Fourth, although all programs surveyed for this study prepared professionals that could potentially be providing services in school systems, OT, PT, and SLP programs have a wider focus and different purpose than SPED programs in that they also prepare individuals to work in medical professions and communities. Because individuals being prepared as OTs, PTs, and SLPs have different training needs, the requirements for demonstrations of competencies for some of these programs may be expected to be different from those of a SPED program, and could have impacted the findings. Future research should evaluate the different AT competencies required based on the specific disciplines and the environments in which they are being prepared to work.

Outcomes and Benefits

Current laws mandate that school districts provide AT devices and services for students with disabilities. Since it is the responsibility of local education agencies to implement state and federal laws and to follow state and local AT policies, districts must have personnel who are knowledgeable about AT. When students receive training in AT at the undergraduate and graduate levels, universities will produce special educators and related service providers who are knowledgeable about AT and can serve as qualified members of the IEP team. When comprehensive training occurs, the ultimate benefit will be for students with disabilities who need AT in order to receive a FAPE.

Current data suggest that many university special education programs are not meeting the need for training in AT. Respondents at training programs indicated they face barriers to including AT instruction in the curriculum such as a lack of fiscal resources, trained personnel, facilities, time, and equipment. However, there were IHEs that were providing extensive training in AT and many have established creative ways to deliver this instruction. A major outcome of this study is the list of some of the ways used by the participants to overcome these barriers. Colleges and universities can benefit from the ideas of others when planning or revising coursework in AT at their institutions. The following section presents benefits for both the IHEs and the students enrolled in their personnel preparation programs.

AT center and university collaborations. Whether on or off campus, this type of collaboration provides opportunities for students to participate in providing services for individuals of all ages and disability areas, opportunities for external grant funding, and integration of AT in the practitioners' professional curriculum.

College and P-12 school partnerships. Such collaborations can offer field placements for students. They also offer realistic and meaningful classroom experiences for students.

Transdisciplinary programs. Resources at IHEs are often limited. By having a transdisciplinary program that may include OT, PT, SLP programs, and the medical campus, faculty can combine resources and provide students with a team approach to providing AT to students with disabilities.

Hands-on experience. A key factor in training personnel in becoming knowledgeable about and skilled in using AT is to have ample opportunities for hands-on experiences. When resources are limited, faculty can incorporate fieldwork into the curriculum to assist students in obtaining these experiences.

Technology. When hands-on experiences are not possible for every situation, technology applications can augment hands-on experiences and provide advantages to both instructors (e.g., distance learning delivery formats, web-based instruction, student observations, and online resources,) and students (e.g., distance classroom observations, video recording students to monitor progress toward objectives, free AT applications).

Qualified personnel. Respondents overwhelmingly reported the importance of having qualified personnel. IHEs can take advantage of regional experts, vendors, school district employees, AT users, and parents of individuals who use AT for guest lectures, interviews, and part-time instructors. In this way, university faculty can expand the scope and depth of their knowledge about AT.

Systematic program planning. The inclusion of AT coursework into the higher education curriculum requires systematic planning. AT coursework needs to go beyond general awareness so that future teachers are knowledgeable and skilled in selecting, using, and implementing AT devices across environments in order for students to meet IEP goals.

Integration of AT into courses. If there is no room in students' academic programs for stand-alone AT courses, AT can be embedded into existing courses in the curriculum. However, an integration model requires the collaboration and commitment of the entire faculty to implement AT topics as planned.

Training for general education teachers. Students often need AT in general education classrooms. Thus, AT instruction should be extended beyond special education and related services to include all teachers.

Conclusion

A commitment by IHEs to increase and improve AT instruction for the school personnel they prepare, can only improve the outcomes for students in schools with whom their graduates interact. The results of this investigation and suggestions of promising practices may help IHEs identify areas of need in their programs and work toward providing quality AT instruction.

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Educators: Are Web-based Resources an Effective Means for Increasing Knowledge in Higher Education?

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Abstract: Many institutions of higher education (IHEs) that prepare teachers encounter the challenge of increasing requirements of general education preservice teachers so they are properly prepared to teach all students, including those with disabilities. This study examined the impact of a Web-based resource on preservice general education teachers' knowledge regarding assistive technology in the general education classroom. A total of 99 participants enrolled in general education content courses participated in the study. Five different conditions were assessed involving various aspects of a Web-based resource as compared to traditional lecture. Results indicate that required use of a Web-based resource with a graded assignment produced the same results as traditional lecture. However, the Web-based resource as a stand-alone program was not an effective means for increasing preservice teacher knowledge of assistive technology. A Web-based resource could potentially be an efficient and effective way under specific conditions to prepare preservice teachers for diverse classrooms in the 21st century

Keywords: Online Learning, Face-to-Face Learning, Institutions of Higher Education, Assistive Technology, Preservice Teacher Learning,

Introduction

When current general education teachers graduate from preparing institutions, they will encounter a higher number of children with disabilities in general education classrooms than in previous years (U.S. Department of Education, 2006). In 1995, 45% of students with disabilities spent 80% or more of their school day in the general education classroom. By 2005, this number increased to 52% of students with disabilities spending 80% or more of their school day in the general education classroom (U.S. Department of Education, 2007). Legislation such as No Child Left Behind Act of 2001 and the re-authorization of the Individuals with Disabilities Education Improvement Act of 2004 continues to emphasize this trend by formally endorsing the education of students with disabilities in the general education classroom.

Even though the federal guidelines have been in place for several years, general education teachers often feel ill-equipped to teach students with disabilities in their classrooms (Skiba, 2006) and frequently report a perceived lack of training during their preservice years in proper interventions for students with disabilities, including modification, accommodations and assistive technology (AT; Andrews, 2002; Kamens, Loprete, & Slostad, 2003). AT has the potential to improve the functional capabilities of students with disabilities and provide a tool in the general education classroom to promote inclusion (Edyburn, Higgins, & Boone, 2005). AT holds considerable promise for students with disabilities (Derer, 1996; Dorman, 1998; Edyburn, 2000; Lewis, 1998; Zhang, 2000).

Previous research suggests one special education preservice course is sufficient to positively affect attitudes, knowledge outcomes, and perceptions of educating students with disabilities in general education (Carroll, 2003; Cook, 2002; Kirk, 1998; Powers, 1992). Since previous research indicates one course can positively affect preservice educators' knowledge, it is reasonable to suggest more classwork around the intended topic as a solution to preservice teachers feeling as if they are unprepared to teach students with disabilities, However, some barriers involved with the solution of more courses/credits exist.

For example teacher educators identify time constraints as one of the biggest barriers in providing an effective overall class on how to educate students with disabilities in the general education classroom (LaMontagne et al., 2002). Two types of time constraints are identified: the lack of time to collaborate with members from different programs, such as those from general education and special education (LaMontagne et al., 2002) and the amount of available time a preservice teacher is enrolled at that institution. Support to collaborate among higher education faculty often is not present in the inherent organization of institutions (Duchart, Marlow, Inman, Christensen, & Reeves, 1999; Pugach, 2005) and student's time limitation is based on fulfilling the highly qualified teacher requirement specified under NCLB, which stipulates that more subject content knowledge is required of preservice teachers than in prior years (U.S. Department of Education, 2004). This creates increased competition for the attention of preservice teachers during their time at institutions of higher education (IHE; Little & Crawford, 2002).

Because of these barriers, IHEs that prepare general education teachers must incorporate, in an efficient and effective manner, the knowledge that teachers will encounter related to working with a very diverse population in their future classrooms. One potential solution to educating preservice general education teachers about methods for working with diverse students involves online instruction (OLI; i.e., a class accessed via the Internet from a location other than the traditional classroom). Previous research has shown that online instruction has aided in the preparation and retention of special education teachers (Dymond & Bentz, 2006; Knapczyk, Frey, & Wall-Marencik, 2005). Online learning is experiencing increased attention given that it provides flexibility for students to move at their own pace, students can learn from a certified institution, regardless of the student's geographic location, students can arrange course instruction to fit their own schedules, and there is less expense to an IHE once the course is created (Fisher, Deshler, & Schumaker, 1999; Schrum, 1998).

Online Learning Verses Traditional

OLI and traditional lecture, or face-to-face (F2F) classroom instruction, have been compared in a variety of studies (Andrews, 2002; Caywood & Duckett, 2003; Cornell & Martin, 1997; Gallagher, 1999; LaMontagne et al., 2002). These studies indicate no difference in achievement between students enrolled in an online course and those instructed in a traditional classroom. While this does not directly address all the constraints institutions of higher education face in preparing preservice teachers, it does provide an indication that other avenues besides traditional classroom instruction can be accessed that would be, at the very least, as effective as traditional classroom models.

In 2006, Sitzmann, Kraiger, Stewart, and Wisher completed a meta-analysis comparing OLI to F2F. The meta-analysis consisted of 96 research reports and included studies where the learning was related to job and/or academic performance. The authors concluded that Web-based instruction was more beneficial for declarative knowledge with an "effect size of .15 indicating that, on an average…6% more effective than classroom instruction for teaching declarative knowledge" (Sitzmann et al., p. 640). These investigators also noted that declarative knowledge is represented by "how knowledge is organized and cognitive strategies for accessing…knowledge" (p. 627). In the same meta-analysis the authors concluded OLI compared to F2F instruction was equally effective for teaching procedural knowledge as defined as how to perform a task, application of knowledge and included grouping steps in more complex production (e.g. work environment; Sitzmann et al.).

Other research comparing student achievement across three different conditions F2F, OLI, or class-in-a-box (DVDs with recorded class material to be played by the demand of the student), found no significant difference in student achievement (Skylar et al., 2005). Fisher and colleagues (1999) compared the knowledge and understanding of inclusive practices of preservice teachers who were enrolled in a traditional workshop versus those who used a computer-based 'virtual' workshop. Both conditions improved participants' knowledge and understanding of inclusive practices, which suggests that virtual workshops could be another means of instructing preservice teachers. Steinweg, Davis, and Thomson (2005) compared the performance outcomes and attitude of preservice general educators enrolled in an introductory to special education course in two different formats-one a traditional 16-week course and the other as on online format. There was no difference in performance or attitude of the two groups.

In 2005, Zhao, Lei, Yan, Lai, and Tan completed a meta-analysis intending to isolate factors that make distance education effective. In their meta-analysis of 51 articles they found the amount and type of interaction students had with peers and instructors greatly influenced learning preferences of students in OLI or F2F. It also appeared that college level courses and those students with a high school diploma had learning outcomes that favored distance education, indicating that content of the class and level of the student should be factors considered when looking at the benefits of OLI or F2F (Zhao et al., 2005). The studies reported indicated that OLI has previously shown positive learning outcomes when used with certain demographics, content, and knowledge. However, OLI required a significant amount of time in both student and faculty resources due to the necessary of the duration to learn material and creation of the course.

A common practice in higher education classrooms is to have guest lectures present special topics during a traditional 16-week course (Kumar & Lightner, 2007), to provide simple informational knowledge on special topics. Guest lectures provide students with information the instructor is unable to or uncomfortable to present, and provides the opportunity for students to be exposed to a variety of information. Guest lectures in educational colleges provide an inexpensive way for IHE to prepare perservice teachers for a diverse student body, enabling them to feel better prepared.

If using OLI to inform preservice teachers' knowledge has positive outcomes, especially given the various factors such as content of the information and audience intended, could a Web-based resource have the same effect as a guest lecture in a traditional F2F situation? A Web-based resource could provide at the minimum, declarative knowledge on subject matter that general educators report they lack (i.e., information, accommodations, and adaptations; Kamens et al., 2003). Given the positive results of OLI especially for declarative knowledge and the possibilities of AT aiding students with disabilities in the general education (Derer, 1996; Dorman, 1998; Edyburn, 2000; Lewis, 1998; Zhang, 2000), it might be possible for a Web-based resource to change preservice teachers' declarative knowledge of specialized topics in the same manner as a guest lecture, however, with the convenience of OLI. This study attempted to answer the following question: Can the use of a Web-based resource compared to a traditional guest lecture be an effective means to change the knowledge about AT for preservice teachers? The curriculum at the university indicated a desire for general education preservice teachers to have information about AT; however, at the time of this investigation the university did not offer courses addressing AT. Also, a review of the syllabi for these courses and consultation with the instructor indicated there was no discussion or demonstration of AT. Hence, the participants had little prior knowledge of AT for students with disabilities.

Method

Participants

Ninety-nine undergraduate students from a large Midwestern university participated in the study. The students were enrolled in multiple sections of the institution's Teacher Education (TE) preparation program course entitled 'Teaching of Subject Matter to Diverse Learners.' This five-credit course is intended for upper-level students; no freshman or sophomores are allowed to enroll. The majority of participants identified themselves as having senior-level status in the university (96%; *n* = 95). Students enrolled in this course must be accepted into the teacher education program. This course consists of traditional lecture and lab time in local area schools. The course framework is situated around diverse learners and their access to the general education curriculum at the elementary level. The majority of participants also declared themselves as general education majors (90%; *n* = 90). In addition, a large number of participants were female (90%).

Materials

Web-based resource. The Web-based resource for this study was Resources in Special Education (RISE), originally created for interns at the same university (Okolo et al., 2006). This Website served as a resource to general education teacher interns facing the challenges of teaching students with disabilities in general education classrooms while engaged during

Table 1
Condition Description

Condition 1 (*n* = 20)	Condition 2 (*n* = 23)	Condition 3 (*n* = 22)	Condition 4 (*n* = 18)	Condition 5 (*n* = 16)
Web-based exposure	Web-based with non-graded assignment	Web-based with graded assignment	Lecture	Lecture with non-graded assignment
Participants were asked to view Web-based resource only.	Participants were asked to view Web-based resources and complete a non-graded assignment.	Participants were asked to view Web-based resource and complete a graded assignment.	Students received a traditional face-to-face lecture using *PowerPoint*™.	Students received a lecture and completed a non-graded assignment.

the student teaching phase of preparation. The Website included sections such as *Professional Resources*, *Frequently Asked Questions*, *Case Studies*, *Tip of the Week*, and *Classroom Tools*. The AT section under 'Classroom Tools' was updated prior to the start of the study so that it could reflect the content that was presented in the lecture conditions. In this section there was a variety of links to aid in the retrieval of the information.

The Web-based resource provided demonstrations through AT multimedia clips. When a visitor to the Website clicked on the one of three video links they could see demonstrations of OCR scanners, magnifiers, and screen readers. Also included on the Website were links to examples of AT devices primarily used for literacy activities (e.g., AlphaSmarts, Inspiration, and various commercial text-to-speech and speech-to-text software). Other links included articles geared to teachers applying AT to the classroom and AT guides. The page also contained links for state AT resource centers and national AT groups. All links that were available to visitors of the site are included in Appendix A.

Face-to-face lecture (F2F). The F2F consisted of a general overview of AT. It described the principles of AT and how AT enables students with disabilities to access the general curriculum. A *PowerPoint*™ presentation with examples of AT devices, primarily for literacy, was embedded into the presentation. These devices were the same items displayed on the web-based resource. The presentation included multimedia clips that demonstrated AT being used by students with disabilities. Again, the same multimedia clips were available on the Web-based resource. In fact, all items pictured in the *PowerPoint*™ presentation along with multimedia clips were also located on the Web-based resource. This was an effort to assure that the same topics, resources, and information were available to the entire population of participants regardless of the assigned condition. The lecture time was approximately 95 minutes in length.

Knowledge test. To evaluate the participants' knowledge, an assessment of AT was created. The same assessment was used for pre- and posttests. There were 14 questions weighted at 23 points for this assessment. The assessment consisted of two sections based on question type. Section one was comprised of declarative knowledge questions. Questions 1-8, and 12-13 were multiple-choice questions weighted at one point for each correct answer for a maximum total of 10 points. Questions 9-11 consisted of short answers; each correct short answer was worth one point. These questions required students to name a type of AT or student characteristic using AT. The maximum score for this section was seven points. The final question was made up of two case studies more qualitative in nature and requiring procedural or application knowledge. There were two different answers for each case study. Students could score a maximum of six points for the qualitative answer. This question required the student to synthesize knowledge and relate it to practical knowledge. The questions were scored using a rubric and answer key. The maximum score for the total correct was 23 points.

Included with the post-knowledge test were two questions asking about the number of times students accessed the suggested Web-based resource and the number of times they accessed any other Web-based source that provided AT information. The students were to self-report the number by circling a range of numbers indicating the frequency of visits to the site. The student could choose 0, 1-2, 3-5, 6-8, or over 9 times visiting a site (see Appendix B for copy of the knowledge test).

Assignment. Students in three of the five conditions received an assignment as part of the study. The assignment was created using material from the Web-based resource and lecture. Six questions were created for this assignment so the participants could review information about AT. Four of the six questions were short answers and multiple-choice questions. One question asked participants to identify potential AT for students in a general education classroom. The last question asked students to describe how to implement AT in lesson plans.

Procedure

This study compared five different conditions. At the start of the fall semester an e-mail was sent to all listed instructors of the course (n = 12). The e-mail explained the study and asked the instructors to participate. Eight instructors responded to the initial e-mail; five instructors agreed to participate in the project. Students in each course section volunteered to have their data analyzed as part of the study. A total of (n = 99) students participated across the five conditions. Course sections were assigned to conditions using random assignment at the class level. The participants were included in the study if permission was received along with a pre- and post-test match. The numbers of participants along with total enrollment numbers according to the online schedule were as follows: Condition 1, 20 participants of 27 students enrolled; Condition 2, 23 participants of 25 students enrolled; Condition 3, 22 participants of 23 students enrolled; Condition 4, 18 participants of 20 students enrolled; and Condition 5, 16 participants of 23 students enrolled.

Conditions

Web exposure only condition. Condition 1 was exposure to the Web-based resource. The participants were asked to read information on the Website four times in a two-week period. Students were told that they would be tested again using the same assessment and that the answers were on the Website. During a brief presentation given by the researcher, students were provided with an orientation and presented with information from the Web-based resource. All students received a sheet of paper with the Website's URL.

Website exposure with optional assignment condition. Condition 2 consisted of students using the Web-based resource along with a short assignment outside of class. The participants were asked to view the Website approximately four times in the next two weeks to complete the assignment. The researcher told the students that the assignment would be collected at the post- test. Students were given a piece a paper with the URL; the URL was also listed at the top of the assignment.

Website exposure with required assignment condition. Condition 3 was similar to Condition 2 in that it was a Web-based condition with an assignment. The participants were to view the Website approximately four times in the next two weeks to complete the assignment, which the instructor told the students was required as part of their course grade. The researcher graded the assignment and returned it to the instructor. The URL was included on a slip of paper and placed on top of the assignment.

Traditional lecture condition. Condition 4 consisted of the traditional lecture with multimedia components given by the researcher during the class period.

Traditional lecture with optional assignment condition. Condition 5 consisted of a traditional lecture and assignment. The assignment was not part of the grade.

Research Design

All conditions were given the pre- and posttest to determine the student's knowledge of AT before and after the intervention. Two visits to the scheduled classroom time occurred in the Web-based conditions (Conditions 1 through 3). Participation and administration of the pretest took place in the first visit. The second visit occurred two weeks later to administer the posttest. The lecture conditions (Conditions 4 and 5) received three visits during the regularly scheduled classroom time. The first visit solicited participation and administration of the pretest. The lecture occurred during the second visit. The third and final visit occurred two weeks after the lecture, when the participants took the posttest.

Scoring

Pre- and post-knowledge tests were scored blindly in the following manner. Each multiple choice and short answer questions were scored as 'correct,' 'incorrect,' 'does not know,' or 'blank.' Examples of answers that were scored as 'does not know' included responses in which students wrote, "I don't know" next to a question or placed a question mark. Questions left blank were coded as 'blank.' The maximum score for correct answers for the short answer and multiple choice questions was 17.

The last questions contained two case studies that required two different qualitative responses. Participants read details about a student in a general education classroom who might benefit from AT. After reading the details, participants were asked to name a device that could support the student and why they would choose this device. The researcher reviewed the answers and developed a response rubric based on the answers. Based on accuracy, the two responses could receive a score of '1,' '2,' '3,' 'not answered,' or 'does not know' for each question for maximum total of six points. Participants were awarded one point if they could name an AT device but provided no other information or offered incorrect information. Participants naming an AT and describing its function accurately received two points. If a participant named an AT and addressed its function but did not explain why he or she chose that technology or if the technology was not appropriate for the student they also received two points. Participants received three points by naming the AT, knowing how the AT worked, and why it was appropriate for the student. Questions left blank were coded as such and questions with an "I don't know" or question mark were coded as not known by the participant and therefore did not receive any points.

A second rater, who is a certified general education teacher working at a middle school, scored 25% of the assessments to determine inter-rater reliability. The researcher trained the second rater on the expected content of the assessment. There were no disagreements on the multiple choice questions. For the last question, the initial inter-rater reliability score was 86%. When disagreement occurred, the raters met for a retraining on the use of the rubric. After the retraining, the raters rescored assessments and achieved 96% agreement. The researcher independently completed the remaining assessments.

Data analysis. An ANOVA was used to determine if there were significant differences among the conditions in the pretest scores. Running comparisons using the pretest as the dependent variable and condition as a factor (to test if the pretest had a significant difference among the conditions) yielded no statistical significant difference among condition means.

An ANCOVA was then utilized with the pretest as the covariate. A power analysis showed that this model had sufficient power .995 ($F_{(5,\ 93)} = 6.8$, $p = .00$) to detect a difference at the .05 level according to the test between subject effects. After running the

Table 2
Mean Scores and Standard Deviations on Pre- and Post-Knowledge Test and Question Type

Condition	Pre- *M* (*SD*)	Post- *M* (*SD*)	Pre- Declarative *M* (*SD*)	Post- Declarative *M* (*SD*)	Pre- Procedural *M* (*SD*)	Post- Procedural *M* (*SD*)
Web-based only (C1)	6.7 (2.6)	10.1 (1.8)	6.0 (2.2)	9.2 (2.1)	1.2 (.93)	2.7 (1.1)
Web-based, non-graded assignment (C2)	6.3 (1.7)	8.7 (2.6)	5.4 (1.3)	7.6 (2.4)	1.0 (.82)	1.9 (.94)
Web-based, graded assignment (C3)	6.0 (2.0)	11.2 (2.4)	5.3 (1.8)	10.0 (2.5)	2.0 (1.1)	3.1 (1.4)
Lecture only (C4)	5.2 (1.7)	12.0 (3.0)	4.6 (1.7)	10.9 (2.9)	2.3 (1.8)	3.3 (1.4)
Lecture with assignment (C5)	6.3 (1.8)	12.7 (2.4)	5.3 (1.7)	11.5 (2.9)	1.5 (.71)	3.8 (1.1)

Comparison by question type.

ANCOVA, a pairwise comparison using Bonferroni adjustment was utilized. This was model was significant $F_{(4,\ 93)}$ = 8.4. p = .00 , with an observed power of .998. There were three different scores to consider: the score of the entire assessment, the score of the short answer and multiple-choice questions, and the score of the case study questions for three separate analyses. Pretest and posttest means and the mean gains are listed in Table 2.

Applying comparisons by two types of questions (declarative knowledge and procedural knowledge) was utilized for analysis. An ANCOVA was used on basic recall questions; a perfect score was 17 points. A power analysis showed that this model had sufficient power .995 ($F_{(5,\ 93)}$ = 6.2, p = .00) to detect a difference at the .05 level according to the test between subject effects. After running the ANCOVA a pairwise comparison using Bonferroni adjustment was utilized. This was model was significant, $F_{(4,\ 93)}$ = 7.7. p = .00, with an observed power of .997. There were significant differences in the adjusted means between conditions two, and, three, four, and five.

Results for total questions. The first ANCOVA examined the total results from the pre- and posttests. The independent variable was the condition; the dependent variable was the posttest score with the covariate being the pretest. A significant main effect was found for condition, $F_{(5,\ 93)}$ = 6.8, p = .00, β = .995. Pairwise comparisons were used to determine differences among the five conditions. The Web-based condition with an optional assignment (C2) was significantly different from the Web-based assignment with required assignment condition (C3; p = .01), lecture-only condition (C4; p = .00), and lecture with assignment condition (C5; p = .00). C5 showed a significant difference compared to C1 and C2.

Comparison by question type. Differences were examined across question types. There were two types of questions. An ANCOVA was performed on the basic recall questions consisting of short answer and multiple choice and revealed a significant main effect for condition, $F_{(5, 93)} = 6.2$, $p = .00$, $\beta = .995$. Results for the basic recall questions were as follows: C2 < C3, C4, and C5 (p = .02, .00, .00) and C5 > C2 (p = .00). These results were similar to the overall ANCOVA. The only change is that C1 was no longer considered significantly different from C5.

The last question type was an open-ended question requiring synthesis of knowledge. These were the case study questions and required application of knowledge; these questions had a potential score of six points. The ANCOVA revealed a significant main effect for condition, $F_{(5, 48)} = 5$, $p = .00$, $\beta = .973$. The results for the pairwise analysis for this question were as follows: C5 > C2 (p = .01). The only significant differences that occurred in the procedural questions were between the lecture with a non-graded assignment and Web-based with a non-graded assignment.

A note of interest for the case study questions is the number of students that left part of the questions blank or answered "I don't know" in the pretest. This data indicates that 43% of the participants did not attempt to answer the question or stated they did not know the answer. The participants during the posttest attempted the last question at a much higher rate; only 9% left the question blank or wrote that they did not know the answer.

Self-reported time of access to site. C1 participants (n = 20) self-reported that 20% (n = 4) never accessed the Web-based resource; 30% (n = 6) accessed the Web-based resource 1-2 times; and 50% (n = 10) accessed the Web-based resource 3-5 times during the two-week period. C2 participants reported accessing the Web-based resource at least 1 to 2 times (39%, n = 9), and more than half accessed the Web-based resource 3 to 5 times (52%, n = 12). Only 9% (n = 2) accessed the resource 6-8 times during the two-week period. Condition 3 participants reported 9% of the students (n = 2) accessing the Web-based resource 1-2 times, 73% (n = 16) accessing 3-5 times, and 18% (n = 4) accessing the resource 6-8 times. Condition 4 participants reported 83% of the students (n = 15) accessing the Web-based resource 1-2 times, 17% (n = 3) accessing 3-5 times. In condition 5, 86% (n = 14) participants accessed the Web-based resource 1- 2 times, 13% of the students accessed the site 3 to 5 times (n = 2).

Discussion

This study attempted to determine if the use of a Web-based resource can be an effective means to change preservice teachers' knowledge about AT compared to a traditional classroom guest lecture as measured by an AT assessment. This study also discovered that overall AT knowledge by general education preservice teachers is generally low. The data suggest that a Web-based resource can be as effective as changing knowledge if a graded assignment is included in conjunction with a Web-based resource. The Web-based condition in which students knew they were going to receive a grade for the assignment consistently performed as well the two lecture-based conditions.

AT Knowledge

The discouraging finding is the AT knowledge demonstrated by the preservice teachers. Overall the scores of posttests ranged from 8.7 to 12.7 correct out of 23. The highest group mean at the end of the intervention was from the condition that participated in the lecture and assignment. If the posttest had been a teacher-created test, the highest mean would have only scored 55%, which is traditionally a failing classroom grade. Although the overall AT knowledge reflected by preservice general educators is poor, gains were found in every condition. This result possibly indicates that preservice teachers have little knowledge of AT but can quickly improve their knowledge base with minimal instruction.

AT knowledge is important for general educators because it can result in skills among teachers that help students with disabilities improve their participation in a general education classroom (Edyburn, 2005). AT can enhance instruction in the classroom, provide students with access to the curriculum, allow students to work at their own pace, and improve students' engagement time (Blackhurst, 2005; Edyburn, 2000; Lewis 2005). Abner and Lahm (2002) discussed the need for teacher preparation programs and other professional development venues to increase the competence of AT for teachers so they more readily will use these devices in general education classrooms. If general educators have a working knowledge of AT it may help dispel some of the myths surrounding students with disabilities and AT that accompanies them into the classroom (Maushak, Kelley, & Blodgett, 2001). AT allows students with disabilities to participate meaningfully in the general education classroom (Dorman, 1998) as required by NCLB and IDEA. Yet, general educators possess little knowledge about AT and how to incorporate AT into the general education classroom (Ashton, 2005).

Learning Condition

Unfortunately, using a Web-based resource as a stand-alone program (C1 and C2) did not yield the same results that other online technology tools have in the past (Caywood & Duckett, 2003; LaMontagne et al., 2002). When comparing a traditional multimedia lecture using *PowerPoint*™ to a Web-based resource, the lecture with an assignment was a better learning medium as measured by the knowledge test then a Web-based resource only and the Web-based with non-graded assignment. Previous studies concluded that multimedia presentations or virtual classrooms were just as effective for content knowledge as traditional means in OLI (Skylar et al., 2005); however the same does not appear to be true for a Web-resource.

When analyzing the data by question types, it appears that questions requiring some type of synthesis of information, the delivery model is not critical; only one significant difference appeared. Again, the lecture condition with an assignment (C5) was significantly different than the Web-based resource with assignment (C2). Both the conditions had the same assignment that required some synthesizing of information; yet, on the performance on the knowledge test, those two conditions showed a significant difference.

The Web-based condition with a graded assignment contained an accountability component that no other condition used. Even the lecture-based conditions did not have a grade requirement for an assignment. A study by Scheines, Leinhardt, Smith, and Cho (2005) found that students did not utilize comprehension checks of online course material, a similar function to this study's assignment. They concluded the reason for this was that effort is exerted on those activities that contribute to their grades. It appears that if students did not feel it was directly related to their grades (such as the Web-based resource without the assignments condition) they chose not to complete an assignment/activity or did not devote the proper attention to it. However, when the instructor of that class announced to students that the assignment would be graded, the students statistically performed just as well as the lecture condition.

It seems that the graded assignment forces students to interact with the Web-based resources. This interaction possibly aids in the retention of the material. The assignment also provides students a framework or an immediate purpose to gather information from the Web-based resource to increase knowledge gains. While viewing a Web-based resource tends to be a student-initiated activity, the graded assignment provides the student motivation to view the Web-based resource.

Limitations

When the researcher visited the classroom for the posttest, some participants reported they had not accessed the Website at all during the 2-week period. This seemed especially true of Conditions 1 and 2 where there was no accountability for completion of the assignment. However, when looking at the self-reports of the amount of time students accessed the Website, Conditions 1 and 2 appear to have fairly equivalent access times with the exception that 20% of the students in Condition 1 never accessed any Website. These results bring into question the quality of engagement with online material. Simple access counts do not 'paint a picture' of how a student is interacting with the material. While the information was provided for the students, this study is limited regarding how the students actually used the resource.

A caveat in the interpretation of results of this study, in comparison to previous research, is that this study had an extremely short duration. One class period or accessing a Web-based resource during the duration of the investigation is not a comparable amount of time as in other studies. The use of the same pre- and posttest measure limits the results within the short timeframe, too. In other studies conducted, where there was no recorded difference, and a longer or more intense duration could possibly influence the outcomes (Caywood & Duckett, 2003; LaMontagne et al., 2002).

Motivation is also a key component to online learning and may arguably be a factor in this study. Cornell and Martin (1997) discussed some of the key components that can influence motivation in online learning: interaction that students have with one another and the role of an on-site facilitator. Neither of these components existed in the Web-based resource utilized in this study. Students' lack of interest and motivation to view the Web-based resource might have been affected by the lack of these components. This presents questions whether the importance of this topic should be emphasized to preservice teachers during their preparation at the university level.

Other limitations are typical of research in this genre. For example, some instructors and students chose not to participate in the research. It is unknown why certain class members and instructors did not participate in the research. The inclusion of these students could have changed the results. The volunteers were not a very diverse group, which caused limited generalization of the results.

Outcomes and Benefits

A Web-based resource has the potential to be influential in knowledge gains of preservice general educators. Regardless of condition, the scores on the posttest indicate that preservice general education teachers do not have simple knowledge of AT. These preservice educators had very little knowledge of AT; moreover, the majority of the participants were in their senior year. Information about AT and other needs concerning teaching students with disabilities will help prepare professionals who teach *all* children and prepare them for the realities they will face in classrooms when they graduate. A Web-based resource could potentially be an efficient and effective way to prepare these teachers for diverse classrooms in the 21st century. However, based on the results of this study, a simple stand-alone Web-based resource is not an effective way to educate preservice general educators. It appears that when the intervention includes a component that will affect students' grades, such as an assignment, then the Web-based tool is just as effective as a traditional lecture.

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Appendix A - Web-based Resource: Resources In Special Education

Classroom Tools

Technology and Assistive Technology

- Michigan Assistive Technology Resources
- Assistive Technology of Michigan
- Assistive Technology Resource Guide
- Abledata
- AbilityHub
- Assistive Technology Training Online
- Assistive Technology devices by student needs

Examples of Assistive Technology Devices

- AlphaSmart
- WatchMinder
- Hal Screen Reader
- Jaws Screen Reader
- Wynn Reader
- Kurzweil
- Dragon Naturally (Comerical Voice Recognition Software)
- Windows Speech Recognition (Comerical Voice Recognition Software)
- IBM's Via Voice (Comerical Voice Recognition Software)
- Mobile Spellcheckers and Thesauruses
- Inspiration

Assistive Technology Website Resources

- Center for Applied Assistive Technology
- Project Intersect
- Assistive Technology Basics

Assistive Technology Videos

- Demonstration of a screen reader for students with visual impairments
- Demonstration of screen magnifiers
- Demonstration of electronic documents and scanners

Assistive Technology Articles

- A family's guide to assistive technology, assistive technology defined, and how to make assistive technology decisions
- Excellent article for future teachers - Assistive Technology: A Handout for Teachers How assistive technology can be applied in the classroom for students with disabilities

Appendix-B: Knowledge Test

1) Assistive Technology is defined as

a) improving capabilities of individuals with disabilities.
b) helping people stay alive or function outside of hospitals.
c) employing a combination of human and nonhuman resources to bring about more effective instruction.
d) instructional approaches systemically designed and applied in precise ways.

2) Which statement about assistive technology is not true?

a) The use of assistive technology is part of the student's IEP
b) With assistive technology a student can learn at their own pace.
c) An alpha smart is an expensive option for students with disabilities.
d) The district is required to pay for the AT device if it is required in an IEP for a student meeting FAPE

3) ____________is a device or a program allowing a student to access print.

a) large print keyboard
b) hypermedia
c) voice recognition software
d) screen reader

4) An example of a low tech assistive technology could be

a) pencil grip
b) braile reader
c) voice recognition
d) co:writer program

5) Assistive technology also includes assistive technology services such as

a) evaluation of functional needs
b) purchase, lease, other provision for AT
c) coordination with other therapies
d) all of the above
e) none of the above

6) Which of the following is not considered assistive technology?

a) speech to text software
b) pencil grip
c) eyeglasses
d) none of the above are considered assistive technology
e) all of the above are considered assistive technology

7) Which of the follow statements is true?

a) As a teacher you have the right to decide when your student uses his/her assistive technology
b) All assistive technology is computer based.
c) As a teacher you have right to know how technology works for the student.
d) Assistive Technology is so advanced that it can replace good teaching.

8) Screen Readers or E-Readers are good for students who…

a) have low listening comprehension
b) only speak English
c) have good vision
d) have a hearing impairment
e) need to access information above their level

9) Name two of the activities in which a WatchMinder helps a student

1__________________________________

2__________________________________

10) What type of student could use a WatchMinder?

1__________________________________

2__________________________________

11) What are the benefits of an Alpha Smart?

1)____________________________________

2)____________________________________

3)_____________________________________

12) Which of the following is NOT a true statement about AT use by students with disabilities:

A) It is the school district's responsibility (as a public agency) to evaluate, select, acquire and train students and significant personnel in the use of AT devices

B) AT devices needed by a student in multiple environments in order to receive a free and appropriate public education (FAPE) must be provided

C) AT must be identified on a case-by-case basis

D) AT must be provided at no cost to student's parents

E) All the above are true

13) The most appropriate location for training and instruction in use of an assistive technology (AT) device is

A) A quiet area with few distracters

B) The student's home environment

C) The environment in which the device will be used

D) A training center where several therapists are available

14) What would type of assistive technology would you suggest for the following students and why?

Tory-Is a 5th grader who has been diagnosed with a mild learning disability in the area of writing. Tory is unable to spell non phonetic (irregular) words. This impedes his written expression fluency. He reads at about a whole grade level lower then his peers and has trouble with specialized vocabulary. What assistive technology would you suggest for him and why?

Danny is a 2nd grader, is a student who is considered a risk but, not yet received a special education label. He reads at grade level and he can spell well when he doesn't have to write out the words. His handwriting is illegible. His grip on the pencil is tight. What AT device would you suggest for him and why?

Approximately how many times did you access the RISE Web site? 0, 1-2, 3-5, 6-8, 9+

Integrating Assistive Technology into Teacher Education Programs:

Trials, Tribulations, and Lessons Learned

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Abstract: This article describes several stages in the integration of assistive technology (AT) into and across the curriculum of a teacher education program. The multi-year initiative included several projects and strategies that differentially affected faculty ability to integrate training and evaluation in using AT in their coursework. All strategies increased faculty familiarity and comfort with AT. However, only video tutorials resulted in faculty infusion of AT in their courses. Implications for teacher preparation programs, including the need to infuse assistive technology within and across coursework are discussed.

Key Words: Assistive technology, technology integration, higher education, professional development

Increasing the integration of AT into teacher education programs has been recommended by leading researchers and AT practitioners in the field (Bausch & Hasselbring, 2004; Edyburn, 2004; Judge & Simms, 2009; Parette, Peterson-Karlan, & Wojcik, 2005; Silver-Pacuilla, 2006). Preparing future teachers to use AT is necessary due to mandates that require them to be responsible for considering AT needs and services for all students receiving special education services (Individuals with Disabilities Education Improvement Act of 2004). Both special and general educators must be knowledgeable about AT so that they can assist in the consideration and selection of devices, software, and/or equipment while also having the necessary skills to provide AT services.

However, in order for teachers to meet these requirements, they must have the skills and knowledge to do so. Insufficient training on AT at the preservice level has been cited as a primary obstacle to achieving meaningful integration and use of AT for students with disabilities in school settings (Bryant, Erin, Lock, Allan, & Resta, 1998; Judge & Simms, 2009; Michaels & McDermott, 2003). According to Judge, Puckett, and Cabuk (2004) teacher familiarity, confidence, and skill in choosing software and integrating AT into the curriculum are dependent on training and time for technology exploration. The success and use of AT by students with disabilities is directly related to the AT knowledge and skills of their teachers (Judge & Simms) and teacher preparedness is the primary significant predictor of student AT use (Connor, Snell, Gansneder, & Dexter, 2010). Although the importance of integrating AT into teacher preparation has been established, few universities provide certification or training in AT (Alper & Raharinirina, 2006; Bausch & Hasselbring, 2004; Lahm, 2005; Todis, 1996), and insufficient training has limited the number of teachers and therapists using AT in classroom settings (Bell, Cihak, & Judge, 2010; Judge, 2001).

To measure how AT is being integrated within teacher education programs across the U. S., two national surveys of special education teacher preparation programs were conducted within the last decade. In 2003, Michaels and McDermott surveyed program coordinators across a sample of institutions of higher education with graduate special education certification programs. They measured how coordinators currently integrated AT knowledge, skills, and dispositions within their programs and how they would ideally like to have AT integrated within their programs. Results indicated a significant difference between the AT integration currently being provided and what the coordinators reported as the ideal integration of AT within their programs. Most agreed that they were not doing an adequate job of preparing candidates to use AT in classroom settings. Inadequate training among teacher candidates was confirmed by Judge and Simms (2009) when they conducted a national survey of special education teacher preparation programs to determine how they addressed AT in their coursework. Results revealed that approximately one-third of undergraduate programs and less than one-quarter of master's programs required coursework in AT, which suggests that many teacher candidates enter the field without adequate knowledge and skills regarding AT. This is problematic especially considering that they will ultimately be required to identify AT devices and provide AT services for their students.

To address the need for providing instruction on AT in higher education, a few researchers have investigated different methods for integrating AT into teacher education programs. Some have investigated the use of multimedia-based instruction for teaching preservice teachers about AT (Blackhurst & Morse, 1996; Van Laarhoven et al., 2008; Wojcik, Peterson-Karlan, Watts, & Parette, 2004). Blackhurst and Morse (1996) evaluated the effectiveness of an AT module that incorporated videos and other hypermedia components for teaching three different groups of professionals about AT. Results indicated that undergraduate, graduate, and inservice professionals were satisfied with the instructional modules. Similarly, Van Laarhoven and colleagues evaluated the effectiveness of video tutorials (i.e., videos teaching learners how to use various AT) followed by hands-on experiences with the technologies, to teach preservice educators how to use AT. They reported significant increases in familiarity with AT, comfort level using AT, and perceived effectiveness and comfort with integrating AT into instruction for both special and general education majors participating in the study. In addition, participants indicated satisfaction with using the video tutorials as an instructional tool.

Wojcik et al. (2004) also described a model for teaching both special and general education teacher candidates to use AT. These authors described two delivery models: (a) an alternative track for elementary, middle, and secondary education teacher candidates; and (b) a traditional track for early childhood and special education candidates. In the alternative track, the researchers described an Instructional Technology Passport System (ITPS) that required teacher candidates to complete six online modules that included descriptions and images or short video clips depicting the use of AT in educational environments as well as links to Web-based resources. Once candidates passed the online exams, they were also required to engage in hands-on experiences and pass competency exams using selected technologies.

In 2006, Jeffs and Banister evaluated the benefits of having faculty from general and special education programs collaborate to develop assignments within undergraduate technology classes. In this investigation, special education candidates taught general education counterparts about various AT, and the general education majors taught special education majors to use various types of multimedia. Results indicated that both groups gained skills and knowledge in using multimedia and AT.

It appears that using instructional modules on AT, collaboration between general and special education faculty, and online modules or video tutorials used in conjunction with hands-on experiences are effective models for integrating AT into teacher education programs. However, the research base is limited, and much more research regarding effective methods, models, and strategies for systematically integrating AT into special and general education preservice programs and related fields is warranted to close the gap between the need for, and supply of, qualified teachers and therapists.

Typically, teacher education programs infuse AT into the curriculum by providing students with a basic overview of AT in introductory courses, offering a single course on AT that is required or offered as an elective, or they rely on individual faculty to integrate AT into their coursework (Judge & Simms, 2009; Michaels & McDermott, 2003). Many researchers (e.g., Bausch & Hasselbring, 2004; Family Center on Technology and Disability, 2008; Judge & Simms, 2009; Lahm & Nickels, 1999; Smith, 2000) have recommend infusing AT instruction across the special education curriculum. This approach involves integrating AT knowledge, skills, and practice across the sequence of courses in the teacher preparation curriculum (Michaels & McDermott, 2003). An integrated approach provides repeated exposure of AT to increase teacher candidates' familiarity, comfort, and skill in using technologies and therefore emphasizes the importance of supporting students' use of AT in classroom settings. Such repeated exposure across courses and technologies increases the likelihood that teacher candidates will attain the skills necessary for selecting, supporting, and using AT effectively with their future students, particularly if hand-on experiences with assistive technologies are provided (Alsalem, 2010).

Although researchers recommend the integration of AT throughout teacher preparation programs, several factors make this approach difficult to implement including (a) lack of faculty expertise with AT; (b) limited space in the curriculum for additional content; (c) lack of resources (e.g., hardware, software, devices); and (d) the perception that AT is only used with a limited number of students. These and other issues often make AT infusion a low priority in teacher education programs (Judge & Simms, 2009; Michaels & McDermott, 2003). Clearly, in order for the infusion of AT to become a reality within teacher education programs, faculty must not only value the inclusion of AT in the curriculum, but they also need to strategically consider its integration across courses within the program sequence. This proposition can be difficult, however, if faculty do not have the expertise or desire to provide instruction on AT. This is especially problematic if the integration of AT requires additional professional development and investment of time on the part of faculty.

One of the largest barriers in effectively integrating AT into teacher preparation is lack of faculty expertise (Bryant et al., 1998; Michaels & McDermott, 2003). To overcome this barrier, researchers have suggested (a) hiring faculty with expertise in AT (Michaels & McDermott); (b) retraining existing faculty and providing incentives for faculty to infuse AT into the curriculum (Judge & Simms, 2009); (c) providing a course release or sabbatical for faculty to redesign or develop courses in AT (Bryant et al.); or (d) pairing tech-savvy students with reluctant faculty members (Smith, 2000).

This paper will present one institution's experience with increasing faculty expertise with AT over a period of several years, through a variety of projects and strategies that focused on AT alone, or in combination with other recommended practices for inclusive classrooms. Specifically, this paper will describe three strategies that were used to support faculty development and integration of AT throughout teacher preparation programs at a major Midwestern university, and the effectiveness of each strategy based on faculty members' reported perceptions and outcomes.

The Institution and Programs

Faculty in special education (Cross-Categorical) and general education (Early Childhood, Elementary Education, Secondary Education) programs in a large, state university in Illinois participated in this project. The special education program led to certification as a K-12 Learning Behavior Specialist (LBS-1), and was separate from certification programs for visual and hearing impairments. Initiatives in the special education program designed to provide teacher education candidates with AT knowledge and skills was expanded to also include other teacher certification candidates. Resources for these initiatives came from a variety of sources, including the College of Education, Faculty Development Grants from the University, and a multi-year grant from the Illinois Council on Developmental Disabilities.

Stages and Initiatives in AT Integration

Prior to AT integration initiatives in the LBS-I program, few faculty had experience or expertise with AT. As a result, candidates' hands-on experiences with AT were primarily limited to methods courses associated with instructing individuals with significant disabilities, a common characteristic among teacher education programs nation-wide (Judge & Simms, 2009; Michaels & McDermott, 2003). Professors of those courses borrowed and brought various AT to class which proved to be both inconvenient and time consuming. Faculty in other special education courses were encouraged to address AT however, they primarily did this by bringing their classes to the small AT lab and asking other faculty or graduate assistants with AT expertise to present to their classes. Few faculty members were able to demonstrate AT in their own classes or to supervise hands-on experiences within the AT lab. Simply providing access to AT did little to increase faculty use of expertise with AT.

Stage 1: Initial Efforts to Infuse AT into Courses

In 2002, two special education faculty (first and second authors) received a four-year grant from the Illinois Council on Developmental Disabilities to enhance the preparation of special and general education preservice teachers for inclusive classrooms. Project Achieving Creative & Collaborative Educational Preservice Teams (ACCEPT) involved multiple curricular enhancements, including purchase of AT and expanded preparation for their use. Some grant funds were used to purchase AT that could provide support for learners with both high and low incidence disabilities. Initially, only five licenses of various AT software were purchased and these were loaded onto a desk top computer in a small office, a laptop that was used to conduct demonstrations of AT in education classes, and project staff's computers. Preservice educators from special, elementary, early childhood, and secondary education who participated in the Project ACCEPT course were required to engage in hands-on activities with all of the software and devices. Project staff also provided demonstrations in additional methods courses by 'co-teaching' with faculty to ensure that all preservice educators received instruction on universal design for learning (UDL) and AT.

As part of this project, AT was introduced in select special education courses and several early childhood, elementary, and secondary education courses. Preservice candidates and course instructors from targeted courses received instruction on UDL and information about AT. Follow-up surveys assessing the project's effectiveness indicated that preservice teacher's knowledge of AT increased substantially (Van Laarhoven, Munk, Lynch, Bosma, & Rouse, 2007). Similarly, during their first year of teaching, participants reported hands-on experiences with AT as one of the greatest benefits of the project (Van Laarhoven et al., 2006). Based on the results of this project as well as their belief that candidates would benefit from learning specific AT associated with content in coursework and clinical experiences, special education faculty made the infusion of AT into additional courses a priority.

Stage 2: Expanding the AT Lab

The success of Project ACCEPT made it clear that more AT was needed to accommodate the increasing number of faculty and students who wanted AT included in their courses. The Department of Teaching and Learning provided funding to purchase additional software licenses and these were placed on 10 computers in the College of Education's Learning Center. However, space was limited and it was difficult to accommodate a large number of students at one time. As a result, the development of an open AT lab that could provide hands-on experiences for approximately 850 candidates (throughout the year) became a funding priority within the College. In January, 2004, a second AT lab was opened, and was primarily funded through private donations and grant funds. This lab was equipped with 25 desktop computers which were replaced in 2006 and again in 2010. A mobile cart with 14 laptop computers was also purchased to accommodate large class sizes and to provide instruction in off campus locations or when the lab was in use. Additional software licenses, devices (e.g., AAC devices, switches), and recently, mobile technology devices (e.g., iPods, iPads), were obtained through course fee accounts as well as funded grants.

Once the challenge of developing and equipping a dedicated AT lab was met, the next challenge was improving the knowledge and skills of faculty so that they could integrate AT into their own courses, rather than relying on a few select faculty to do this for them. The remainder of this paper focuses on strategies that were implemented to support faculty integration of AT within the teacher education program.

Stage 3: Strategies to Increase Assistive Technology Integration Among Faculty

Three strategies were employed to improve the efficacy of our teacher educators: (a) co-teaching arrangements, (b) faculty development opportunities, and (c) development and use of written and video-based tutorials. Each of these strategies is described in the following sections.

Co-Teaching Arrangements (2002-2004)

Description. During the initial years of Project ACCEPT, the two faculty coordinators and project staff worked collaboratively, in a co-teaching model, with other faculty to provide demonstrations and hands-on experiences with AT for students in methods and field experience courses. Faculty from each of the teacher preparation program areas participated: Early Childhood (general and special education methods courses); Elementary Education (Science, Social Studies, Reading, and ELL courses; and Field Experiences); Special Education (Foundations, Collaboration, High and Low Incidence courses; and Field Experiences); and Secondary Education (Biological Sciences, History, and English courses; and Field Experiences). The co-teaching model was designed to have project staff provide the majority of initial instruction on AT during class sessions and for course instructors to supplement AT instruction and practice in subsequent sessions. The goal of the co-teaching model was that course instructors eventually would be responsible for providing all AT instruction in their courses.

Effectiveness and outcomes of co-teaching arrangements. Although co-teaching experiences allowed for more integration of AT into the teacher education program, and faculty reported satisfaction with co-teaching arrangements, this model could not be sustained. Project staff were not able to shift responsibility for teaching AT to primary course instructors and faculty often relied on graduate assistants to work with candidates in the AT lab. As a result, faculty members' expertise and comfort levels with AT did not increase. In addition, project ACCEPT faculty could not continue to provide AT instruction in multiple sections of multiple courses and also maintain their own teaching load.

Evaluation of co-teaching revealed two findings. First, while faculty recognized the importance of integrating AT into their courses, they did not take the initiative to develop expertise with AT, preferring instead to rely on project staff. Second, as a result, faculty were unable to participate in co-teaching in a meaningful way and, more importantly, they were unable to sustain the integration of AT into their coursework after the co-teaching sessions ended. Evaluation and reflection on the effectiveness of co-teaching suggested that although faculty demonstrate positive dispositions toward AT and co-teaching, those traits do not predict the development of expertise with AT. Clearly, faculty require a more intensive experience in which they learn how to use AT with some proficiency before they can integrate it within their own courses. Hands-on workshops were identified as a strategy for enhancing faculty expertise.

Faculty Development Opportunities (2004-2005)

To encourage faculty members to take a more active role at integrating AT into instruction, two faculty development opportunities were offered. The first involved a full-day workshop and the second involved a five-day workshop focused solely on AT.

Description of full day workshop: Overview of universal design and introduction to AT. Program faculty who were participating in Project ACCEPT were invited to participate in a full day workshop that addressed methods for supporting learners with disabilities in inclusive classrooms such as differentiated instruction, UDL, and AT. Faculty received instructional materials to use in their courses (topic modules), and were allowed to purchase AT to integrate into their courses. Eighteen faculty from a variety of teacher preparation programs participated. They received a small stipend to attend the workshop and integrate AT content into their courses.

Effectiveness and outcomes of the full-day workshop. Although several faculty members integrated some of the workshop content into their instruction (e.g., simulation experiences, UDL), and reported satisfaction with the workshop, only two of the 18 participants (11%) independently integrated AT into their coursework. The other faculty continued to request assistance from ACCEPT staff to provide demonstrations in their courses. These results indicate that a one-day workshop with some hands-on experience did not provide sufficient support for faculty to feel confident in independently integrating the technologies into their instruction. Therefore, project staff, and other special education faculty, decided to offer more intensive and extended instruction on assistive technology.

Description of the five-day workshops on AT. To provide more in-depth instruction on AT for faculty, the first three authors obtained funding from two internally-funded grants to offer five workshops on AT during the summer of 2004. The workshops provided faculty with extensive hands-on experiences using AT and participants also received written AT tutorials to use with students in their own courses.

Effectiveness and outcomes of five-day workshop. An email describing the workshop was sent to faculty across the university who had participated in any of the Project ACCEPT opportunities (e.g., co-teaching, full-day workshop) as well as other faculty in the College of Education. Seven faculty and one student participated in the workshops. To measure the effectiveness of the faculty development workshops on faculty integration of AT, participants completed two surveys (i.e., *Familiarity and Comfort Level with AT; Current level of AT Integration*) prior to and one year following the workshops. The first survey, Familiarity and Comfort with AT survey, measured faculty members' familiarity, comfort level, and perceived effectiveness in using and integrating AT within their courses. Table 1 presents the items on this survey. The second survey, *Current Level of AT Integration* survey, measured faculty members' current level of AT integration prior to and one year following workshops. Table 2 presents the items for the *Current Level of AT Integration* Survey.

Design and instrumentation. A pretest, posttest design was used to assess the effects of the five-day faculty development opportunity on participating faculty members' familiarity, comfort level, and perceived effectiveness in using AT. Participating faculty members were given a *Familiarity and Comfort with AT* survey that consisted of 40 statements regarding general technology or AT, and instructions to rate their level of agreement with each statement by marking a number on a 6-point scale (i.e., 1 = strongly disagree, 3 = somewhat disagree, 6 = strongly agree). Individual items and survey subscales appear in Table 1 and the survey instrument is available from the first author.

Results of faculty development workshops as measured by the familiarity and comfort with AT survey. Table 1 presents the pretest and posttest scores and significance of difference for each of the items and subscales. Overall, the results indicated that the faculty development workshops were effective at increasing faculty members' familiarity, comfort level, and perceived effectiveness with using AT. Results for individual survey items reflected small to large effect sizes for the workshops and pre-post scores focusing on AT indicated significant gains for each item with the exception of Overall Integration of AT into Instruction. Significant gains were made with Overall Familiarity with AT ($F_{(1,6)} = 6.25$, $p < .047$), Overall Comfort with using AT ($F_{(1,6)} = 20.25$, $p < .004$), and Overall Comfort with Teaching AT ($F_{(1,6)} = 10.50$, $p < .018$). Overall Integration of AT into Instruction, however, did not result in significant findings ($F_{(1,6)} = 3.69$, $p < .103$).

The magnitude of growth from pre- to post- was analyzed using partial η^2 (Cohen, 1988),

Table 1
Familiarity and Comfort with AT Survey: Comparisons of Pretest and Posttest Survey Responses

Individual Items	Pretest		Posttest		Sig.		η^2	Effect size	
	M	*SD*	*M*	*SD*	*df*	*F*	*p*		
Overall familiarity with general technology	5.71	.48	5.71	.48	1, 6	.00	1.00	.000	Small
Overall comfort with using general technology	5.14	1.21	5.57	.53	1, 6	1.35	.289	.184	Large
Overall comfort with teaching general technology	4.29	1.38	5.14	.38	1, 6	2.07	.200	.257	Large
Overall familiarity with AT	4.14	1.07	4.86	.69	1, 6	6.25	.047	.510	Large
Overall comfort with using AT	3.29	1.11	4.57	1.13	1, 6	20.25	.004	.771	Large
Overall comfort with teaching AT	3.00	1.15	4.00	1.53	1, 6	10.50	.018	.636	Large
Overall integration of general technology into instruction	3.71	1.80	4.86	.90	1, 6	2.21	.188	.269	Large
Overall integration of AT into instruction.	3.14	1.22	3.71	1.25	1, 6	3.69	.103	.381	Large
Subscales									
Familiarity with specific AT (8 items)	3.00	1.01	4.34	1.04	1, 6	12.71	.012	.679	Large
Comfort with using specific AT (8 items)	2.73	.92	3.91	1.11	1, 6	12.71	.012	.679	Large
Perceived effectiveness and comfort with integrating AT into instruction (6 items)	2.90	1.17	3.79	1.33	1, 6	12.30	.013	.672	Large
Importance of AT in education (8 items)	5.79	.28	5.83	.18	1, 6	.30	.604	.048	Small

6-point scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Somewhat Agree, 5 = Agree, 6 = Strongly Agree

which represents the difference between the pretest and posttest scores, divided by the standard deviations. The following scale was used to interpret the magnitude of an effect: η^2 = .01 = small effect; η^2= .06 = moderate effect; and η^2= .14 = large effect. Partial η^2 values reflecting large effect sizes were found for items that focused specifically on AT, including Overall Familiarity with AT (.510), Overall Comfort with Using AT (.771), Overall Comfort with Teaching AT (.636), and Overall Integration of AT into Instruction (.381). Pretest to posttest scores on items focusing on general technology suggested no significant gains; however, partial η^2 scores indicated large effect sizes for items that focused on Overall Comfort Using Technology (.184), Overall Comfort Teaching General Technology (.257), and Overall Integration of General Technology into Instruction (.381). Additionally, relatively lower effects on general technology, versus

AT items might be expected given that the workshops focused specifically on AT and faculty may have had much more prior experience in using general technology (e.g., word processing, email).

Results for the subscale, Familiarity with Specific AT, indicate that faculty gained enough information regarding specific devices (e.g., switches) and programs (e.g., software for reading challenges) to report high levels of familiarity ($F_{(1,6)} = 12.71$, $p < .012$). This suggests that the workshops provided adequate levels of instruction for specific devices and software to allow faculty to be familiar with what devices are available and for whom they would benefit. Results for the subscale, Comfort with Using Specific AT, suggest that faculty received enough instruction and hands-on experiences with specific devices and software to feel comfortable using those items ($F_{(1,6)} = 12.71$, $p < .012$). Given that comfort level is a predictor of whether teachers will adopt a new strategy in their classrooms, this finding is encouraging.

Results for the subscale, Perceived Effectiveness and Comfort with Integrating AT into Instruction, suggest that faculty gained confidence in their ability to integrate content on AT into their coursework ($F_{(1,6)} = 12.30$, $p < .013$). This finding was very promising as the goal of the workshops was to encourage faculty to integrate AT into their instruction. Results for the final subscale, Importance of AT in Education, did not result in significant findings ($F_{(1,6)} = .30$ $p < .604$ perhaps because faculty had prior understanding and appreciation for AT, and the belief that both special and general educators should integrate AT into their instruction.

Partial η^2values revealed a large effect size for Familiarity with Specific AT (.679), Comfort with Using Specific AT (.679), and Perceived Effectiveness and Comfort with Integrating AT into Instruction (.672). A small effect was observed for the subscale of items addressing Perceived Importance of AT in Education (.048). However, the smaller effect may be attributed to the fact that faculty came in to the workshops with positive attitudes toward the use of AT in instructional settings.

Results of faculty development workshops as measured by the current level of integration survey. Faculty were given a 17-item survey with statements related to different methods for integrating content on AT into instruction. The first 16 items provided statements, while the 17th item offered a write-in response for 'other,' however, faculty did not respond to this item. Faculty were asked to indicate how often they used the described methods by selecting from the following scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Frequently, and 5 = Always. Results are presented in Table 2.

Modest increases were reported for all of the strategies except question 8 (use of guest lecturers). However, ratings indicate that none of the integration strategies were utilized more often than 'rarely' or 'sometimes.' Items 11-13 most directly assess the faculty member's expertise with integration, and ratings for these items suggest that faculty rarely provided demonstrations of the AT in their own courses, which may explain, in part, why they did not require their students to complete assignments that involved the actual use of AT to produce an outcome or product. Although it was promising to see an increase in the provision of hands-on experiences, in most cases, faculty provided hands-on experiences following a demonstration by guest lecturers.

Table 2
Results of Current Level of AT Integration Survey.

	Individual Items	*M* Pretest	*M* Posttest
1.	I cover AT in my coursework by assigning readings on the topic.	3	3.33
2.	I cover AT by providing students with links to websites, or by having them find relevant websites on their own.	3.33	3.33
3.	I test my students on their knowledge of the laws related to AT.	2.33	2.33
4.	I test my students on their knowledge of specific types of AT (e.g., switches, writing software) that can be used for a variety of learning challenges.	2.5	2.8
5.	I provide information on AT through lecture.	3.17	3.67
6.	I actively seek out information on AT to incorporate the information within my courses.	3.17	3.5
7.	I provide information on AT by showing videos on the topic.	2.67	3.17
8.	I provide information on AT through guest lecturers who *describe* or lecture on the topic.	2.67	2.5
9.	I provide information on AT through guest lecturers who *demonstrate* AT.	3	3.17
10.	I provide information on AT through guest lecturers who provide hands-on-practice with the technologies.	3	3.33
11.	I personally provide brief demonstrations on how to use AT software/devices.	2.33	2.67
12.	I demonstrate AT in my own courses & also act as a guest lecturer for others.	2	2.17
13.	I provide my students with hands-on practice with AT.	2.67	3.83
14.	I assign homework that requires students to write about AT (e.g., papers) or to describe how they would incorporate AT into lessons.	2.33	3
15.	I assign homework that requires students to demonstrate the use of AT.	1.83	2.67
16.	I assign homework that requires students to submit products developed with AT (e.g., picture schedules).	1.67	1.83

Scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Frequently, and 5 = Always

Outcomes and effectiveness of five-day workshop. Together, the results of the two surveys suggest that the extended workshop strategy was effective for increasing the participants' familiarity and comfort with AT, as well as their confidence in integrating AT into their courses. However, as was observed for the earlier strategies that provided access to the AT lab and co-teaching experiences with project staff, generally positive perceptions of AT integration did not necessarily result in faculty expanding their expertise in demonstrating AT and including assignments that required hands-on experiences with their students.

The disparity between reported comfort and confidence with AT integration and assuming responsibility for developing expertise and demonstrating AT within courses was further highlighted in the outcome data for the workshops. While faculty were able to articulate how AT could, and should be integrated into instruction, they were not demonstrating AT for their students, nor were they creating assignments that would provide hands-on experiences. For that expertise, they continued to rely on project staff. Observation and informal discussion with participating faculty, combined with the results of previous strategies, suggested that a next step should include 'tutorials' to support faculty both in, and outside of, the classroom. Tutorials would allow faculty to develop expertise at convenient times, and would also provide them with actual exercises they could assign to their students.

Written and Video-Based Tutorials (2005-Current)

Because faculty members still indicated discomfort with integrating AT into their coursework and continued to request demonstrations from ACCEPT staff, it was necessary to plan for sustainable support when Project ACCEPT ended. For this reason, video tutorials of all of the AT available in the lab were developed and placed on a DVD entitled, *The Encyclopedia of Assistive Technology* (EAT). The tutorials include videos depicting software programs and/or devices that support individuals who have difficulties with written language, reading, math, communication, study skills, and/or physical control of their environment. The tutorials have several features that include an overview of the program/ device, videos depicting critical components of the program/devices, short tutorials (video-based and written) for using the program, and a list of resources. All featured AT devices and software are categorized by the type of support they provide (e.g., written language) or by the type of product (e.g., AAC, environmental control). Once a category is selected, a drop down menu of available software/devices in the program appears and the user then selects a product. After the program or device is selected, a description of the product appears and the user selects one of the features from the features toolbar to learn more about the product. Essentially, the DVD provides videos that teach learners 'how to' use various technologies (similar to the popular 'Video Professor' CDs sold commercially). It is available online at http://at-video-tutorials.com/

These tutorials were intended to provide faculty with a tool that allowed them to demonstrate AT by loading a DVD into a computer and presenting video sequences of a variety of AT during their instruction or by having teacher candidates access them independently. The tutorials also provided written and video lessons for students to use for hands-on experiences and also offered candidates supplemental information through links to helpful resources. Thus, faculty were provided with content on AT without having to gain expertise themselves in order to provide instruction on AT to preservice teachers. The video-based tutorials made it possible for faculty to integrate the technologies into their coursework with very little effort or training.

Outcomes and effectiveness of video tutorials. Video tutorials were distributed to faculty members in Spring of 2006. To evaluate the effectiveness of video tutorials to support the integration of AT for faculty, a post-only design was used and these results are presented in Table 3. Twelve surveys were sent to full-time and adjunct faculty who used the tutorials and nine were completed and returned for a response rate of 75%. Faculty and instructors who used the tutorials for a year were asked to complete a 20-item survey

Table 3
Results of Video Tutorial Evaluation Survey

Satisfaction with Video Tutorial	*N*	*SD*	*M*
Overall Satisfaction with Video Tutorials	9	.17	4.89
Satisfaction with Components of Video Tutorials	9	.17	4.89
Usefulness of Video Tutorials	9	.00	5.0
Benefits/Effects of Using Video Tutorials	9	.36	4.72
How Video Tutorials were Used	***N***	***N* of faculty using this method**	**% of faculty**
Candidates viewed tutorials independently without hands-on practice	9	1	11
Candidates viewed tutorials independently followed by hands-on practice	9	7	78
Tutorials were shown through a projector without hands-on practice	9	1	11
Tutorials were shown through a projector followed by hands-on practice	9	6	67
Used tutorials to practice skills prior to demonstrating in class	9	7	78
Other: Used video tutorials for students to make up assignments if absent	9	1	11

Scale for satisfaction: 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly agree. Responses for how tutorials were used = yes/no

to evaluate the video tutorials and their components.

The first 13 items of the survey included statements about the video tutorials and faculty were asked to indicate their agreement/disagreement with each statement using a 5-point rating scale (1 = strongly disagree; 5 = strongly agree). Rating scale items were categorized into four subscales for analysis and included: (a) Overall Satisfaction with Tutorials (3 items); (b) Satisfaction with Components on Tutorials (i.e., overview videos, critical content videos, short tutorials, and resource section; 4 items); (c) Usefulness of Tutorials (3 items); and (d) Benefits/Effects of Tutorials (2 items). Six additional items, five of which required a yes/no response, asked faculty to indicate how they used the tutorials with teacher candidates. The sixth item was listed as 'Other' and required a written response. These six items were included in the survey to determine how faculty used the tutorials to present AT in their courses. The final item on the survey was an open-ended question asking faculty to provide feedback and suggestions for improvement. This information was used to refine the tutorials and all comments were coded as being 'positive,' 'negative,' or 'constructive.'

Results of video tutorials. Of the nine faculty who completed the survey, all agreed or strongly agreed that they were satisfied with the tutorials and found them useful and beneficial for teaching preservice educators to use AT. For the first and second subscales, Overall Satisfaction and Overall Satisfaction with Components of the Tutorials, respectively, most faculty strongly agreed that they were satisfied with the tutorials (M = 4.89 on a 5-point scale). All faculty strongly agreed the video tutorials were useful (M = 5.0), and most indicated they were beneficial and effective (M = 4.72).

When asked to indicate how they used the tutorials, the majority of faculty (78%) indicated that they required candidates to view the tutorials independently followed by hands-on practice with the technologies. Seventy-eight percent also indicated they used the tutorials to practice their own skills prior to demonstrating in class. Sixty-seven percent of faculty used the tutorials by projecting the videos on to a screen in class followed by hands-on practice. Only one faculty reported requiring students to independently view the tutorials outside of class and projecting the videos in class without hands-on practice; however, this faculty member reported that this only occurred in courses in off-campus locations. Only one faculty reported using the tutorials for make-up sessions when students missed in-class demonstrations. Most faculty reported using the tutorials in more than one way. The most common combination reported by 56% of faculty involved requiring students to view the tutorials independently followed by hands-on practice, projecting the videos on screen during class followed by hands-on practice, and reviewing the tutorials independently prior to demonstrating them in class.

Faculty provided a total of 11 written comments and they were coded as positive, negative, or constructive. Results indicated that 64% of comments were positive and included statements such as, "The tutorials were extremely useful," "These videos were a great supplement to the content of the course! I don't think I could have covered AT in my course without these," or "I used these for two courses and they were wonderful. The students loved them!" One faculty provided a negative comment (9%) stating that, "Some of the videos seemed a little dark." The remainder of the comments were coded as constructive (27%) and included statements such as, "I recommend that students read the tutorial print before watching the video or having the print copies to follow along," or "Could you add a component where teachers, parents, and students talk about specific AT? They could explain how item works for them and how they use it." In general, faculty provided positive responses to using the video tutorials and continued to use them with students.

Discussion on use of video tutorials. Creating an interactive video-based product requires an incredible amount of time and dedication. Though time intensive to develop, video tutorials appear to be an effective tool for supporting faculty and for integrating AT into teacher education programs. Not all faculty are confident in their ability to use or demonstrate AT and the video tutorials provide them with an opportunity to demonstrate AT devices and software without fear of making an error in front of students. They also provide 'on-demand' refreshers for faculty who want to practice their skills prior to demonstrating in class. In addition, the tutorials have been invaluable for supporting new and adjunct faculty with limited or no prior exposure to AT. Without the video tutorials, professional development opportunities would need to be provided on an ongoing basis, which could also be time-consuming and potentially ineffective. Most important, results of previous research has also indicated that the use of video tutorials is an effective strategy for increasing the familiarity, comfort level, and perceived effectiveness of integrating AT into instruction for both special and general education majors (Van Laarhoven et al., 2008), which will hopefully increase the use of AT with their future students.

How AT is Integrated into the Teacher Education Program at Northern Illinois University

In order to integrate AT throughout the teacher education program, participating faculty engaged in curriculum mapping activities following the workshops to identify specific AT that supported or were relevant to content being taught in various special education undergraduate methods courses. The resulting document listed courses and their corresponding AT and thus displayed how AT would be integrated throughout the program. This matrix is available from the first author. All teacher candidates now are introduced to AT during early coursework and are later required to complete AT proficiency checkouts during early clinical experiences. Content on AT is typically introduced in class and followed by hands-on experiences in the AT lab. General education programs integrate AT across two or three courses whereas special education programs integrate AT across seven-eight methods courses across different content areas (e.g., collaboration, reading, multiple disabilities). Throughout the program, preservice candidates are expected to demonstrate proficiency of selected AT in several different courses and are encouraged to use AT in corresponding field-based experiences. Recent surveys of our special education candidates indicate that they are satisfied with how AT has been integrated throughout the program. Candidates reliably indicate that instruction on AT is important; they believed they were well prepared to use AT with students in classroom settings, and they were familiar with and comfortable using various AT (Van Laarhoven & Conderman, 2011).

Outcomes and Benefits

This purpose of this paper was to describe stages in the integration of AT into the curriculum of a teacher education program in the College of Education at Northern Illinois University. The multi-year initiative was comprised of multiple projects and strategies funded by several grants and support from the College of Education. The evolution of the strategies, from providing demonstrations in a variety of courses across the teacher education program, to development of tutorials to guide both faculty and their students was not pre-determined, and in fact, was the product of a recognizable cycle of innovation followed by evaluation and response in the form of more innovation.

The trials and tribulations experienced throughout the roughly 10 years of work summarized here yielded several important findings, including the repeated evidence that professional development that exposes faculty to AT and provides information and demonstration on its integration can positively influence perceptions of AT. All of the strategies, from a visit to the lab to a five-day workshop, enhanced familiarity and comfort with AT. We might infer from these findings that faculty with expertise with AT and a goal of promoting its integration can positively influence colleagues. However, the collective findings also suggest an ongoing reliance on the 'experts' to provide demonstrations and hands-on activities for the preservice educators in special and general education programs. This reliance was necessary because the novice faculty had not developed the level of proficiency with the AT necessary to demonstrate for their classes, and as a result, had not conceptualized hands-on assignments for their students. Thus, as has been demonstrated with in-service teachers, a change in attitude and disposition did not produce a change in actual practice.

The chronology of strategies concludes with video tutorials, which were designed to address the need for faculty (and students) to learn about and practice using AT outside of the classroom, and to provide activities that prompted the use of the important features of each tool or device. Reports by faculty indicated gains in proficiency and sustained independent use, presumably because the video tutorials were conveniently available and provided modeling and guided practice, along with actual exercises for using AT. The final step to address the integration of AT in teacher preparation programs was to distribute content and practice across the curriculum. This assures that programs are introducing AT content early and providing opportunities for candidates to develop knowledge and become proficient in using AT with students with disabilities in classroom settings.

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The Efficacy of Assistive Technology on Reading Comprehension for Postsecondary Students with Learning Disabilities

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Abstract: Despite the large increase of students with learning disabilities (LD) entering postsecondary institutions and the legislative emphasis on providing students with disabilities equal access to education, we have yet to develop comprehensive planning of accommodations for postsecondary students with LD in regard to assistive technology (AT). The purpose of this study was to provide empirical insight related to using AT to support reading comprehension in postsecondary students with LD. Participants were six postsecondary students with LD. A multiple baseline across participants design was employed to examine the effects of AT, specifically the ClassMate Reader, on reading comprehension. The data were analyzed to discern participant performance with and without the device, social fidelity, and acceptability.

Keywords: Assistive technology, Learning disabilities, Postsecondary students, Reading comprehension

*No financial interest or intellectual aid was provided by Classmate Reader and/or Human Ware, Inc. to support this study.

Changing workforce demands have created an environment in which postsecondary education has become a necessity for students with LD (Eckes & Ochoa, 2005; Madaus & Shaw, 2006). In addition, the National Center for Educational Statistics (2000) reported that students with disabilities graduating from college demonstrate employment rates and yearly salaries comparable to their colleagues without disabilities. Beyond the mere financial motivation, students with LD are striving for increased self-esteem and improved quality of life by demanding access to and success at the postsecondary level (National Council on Disability, 2003).

The number of students identified with LD entering higher education has increased markedly (see e.g., Stodden, Conway, & Chang, 2003), and these students constitute approximately 2% of the total undergraduate population in the U.S. (Vickers, 2010). According to Sparks and Lovett (2009), one of the possible explanations for this increase is the range and variability of services available at the postsecondary level. However, there is noted concern in the disparity of services provided at the secondary level and eligibility for those same instructional supports at the postsecondary level. In K-12 settings, the primary focus is to provide supports to learners during instruction that allows for increased access to learning materials, increased engagement, and the demonstration of knowledge. Conversely, at postsecondary settings, the focus often is only to provide reasonable accommodations during assessment situations.

Recent legislation addresses these continuous and challenging issues. The reauthorization of the Higher Education and Opportunity Act of 2008 (HEOA; P.L.110-315) supports access, participation, and successful learner outcomes at the postsecondary level. HEOA seeks to provide strategies and innovation to improve transition of students from K-12 to postsecondary settings, as well as bolstering instructional support services to postsecondary students with disabilities within their postsecondary environment. More specifically, the provision requires the development and implementation of effective transition practices, improved distance learning opportunities for students with disabilities through course design and strategy instruction, overall increased accessibility, and opportunities for persons with disabilities in postsecondary educational settings.

One variable which influences students' ability to succeed in postsecondary environments is reading comprehension. Students with LD face many challenges during their elementary and secondary educational careers, and these challenges persist into adulthood, thus influencing performance in postsecondary settings (Gerber et al., 1990; Heiman & Kariv, 2004; Vickers, 2010). Therefore, poor reading comprehension at the postsecondary level is likely to impede the performance and persistence of students with LD in their new learning environment.

Based on data presented in the National Assessment of Educational Progress (U.S. Department of Education, 2011), 64% of grade 8 students with disabilities scored in the below basic range in the area of reading. Further, in the National Longitudinal Survey – 2 (Wagner, Newman, Cameto, Garza, & Levine, 2005), it was found that more than 50% of secondary students with LD performed below the 16th percentile on reading comprehension measures. It is these same secondary students who enter postsecondary settings already at a disadvantage. Even though all students transitioning from secondary to postsecondary settings experience the same increased rigors and expectations, there is a greater risk of failure for students with LD given their inherent learning challenges (Lerner & Johns, 2012). With research supporting that LD persists throughout the life of the individual (Gerber et al., 1990; Roberts, 2008), the challenges and struggles that learners face with reading and reading comprehension at the secondary level are the same challenges and struggles they will face at the postsecondary level. With reading comprehension being a vital and integrated aspect of college coursework, students with LD are at a significant disadvantage than their typically developing peers in comprehending college-level textbooks (Warde, 2005). Therefore, students with LD will need support in postsecondary environments to improve their reading comprehension skills, and thus assist in success at the postsecondary level (Allsopp, Minskoff, & Bolt, 2005; Mull, Sitlington, & Alper, 2001; Trainin & Swanson, 2005). One promising accommodation for students with LD is assistive technology (AT) devices such as screen readers or alternative media.

AT and Postsecondary Education

Screen readers were originally designed for students who were blind or had low vision (Anderson-Inman & Horney, 2007). Since then, researchers have examined the technology as supports for students with other print-related disabilities (Elkind, 1998; Hecker et al., 2002; Olson & Wise, 1992). The use of screen readers or other text-to-speech software has led to increased reading comprehension performance for students with the weakest reading skills (Elkind, Black, & Murray, 1996). There is swelling support for the use of screen readers and other forms of electronic text to assist students performing below grade level in reading (Castellani &

Jeffs, 2001; Edyburn, 2000; Raskind, 1994; Welch, 2010).

Several studies have examined the use of alternative media for improving reading comprehension for students with LD at the postsecondary level. Raskin and Higgins (1995) examined the effectiveness of speech synthesis on the proofreading aptitude of postsecondary students with LD. Students improved their proofreading skills by demonstrating an increase in identification of errors when using this alternative media versus relying on a human reader or proofreading with no assistance provided. This study was followed by Elkind et al. (1996) who examined the effectiveness of using speech synthesis during reading tasks on reading performance for postsecondary students with dyslexia. Their results showed participants not only demonstrated improved reading rates and comprehension, but also increased their ability to sustain attention while reading.

A multi-year study on AT for postsecondary students with LD was conducted at the Center on Disability (Higgins & Raskind, 1998). Higgins and Raskind examined the use of optical character recognition and speech synthesis and their compensatory value in addressing reading comprehension difficulties for 37 postsecondary students with LD. The findings demonstrated an increase in performance for the students with the lowest silent reading scores. That is, the students with the lowest silent reading scores improved most with the use of the technology support.

In 1998, Elkind investigated the effectiveness of a supported speech software program, *Kurzweil 3000*, on the reading performance of postsecondary students with LD. Twenty-six students completed reading comprehension tests, one with the use of the *Kurzweil 3000* and one without the software. The findings revealed that students who had lower reading comprehension scores had greater benefit from the use of the technology than those students who had higher reading comprehension scores.

Furthermore, Hecker, Burns, Elkind, Elkind, and Katz (2002) examined how the use of *Kurzweil 3000* influenced the reading performance of 20 postsecondary students with the primary diagnosis of attention disorder. Of the 20 students, five were also identified as having reading disabilities. Although there were several variables measured, of importance to this study is the influence on reading comprehension. Although gains were noted among individuals, there was not a statistically significant improvement in reading comprehension for all participants in the study. However, students with the lowest comprehension test scores had noticeable improvements from use of the *Kurzweil 3000* software.

Due to the unique reading challenges of postsecondary students with LD, it is imperative that the most versatile and portable AT be available to these learners. Designing the most effective and innovative accommodations are critical so that students with LD are not denied full benefit from their postsecondary program of study. As instructional technology, AT, and alternative media options in our society continue to advance, so should the breadth and appropriateness of accommodations that are afforded to students with LD. Although the use of AT to support reading at the postsecondary level an area of key importance in supporting students with learning disabilities ability to persist to graduation, there have been few empirical studies to investigate this phenomenon at that the postsecondary level.

Purpose

Although researchers and educators alike have witnessed the increase in students with LD entering postsecondary settings, support for the reading and comprehension of printed material is widely unsupported at the postsecondary level. The primary purpose of this study was to examine the efficacy of AT, specifically *ClassMate Reader* (HumanWare Group, 2005-2012), on the reading comprehension performance of postsecondary students with LD. The secondary purpose was to examine whether *ClassMate Reader* is perceived as socially acceptable by participants and if participants would use *ClassMate Reader*, if made available in the future.

Method

Participants

All participants were served in the Supporting Transition and Education through Planning and Partnerships Program (STEPP) at a public university in the southeastern region of the U.S. The program offers comprehensive academic, social, and life-skills support to students with identified Specific Learning Disabilities who have shown the potential to succeed in college, but would have difficulty doing so without significant educational supports.

Six participants, four males and two females, were selected for participation in this study after an initial screening by the STEPP Director. To be eligible for the study, students within the STEPP Program had to been (a) already identified as having a learning disability via the screening process acceptance into the STEPP Program, and (b) demonstrated challenges in the area of reading comprehension. From the initial screening, eight students were identified.

The researcher met with each individual interested in participating and presented perceived risks and benefits of the study. Further, the researcher discussed the time commitment needed to complete the study. From these meetings, six students volunteered to participate and were asked to sign Informed Consent. Each participant provided specific learning disability documentation from their school system as well as confirmation of his or her present reading level at the onset of the study. The reading comprehension scores of the participants ranged from 5th grade to 8th grade, as measured by *The Basic Reading Inventory* conducted by Project STEPP Director prior to the onset of the study. The participants ranged in age from 19–22 yrs of age and had class ranks from freshman to junior level.

Annie. Annie is a 20-yr-old Caucasian female diagnosed with dyslexia. Although she has three accommodations available to her, she reportedly does not use the accommodations. She was first identified at age seven as having both a learning disability and attention deficit hyperactivity disorder (ADHD). To assist with the attention and concentration challenges, Annie takes medication daily. Her current full-scale IQ score, as determined by the *Wechsler Adult Intelligence Scale – III*, was 90. Her instructional reading level was determined to be at the 5th grade level based on her performance on *The Basic Reading Inventory* prior to the beginning of his study.

Colin. Colin is an 18-yr-old Caucasian male diagnosed with a learning disability. His current full-scale IQ score, as determined by the *Wechsler Intelligence Scale for Children – III*, was 121. His instructional reading level was determined to be at the 7th grade level based on his performance on *The Basic Reading Inventory* prior to the beginning of this study. Of the three accommodations available to him, Colin only uses extended time for taking his tests.

Jeff. Jeff is a 19-yr-old Caucasian male diagnosed with a learning disability. His current full scale IQ score as determined by the *Wechsler Intelligence Scale for Children – III* was 109. His instructional reading level was determined to be at the 8th grade level based on his performance on *The Basic Reading Inventory* prior to the beginning of this study. Jeff's accommodations include extended time, note taker, and a low distraction-testing environment.

Hugh. Hugh is a 19-yr-old Caucasian diagnosed with a learning disability, anxiety disorder, and ADHD for which is he currently taking medication. He has been assigned extended time, note taker, low distraction testing environment, and a word processor for essay exam by disability support services. As determined by the *Wechsler Intelligence Scale for Children – IV*, his current full-scale IQ score was 98. As measured by the *Woodcock-Johnson III*, his grade equivalent for reading fluency, word attack, and reading comprehension were 14.1, 11.6, and 13.0 respectively. His instructional reading level was determined to be at the 8th grade level based on his performance on *The Basic Reading Inventory* prior to the beginning of this study.

Sabron: Sabron is a 19-yr-old Caucasian freshman diagnosed with a learning disability and ADHD for which he is taking medication. Disability Support Services has assigned Sabron extended time, note taker, and a low distraction environment for testing as his accommodations for the current school year. His full-scale IQ score, as determined by the *Wechsler Intelligence Scale for Children* – IV, was 117. His instructional reading level was determined to be at the 5th grade level based on his performance on *The Basic Reading Inventory* prior to the beginning of this study.

Joanna: Joanna is a 22-year-old Caucasian junior diagnosed with a learning disability and dyslexia. Her current full-scale IQ score, as determined by *the Wechsler Intelligence Scale for Children – III*, was 99. Her instructional reading level was determined to be at the 5th grade level based on her performance on *The Basic Reading Inventory* prior to the beginning of this study. Disability Support Services has assigned extended time, low distraction environment, word processor for essay exams, and a reader for exams as Joanna's accommodations.

Setting

The research venue was the AT Lab located at the participating university where the participants were currently enrolled. Within the AT Lab, there are five pods housing 27 computers. A conference table, as well as a reception area, is located near the entrance of the lab. A separate study room is located directly across from the reception area. Collection of data for this study occurred in the separate study room that was visible to the researcher, but provided a barrier to assist with noise reduction. All materials and collected data were stored in a locked cabinet within the AT Lab.

Instructional Materials

ClassMate Reader. The specific AT device used in the study was the *ClassMate Reader* developed by HumanWare, Inc. (2009). The *ClassMate Reader* is a portable text reader designed to promote reading and learning independence. Students can listen to the audio version of text or other materials while following the highlighted text on screen. More specifically, the touch screen or navigation buttons can be configured to a participant's preference (e.g., color, font type and size, line spacing, text speed). The *ClassMate Reader* files can be stored on a removable Secured Digital (SD) memory card. It is compatible with National Instructional Material Accessible Standard (NIMAS) format, Digital Accessible

Information System (DAISY), Bookshare.org, and .txt files.

The *ClassMate Reader* allows students to modify/adjust the rate at which the text is read the volume of the reading, and the highlighting features to meet their needs. The color of the text, font style, and highlighting colors can be changed to address the students' preferences. Further, there is an on-screen dictionary that allows for immediate retrieval of word meaning and pronunciation. Setting preferences can be changed during text reading with a simple touch of the screen. The hardware features of the device include a net weight of 10.7 ounces and dimensions of 3.54" x 6.1" x 0.98." The device uses Nuance Vocalizer human-sounding voice for the built-in text-to-speech (TTS). The full color-reading screen is 2" x 3." The only aspect of the device that was utilized was by one participant in which she changed the color of the text. Participants reported that they did not use the on-screen dictionary.

Reading passages. A pool of 15 standardized reading passages at the 11th grade reading level was utilized given that the textbooks used by participants in the college coursework had readability scores at the 11th grade reading level. The SAT Critical reading passages published by Major Tests at www.majortests.com (Mathur, 2010) served as a resource for reading passage selection. All passages used during baseline were produced in printed form and then these same passages were converted to a *.txt* file for use during intervention. Each reading passage was expository text, approximately 400 - 600 words in length, and described a unique topic. The length of the passages did not vary across phases.

Measures

Reading comprehension. Tests were administered to each participant to obtain repeated measures for each condition. A pool of 15 reading passages at the 11th grade level was utilized for all comprehension measures. Each reading passage contained a reading comprehension measure consisting of six to eight questions that addressed factual, main idea, prediction, purpose, or clarifying questions. A percentage score was calculated for the number of correct answers to the six to eight questions on each test. The number of correct answers divided by the total number of questions and multiplied by 100 was the formula used for the percentage score.

Social validity measure. A Student Exit Interview consisting of five questions each formatted with a five-point Likert-type scale, ranging from '1' (*strongly disagree*) to '5' (*strongly agree*) and three open-ended questions were used to assess the social validity of the intervention. The survey items required the participants to rate their attitudes about reading, the use of the *ClassMate Reader*, and the potential for further utilizing *ClassMate Reader* in their coursework, if made available. In addition, the three open-ended questions were conducted individually with each participant and the researcher. Open-ended responses were analyzed qualitatively using the constant comparative methods described by Glaser and Strauss (1967). This survey was administered at the completion of the study and lasted no longer than 30 min.

Research Design

The design for this study was a multiple baseline across participants design. In a multiple baseline across participant design, each participant begins baseline at the same time and the independent variable is systematically presented to each participant in a sequential order (Kennedy, 2005).

The order of reading passages was counterbalanced across participants between baseline and intervention phases. This design allowed for within-individual comparisons and provided an opportunity for each participant to have access to the *ClassMate Reader*, a potentially beneficial source of support.

Dependent Variable

The dependent variable was the percentage correct on reading comprehension measures. Upon completion of the comprehension measure, each participant's score was converted into a percentage.

Independent Variable

The presentation of the comprehension quiz varied from baseline to intervention. This research study examined the variation in comprehension scores when the participants (a) read and completed the comprehension quiz without any supports other than the traditional paper/pencil format (baseline); and (b) utilized *ClassMate Reader* for both the reading and completion of the comprehension quiz (intervention). Therefore, the independent variable for this study was the implementation of the *ClassMate Reader* to assist with the reading of the passages and the comprehension measures.

Procedure

General procedures. All sessions occurred in the AT lab. Each participant participated independently, and provided his or her participant ID to the research assistant who then supplied the student with the randomly assigned reading passage and reading comprehension measure. The participant sat in the separate study area in the lab. Each session required the participant to independently read a passage and complete a reading comprehension measure in paper format during baseline or with the aid of the *ClassMate Reader* device during the intervention phase. Each session required approximately 30 min of student participation.

Regardless of the condition, the scoring sheets were the same. After completing the measure on the scoring sheet, participants were prompted to provide their perceived score on the present measure as well as indicate any changes made to the device during the reading of the passage or test completion during the intervention condition. The time of day for the sessions varied across participants. Although the times varied across participants, each participant's session time of day remained constant throughout the study. Verbal reinforcement was given at the end of each session, but only with regard to the participants' commitment and participation. Participant performance on comprehension measures was not scored in view of a participant. Comparisons of their perceived performance noted on the participant's scoring sheet and their actual performance were recorded for all tests.

Baseline. The participants were given a reading passage at the 11th grade instructional level in a paper format. Each participant independently read the passage in text format and was provided as much time as necessary to read the passage. He or she was instructed to read the passage in their preferred manner (e.g., silently or aloud). After reading the passage, the participant returned the reading passage to the research assistant and was given a paper test and answer sheet. No additional instructional prompts or feedback were provided. The participant was not given access to the reading passage during the completion of the reading test. Upon completion of the test, the participant returned the test to the research assistant who confirmed the next appointment day and time and thanked the participant for participation. Out of view of any participants, the researcher scored and recorded the percentage correct on the test. Then a research assistant conducted a reliability check.

Intervention. When the participant's baseline data became stable, group training on the use the *ClassMate Reader* was conducted. The director of the AT Lab at the participating university gave the group training. The *ClassMate Reader* training session lasted 55 min in length. Participants were shown how to open and play reading passages saved to their device. The researcher observed the training and completed a Procedural Checklist to ensure all key elements of the *ClassMate Reader* were addressed.

The training was an interactive demonstration of the features of the device. Participants were provided a handout of the *PowerPoint*™ presentation utilized during the training. Each participant was assigned a device during the training so that the device could be set during the training based on his or her preferences. Participants were shown basic features of the device (e.g., power, accessing materials, and dictionary use) as well as elements that would allow for individualization (e.g., highlighting features, rate of reading, font size). The format of the training was to demonstrate a particular feature or function of the device, then requesting the participant to replicate the demonstration immediately with assistance as needed. At the completion of the training, each participant was asked to demonstrate his or her ability to independently navigate the device. All participants successfully completed all items on the Competency Checklist at which point the training ended.

In subsequent intervention sessions, the participants were provided with an 11th grade reading passage on the *ClassMate Reader*. The participant asked the researcher or research assistant to locate his or her assigned *ClassMate Reader* device. The researcher or research assistant verified that the device was working properly and inserted the appropriate SD Card for the participant. After verifying the correct reading passage, the researcher or research assistant then left the study room. After reading the passage with the use of the *ClassMate Reader* device, the participant requested the reading comprehension test from the researcher or research assistant. The test was presented on the *ClassMate Reader*. The *ClassMate Reader* read the questions to the participant who completed the scoring sheet with paper and pencil. The participant was not given access to the reading passage during the completion of the reading test. The participant completed one reading passage comprehension test per session. Participants remained in the intervention phase until a percentage of 80% or greater had been achieved on two reading comprehension tests.

When participants met intervention exit criteria (i.e., 80% on two comprehension tests), they were scheduled for an exit interview with the researcher. During this interview, the researcher provided an overview of their performance (e.g., scores with and without the device, comparison of perceived and actual scores). Following this overview, the participant provided responses to the Student Exit Interview questionnaire via a speech recognition software program, *Dragon Speak*™ (Nuance Communications, Inc., 2009). After the interview, the participants were presented with a collection of gift certificates to local businesses in appreciation of their participation.

Inter-observer Agreement

Inter-observer agreement data was collected for each participant by a trained second observer during a minimum of 40% of the sessions for each participant across phases. Two scorers independently scored each reading comprehension measure. An agreement was tallied if both scorers recorded the same score. The percentage of agreement was calculated by dividing the number of agreements by the number of disagreements plus disagreements and then multiplying by 100. A minimum percentage score of agreement must meet 90%. A total of 50% of all reading comprehension tests were selected and checked for accuracy of scoring. There was 100% agreement on the scores given on comprehension tests.

Procedural Fidelity

The research assistant observed and recorded independently and simultaneously on the researcher's implementation of intervention procedures using a prepared intervention protocol data sheet. Procedural fidelity was assessed for each participant in 100% of the sessions across phases. Procedural reliability was calculated by dividing the number of agreements by the number of agreements and disagreements and multiplying by 100%. Across all phases and all participants, procedural fidelity was followed in 99% of the sessions. Interrater agreement of procedural fidelity was calculated for 50% of sessions. Results indicate a 100% agreement of treatment fidelity for the study.

Results

Effectiveness

Figure 1 presents the percentage of reading comprehension questions correct across all participants as well as individual participant's data graphs with trend lines. A visual analysis of data showed an accelerating trend for the six participants in their performance only when the intervention was introduced.

Annie showed both low and declining test performance during baseline (M = 54.00%, n = 3), with a great measure of variability during the intervention phase. Colin's baseline phase M was 44.75%, with a downward trend being noted (n = 4). Three of his highest scores occurred in the intervention phase (n = 4), even with some variability being noted. Hugh's mean score during baseline was 54.2% with a downward trend noted (n = 5). Once in intervention, Hugh demonstrated a clear upward trend after the initial session with the device (M = 78.13%, n = 4). His final three data scores indicated a mean of 83.3%. During baseline, Joanne showed variability, but ultimately presented a downward trend in performance (M = 37.50%, n = 4). Once in intervention, she scored her five highest test scores, even with variability again being noted. Jeff's baseline demonstrated a downward trend with an average comprehension test score of 36.7% (n = 4). An immediate effect of intervention was noted, with a 42-point improvement in his first intervention comprehension test. Further, his three highest test scores occurred during intervention. During baseline, Sabron demonstrated variability in his test performance, but once the intervention was introduced, he steadily increased his test scores on all but one concurrent session during the intervention phase. Only a slight increase in his trend line was noted from baseline to intervention phase.

Further analysis consisted of calculating a percentage of non-overlapping data points (PND). Given that the intervention for this study was designed to increase target behavior (i.e., reading comprehension test scores), the PND procedure was used to determine the percentage of all data points during intervention which fell above the highest baseline data point. When evaluating the effectiveness of an intervention, PND scores above 85% suggest a highly effective intervention; scores between 65% and 85% suggest a moderate intervention, and scores below 65% may indicate marginally effective intervention. Therefore, Colin, Joanna, Annie, and Jeff's percentages suggest a moderate intervention effect. Hugh's percentage would suggest this intervention was only marginally effective for him, while Sabron showed no benefit from the use of the device.

Improvement rate difference (IRD) was calculated for each participant and were reported as percentages. An IRD score of 100% would indicate that all data points during the intervention phase exceeded all baseline data points. Therefore, the closer the IRD value is to 100%, the more effective the intervention (Parker, Vannest, & Brown, 2009). Under this measure of effect, Colin and Jeff demonstrated improvement rates of 50% that suggest a moderate effect of the intervention. Joanna and Annie demonstrated slight improvement rates with scores of 19% and 17% respectively, with Hugh and Sabron showing limited difference in the improvement rate across phases with a score of 10% and 7%, respectively. Thus based on these results, the intervention achieved mixed benefits with some students performing better with the use of Classmate Reader whereas others demonstrating slight improvements.

Social Acceptability and Validity

After the study concluded, most students reported that the use of *ClassMate Reader* aided their performance on the comprehension quizzes and they would use the device to assist with their coursework if the device were available to them. Conversely, only 16.7% felt their performance was aided most in the traditional format of paper/pencil alone. In addressing the participants perceptions of their comfort with the device, five out of the six participants agreed with the statement that they would feel comfortable using *ClassMate Reader* around their peers.

Five concerns emerged from the anecdotal comments by participants related to the social acceptability and validity of the device: portability, time benefit, ability to proofread, increased memory, and technology as a benefit. The most prevalent concern centered on the portability of the device. For example, participants discussed the benefit of having a device that can "just be thrown in my book bag." As one participant stated, "This thing is so little. I can throw it in my purse and have it available when I have a few minutes. I cannot do that with my laptop." Another noted, "I can still get done what I need, but it is easier for me to carry the Classmate around versus an entire computer."

A second concern reflected the time benefit of using the device. For example, five of the six participants discussed how time intensive reading material for class was for them. Each of the five discussed having to "read material over and over" to retain the information. One participant stated that, "My reading is so slow that I know I miss stuff, so I go back and read and read. When I listen, I still get it, but it don't take as long." Another participant noted that the device would assist in both time for reading as well as time management when stating, "The fact I read slow – I get it. This device takes that pressure off and so I feel like the time I save struggling with the reading or procrastinating to not read will help with my overall time management."

A third concern that was expressed by four of the six participants was the additional benefit of the device to have the ability to proofread their work before submitting an assignment. For example, one participant stated,

> I am a slow writer too and so by the time I finish, I don't wanna mess with reading it over, so I just turn it in. This thing will let me listen to my assignment and I can check for errors without looking at the paper.

A fourth concern related to the helpfulness of both seeing and hearing the information was to their ability to recall information. One participant stated, "When I hear it, I can remember it – so I know that helps. I mean it

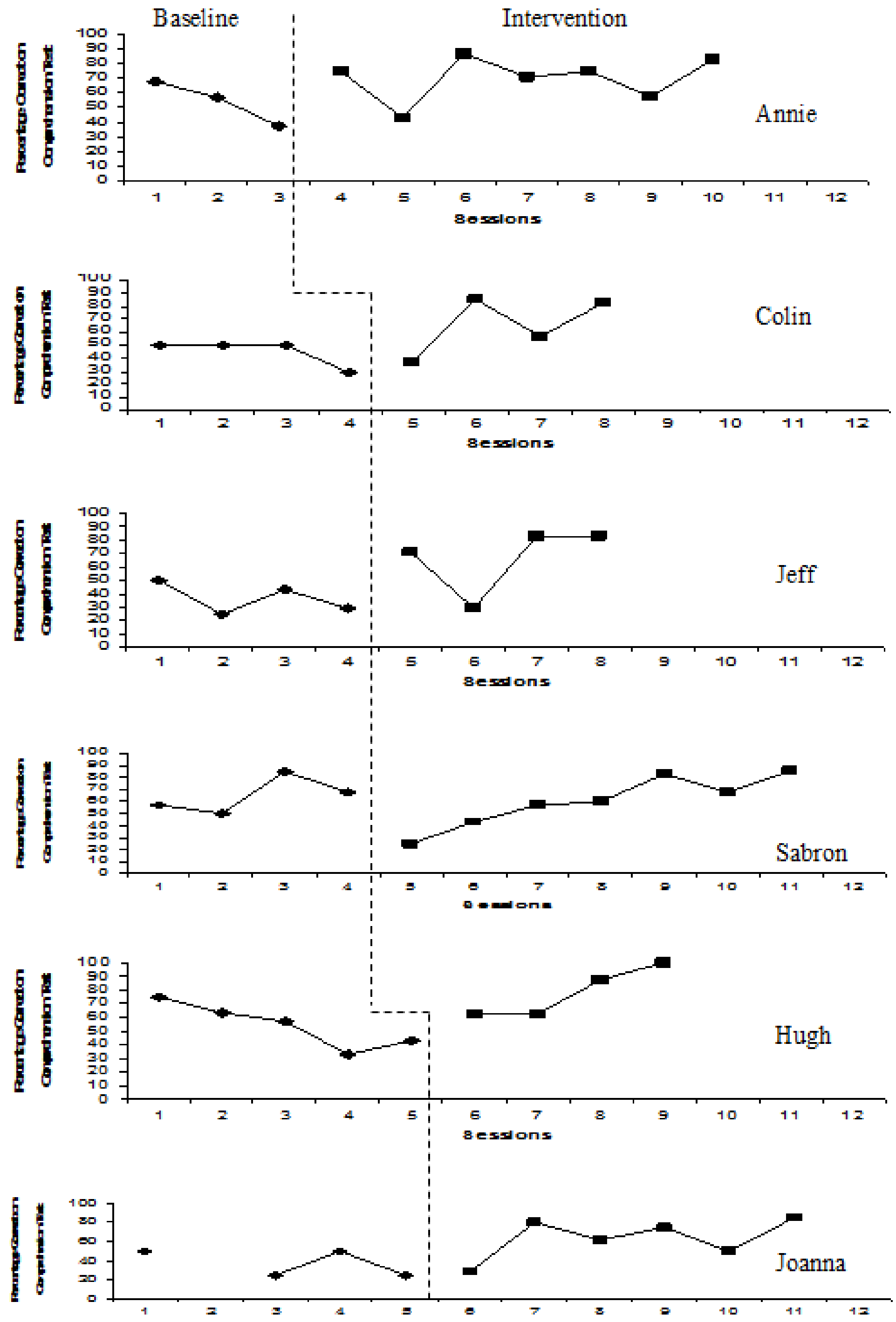

Figure 1. Percentage of reading comprehension questions correct across all participants.

has to give me some help, you know." Another participant is keenly aware of the challenge of his disability and notes the challenge that reading fluency may play in his ability to remember information by stating: "I am fighting to decode and sound out, so I lose the mental image. When I hear it, I can also see it and that helps me remember what I have just read."

A final concern reflected technology as being a benefit to these participants. Three of the six participants felt that technology aided their learning in ways that are separate and unique from the assistance of people as evidenced in one participant's thought that "I would much rather rely on technology than people. My laptop and this thing have not shown up or given me wrong information." Additionally, another participant noted, "I have found that technology has been a life saver for me. I need to have technology to support and combat, I guess, my struggles that come from my dyslexia."

Discussion

Although this study specifically sought to ascertain the effectiveness of *ClassMate Reader*, outcomes illustrate that AT can be a viable support at the postsecondary level. The relevance of such information parallels the fact that most frequent accommodations for postsecondary students with LD is testing accommodations (e.g., extended time, read aloud, separate setting). There is much research needed to effectively meet the educational needs of postsecondary students with LD as it relates to the reading and comprehension of printed material.

Effects of ClassMate Reader

Carson, Chase, Gibson, and Hargrove (1992) found a postsecondary student's ability to read is of vital importance for academic success as reported by both faculty and students. In this current study, it was hypothesized that the use of the device would aid in reading comprehension performance, given that the device would read aloud text to the participant, thus removing the barrier of participant's independent reading ability. Removal of this barrier allowed for the demonstration of their knowledge, which is the essence of an effective accommodation (McKevitt & Elliot, 2000).

The results of this study mirror the findings that AT is a viable support for postsecondary students with LD in completion of reading comprehension tasks (e.g., Elkind et al., 1996; Hecker et al., 2002; Higgins & Raskind, 1998). In the previous studies, benefit was noted when reading performance with the use of Kurzweil was compared to similar reading performance without the aid of the text-to-speech software. One noted difference from these studies is that not all participants demonstrated improvement. This was not the case for the current study, given that all participants, regardless of their reading ability, performed at a higher skill level with the support of the device. For example, only one of the participants was able to score above an 80% on the reading comprehension test without the aid of the device. Conversely, all participants achieved two scores of 80% within a maximum of seven trials when utilizing the device. Clearly, these participants were better able to demonstrate their comprehension abilities with the device than without it. These observations are further supported by the fact that several different metrics demonstrated positive intervention for most participants.

It was of interest that none of the participants demonstrated apprehension of using new technology. Perhaps the participants, being natives of the technology generation, could explain this. Further, prior to the onset of this study, only one participant took advantage of text-to-speech capabilities, yet all participants were aware of computerized speech and quickly grew accustomed to the didactic presentation of text. Commonly, AT is often viewed as being primarily for students with more significant disabilities; therefore, this study further extends the literature as to the feasibility of providing AT for students with mild disabilities such as LD. With a clear trend reversal noted in all participants during the intervention phase, the findings of this study support the conclusion that the use of

ClassMate Reader does benefit some postsecondary students with LD.

Social Validity

Measuring the student's perceptions of their performance with and without the device, as well as the acceptability of using the device around their peers, were other measured outcomes of the study. Without knowing reading performance outcomes on the reading comprehension tests, five of the six participants felt the device aided their performance on the reading tests. This clearly demonstrates their confidence in the effectiveness of using such a device. Likewise, five of the six participants answered that they would feel comfortable using the device around their peers. With some research suggesting that one of the strongest indicators of AT abandonment is peer acceptance (Dickey & Bowman, 2004; Parette & Scherer, 2004), this high social acceptability is very encouraging for the likelihood of continued use.

Of further significance was that all but one participant would be willing to use the device for future coursework, if made available. Three participants have already placed requests with the AT Lab director for use of the device in their courses. Participants felt that having both the visual and oral presentation of the material would assist them in both the reading of material, but also a proofreading aid to their own work. Additionally, participants discussed how seeing and hearing the text would help with long-term memory. Without the device, the participants mentioned that they would struggle with simply reading the words and that the text was often quickly forgotten. This device would provide them with the support they need to have material presented in such a way that they can glean meaning and interact cognitively with the material more easily.

Beyond the realization by participants that this technology was beneficial, was the belief in technology as a tool to academic success. Each participant had a minimum of three accommodations afforded to him or her through disability services. Only two actually took advantage of those accommodations. However, all participants use various forms of technology to support their coursework (e.g., *DragonSpeak*™, *Pulse Smartpen*™, and *Natural Reader*™) which were not provided through disability support services.

All participants shared that they recognized the importance of reading at the postsecondary level. This realization ties to the expectation of increased literary competence at the postsecondary level held by both faculty and students. In support of this realization, five of the six participants indicated that having assistance with reading comprehension was vital to their success in college. Further stated, their perception was that ongoing reading support was a necessity, not a luxury.

Limitations and Future Research

There are several limitations to this study that should be noted. One limitation is the small sample size. Although a small sample size is appropriate for single subject research designs, only six students were involved. Further, the specific deficits and learner characteristics of the participants within the study may limit the ability to generalize the findings to a larger disability set. Replication with more participants and participants with different skill levels will be beneficial in understanding the use of *Classmate Reader* to improve reading comprehension performance.

To address external validity, experimental conditions were replicated across participants and materials. Lack of ethnic diversity of the participants may also limit the ability to generalize the findings to a larger population. Further, this study was comprised of a convenience sample of students who volunteered for the study. These students were a subgroup of the STEPP Program that represents a very unique group of learners that limits the external validity as well.

To address internal validity, possible maturation effects were compensated for by each participant completing the study within the same time frame. Given that each comprehension measure was unique, there was limited influence of testing effects. Yet, there may be a risk of variability in the results across the reading samples due to inherent differences in the samples. To mitigate this possibility, however, samples were randomly assigned across participants. Instrumentation effects were addressed by requiring the researcher or research assistant to perform a maintenance check on each *ClassMate Reader* prior to its use by participants.

To address the potential for interaction among participants, the use of a text passage and test bank was utilized. The duration of the study was a limitation in that the study lasted for only six weeks. Although extending the study in this instance was not feasible due to program requirements of STEPP in which participants were involved, a lengthier study would provide evidence of sustainability of the participant performance. Current findings need to be viewed in light of the above limitations, thus caution is advised in generalizing these findings to populations involving LD.

The need for further examination of avenues in which to increase the carryover of successful accommodations and AT from secondary schools to postsecondary institutions is needed. Careful and systematic review of documented accommodations and AT that aligns with the student's skill deficits should provide a clear description of needed supports in settings beyond high school. Future research should include the investigation of other products available such as smartphone apps, *Pulse Smartpen*™, and *Natural Reader*™ to see if similar results are achieved. Future research should also include examination of students' participation in IEP meetings at the secondary level to determine if their participation better prepares them to effectively self-advocate once they enter postsecondary settings. By providing a succinct and direct process, the student will gain skills needed to navigate the challenges of self-advocacy in a straightforward and consistent framework.

More information is needed on the influence exerted by postsecondary faculty on the educational success of students with LD at the postsecondary level. The empirical body of research needs to be expanded in order to provide such directives to postsecondary faculty. Once strategies, accommodations, and technology are established, faculty must be trained and supported as they work toward including effective practices into their classroom environments. Just as faculty are encouraged to learn the elements of effective instruction in distance learning environments, the same effort must be placed into providing classroom instruction focused on research-based instructional strategies and technologies that benefit postsecondary students with LD.

Conclusions and Implications

The results of this study provide support for the use of the *ClassMate Reader* to improve the reading comprehension performance of postsecondary students with LD. This is an initial step in addressing the academic challenges students with LD face at the postsecondary level.

Recognizing the current state of support for students with LD at the postsecondary level, there is a need for mandated examination of effective intervention practices for this population. Therefore, with the current passage of the HEOA, the timeliness of this research is without question. From the findings of this study, it is evident that AT provides a viable option for these students.

Postsecondary institutions have the luxury of being exempt from Copyright Act by the Chaffee Amendment (1996). This exemption is afforded to nonprofit organizations or governmental entities for the purpose of training or education (Wolfe & Lee, 2007). Postsecondary institutions can capitalize upon this opportunity to convert print materials into alternative media formats as well as encourage publishers to provide textbooks and other instructional materials in alternative media formats. As more alternative media materials become available through government initiatives (e.g., NIMAS; NIMAC), research agendas must be developed to ascertain the most effective format for assisting students with LD across skill areas.

Postsecondary disability support personnel must be kept abreast on the use and benefits of AT for students with LD. By doing so, appropriate supports and services can be made available to students upon entering the postsecondary environment. By providing appropriate AT to assist with the completion of coursework, in conjunction with supports during testing situations, this dual effort may combat the high attrition rate experienced by students with LD at the postsecondary level.

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