Assistive Technology Outcomes in a Teacher Education Curriculum

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Abstract: This article describes a comprehensive assistive technology (AT) teacher preparation model designed to address both general education and special education or early childhood education students. National technology standards provide the context for the model that incorporates (a) an innovative component, consisting of web-based modules and hands-on experiences, designed to prepare general education teacher candidates; and (b) a traditional component, consisting of coursework and experiential activities designed to prepare special education and early childhood education teacher candidates. This report presents preliminary outcome data for 503 general education teacher candidates who used the innovative component. The data indicate that a majority of students (86.9%) using the two-stage innovative component achieved targeted knowledge and performance competencies. Recommendations are offered for expansion of the outcomes measurement system to include a range of both teacher and student outcomes and for expansion of the model to inservice training to general education and special education teachers.

Keywords: Outcomes, Benefits, Assistive technology, Higher education, Teacher education

Technology development and related societal changes, the standards-based reform movement, and legal mandates are propelling changes in the way we view the knowledge and practices teachers must have about technology on exiting higher education. Technology is developing both in terms of reduced cost, greater potential benefit and greater integration into home, work, and school settings. By 1997, 80% of children had used a computer at home or in school (Tapscott, 1998). The explosion of the computers, the Internet, and digital technology has, in turn, produced the 'Net Generation' (Tapscott, 1998). These children are "the first to grow up surrounded by digital media…that they think it is all part of the natural landscape (Tapscott, 1998, pp. 3-4). They are also more comfortable and have greater knowledge about the technology of our society than their parents and teachers. In addition, cultural, educational, and legal changes have increased the variety of students served in a typical elementary, middle or high school building (Rose & Myer, 2002). Today's schools are a mix of students from varied cultural and economic backgrounds of which some are making educational progress, some are not reading on grade level, some are gifted, some whose first language is not English, some have behavioral, attentional, and motivational problems, and some have sensory, communication, cognitive, emotional or learning disabilities (Rose & Myer, 2002).

Student outcomes have become a clear focus of national debate and action. Both the 1997 IDEA Amendments and The No Child Left Behind Act of 2001 (NCLB) have increased the focus on the academic outcomes of students with disabilities in the general education curriculum. At the same time, increased attention to determining and measuring meaningful outcomes related to AT is emerging as a national dialogue (e.g., Assistive Technology Outcomes Measurement System, 2003; Consortium on Assistive Technology Outcomes Research, n.d.). However, the preparation of today's teachers to utilize technology directly impacts

the potential for students to achieve meaningful outcomes through educational or assistive technology (AT) use. The number of students per computer in schools has declined from an average of 125 to 4.9, though the use of those computers varies widely (Lahm, 1996). The AT available to persons with disabilities has grown to over 25,000 assistive technology items, equipment and product services (Abledata 2000) and the IDEA Amendments of 1997 *require* that AT must be considered for use with an estimated 6.2 million students ages 6-21 with disabilities. However, the preparation of teachers to consider and use technology in general, and AT in particular, has demonstrated a varied response. Less than half of teacher preparation programs have stringent technology requirements and few preservice training programs include coursework or experiences on AT applications and issues (Lahm, 2003).

In response to these needs and trends, standards have been established for the preparation of teachers to use educational technology, in general, (ISTE, 2004a, 2004b) and for the preparation of special education teachers to use technology and AT, specifically (CEC, 2001; Lahm, 1996). These standards incorporate the principles of the standards-based reform movement in K-12 education (cf., McDonnell, McLaughlin, & Morison, 1997; Thurlow, 2000). Key elements of education include (a) goals, (b) indicators of success, (c) measures of progress, (d) reporting, and (e) consequences (Thurlow, 2000). The purpose of this article is to: (a) provide a description of the instructional and AT influences on teacher preparation curricula, (b) present an overview of a teacher preparation model to foster AT outcomes, (c) discuss preliminary results from the model, and (d) present future directions for the model.

AT Influences on Teacher Education Curricula

Consideration of AT outcomes for teacher preparation in higher education has been influenced by the emergence of *instructional technology*, by the emergence of state-delineated K-12 educational standards, and by the broadening of the conceptualization of what constitutes AT. These influences are briefly described in the following sections.

Instructional Technology

Instructional technology (IT), sometimes referred to as educational technology, has developed in response to demands to improve teaching, learning, and information management. Generally, IT focuses on six interrelated teaching processes: (a) planning instructional interventions; (b) preparing print, audio, video, or digital instructional materials; (c) instructing the relevant content (knowledge and skills); (d) managing student interests, materials, or data during instruction; (e) assessing student learning; and (f) extending instructional impact through maintenance and generalization procedures (Newby, Stepich, Lehman, & Russell, 2000). In a Concord, NH high school, students in the English class read *Catcher in the Rye* in either paperback or digitized text version; have prompted strategies to improve reading comprehension available in the digitized version if they need them; and synthesize important elements in a chapter, tie them to their own lives, and communicate this to classmates using videos, posters, animated scenes, written papers, oral reports, and collages (Rose & Myer, 2002). Developing such integrated use of IT in teaching has greatly impacted preservice teacher education programs and the development of standards for teacher education (ISTE, 2004b).

K-12 Standards Movement

At the same time that teacher preparation standards are developing in response to technology development, so too are the expectations for how students graduating from our nation's schools will use technology. The current K-12 educational reform movement began with the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983), and its specific concerns regarding the mediocrity of education in the U.S. Many rigorous responses ensued, particularly at state levels. For example, the Illinois Learning Standards (ILS) (Illinois State Board of Education, n.d.) define what students should know and be able to do as a result of their school learning experiences and reflect a new understanding of the role of technology in preparing students to successfully exit from public education. Beyond the specific knowledge and performance standards to develop skills in English/Language Arts, Math, Social Studies, and Science, the ILS explicitly require students to: (a) apply learning using technology to solve problems; (b) communicate and make connections; and (c) use technology to access information, process ideas and communicate results (Illinois State Board of Education, n.d.a). Therefore, it is essential that teachers be competent in both knowledge and application of technology if these outcomes are to be achieved with diverse learners (Illinois State Board of Education, n.d.b).

A Broadened Conceptualization of AT

Instructional technology and the expectations for student competence with technology represent a macro context within which the AT mandate serves to influence teacher preparation. The requirement itself--to consider the student's educational need for AT--developed in the larger context of the technology, disability, and public policy. The potential of technology to impact the lives of people with disabilities was first highlighted as public policy in Technology and Handicapped People (U.S. Congress, Office of Technology Assessment, 1982). This report was powerful in advancing the argument that public investment in research and development would reap individual and public benefit (Edyburn, 2000). This argument resulted in a series of public laws that have advanced public policy and funding for research, development, and adoption of technology by individuals with disabilities. Historically, however, educational professionals have focused their attention on understanding the functional outcomes of AT for persons with physical, sensory, and communication disabilities. Recent AT research, development, and application has placed increasing emphasis on students with mild disabilities (Behrmann & Jerome, 2002), thus broadening the scope of educators' understanding of AT. Although there is a range of technology that can support reading, writing, math, information acquisition, organization, and cognitive processing, the issues of what, how, and when to use these technologies with K-12 students with disabilities are not yet clearly understood (Peterson-Karlan, 2003). The current broadened view of AT use requires teachers to be able to consider AT to both enhance acquisition and performance of academic skills and enable functional outcomes (Peterson-Karlan, 2003) for some students while also attempting to integrate instructional technology (IT) for all students (Blackhurst, 1997).

Technology Standards in Teacher Education

To meet these dual goals, new teachers must emerge from teacher preparation programs with appropriate knowledge and skills. To accomplish this, there must be national standards to create consistency and credibility for teacher preparation programs (Lahm, 2003). Technology standards for all teachers

[International Society for Technology in Education (ISTE), 2004a, 2004b] have been adopted by the National Council for Accreditation of Teacher Education (NCATE) to support technology integration into professional teacher preparation programs. The Council for Exceptional Children (CEC) (2001) has also created performance-based technology standards for teacher preparation (both initial and advanced certification) that include the use of AT.

Accredited teacher preparation programs must align specific national technology standards (ISTE, CEC, and NCATE) with: (a) course sequences, practica, field-based experiences, and student teaching; and (b) requirements of the state-level certification standards for general and special education teachers. Presented in Table 1 are general categories of current technology standards, with links to sites containing specific information about these standards.

TABLE 1

Technology Standards Related to Teacher Preparation

National Educational Technology Standards (NETS) http://cnets.iste.org/	*ITPS-9: Assistive Technology Standard (All teacher education candidates)* http://www.itps.ilstu.edu/	*Core Technology Standards (ISU)* http://www.isbe.net	*Advanced Technology Standards (ISU)* http://www.isbe.net http://www.cec.sped.org
• Demonstrate sound understanding of technology operations & concepts; • Plan & design effective learning environments & experiences supported by technology; • Implement curriculum plans, including methods & strategies for applying technology to maximize student learning; • Apply technology to facilitate variety of effective assessment & evaluation strategies; • Use technology to enhance their productivity & professional practice; • Understand social, ethical, legal, & human issues surrounding use of technology in PK-12 schools & apply those principles in practice.	• Demonstrate ability to use range of AT to work effectively & equitably with students with disabilities.	The following statement represents a synthesis of 8 knowledge & 10 performance standards: • Understand legal, educational, & societal issues regarding technology & AT; • Demonstrate skills using range of AT devices or materials, educational software, & AT product systems that promote accessibility & independence; • Understand roles of special educators, related service providers, general educators, & families in collaborative service delivery processes that address assessment, selection & matching to learner's needs & preferences • Understand potential funding sources, implementation of AT, curriculum integration, & periodic evaluation	The following statement represents a synthesis of 6 knowledge & 22 performance standards: • Understand AT concepts & relationship to diversity, educational technology use, assessment, diagnosis, evaluation, equity, ethical, legal, & human issues. • Understands and uses AT funding sources & processes for acquisition, maintenance, security, & ergonomic implementation. • Develops personal philosophy & goals for using technology in special education. • Matches learner, technology, tasks, & environmental factors using team process, to include determination of need for comprehensive assistive or instructional

associated with providing assistive technology in K-12 learning environments.

- technology evaluation.
- Utilizes best practice strategies for acquiring information and technology & subsequent effective classroom implementation, including data management strategies, with students/others to achieve mastery & AT maintenance.
- Provides culturally-sensitive technology supports to students receiving instruction in general education classrooms & other professionals & family members.
- Participates in best-practice AT teaming & advocacy activities, including provision of inservice training.
- Maintains AT professional development knowledge & skills.

Creating a Model to Achieve Student Outcomes

The standards-based reforms, legal mandates, and the broadening conceptualization of what constitutes AT compel higher education to develop AT instructional delivery and assessment systems to prepare all future teachers. The Illinois State University (ISU) model, described in the following sections employs two complementary instructional systems—alternative and traditional--for the delivery and assessment of AT competencies (see Figure 1) for both general education, special education, or early childhood education teacher candidates. These systems work together to ensure *all* teacher education candidates can demonstrate competence in using assistive technology in the classroom.

The Alternative System – ITPS Competency 9

In response to planning for NCATE program accreditation review at ISU, an Instructional Technology Passport System (ITPS) was developed (see http://www.itps.ilstu.edu/ for more information) as a performance-based assessment system for meeting both the national and the Illinois Technology Standards for All Teachers (Illinois State Board of Education, n.d.b). The ITPS system includes 10 technology standards designed to develop technology competence among all teacher education candidate graduates. Approximately 750 teacher candidates across 37 teacher education programs participate in the ITPS system each semester.

Of particular interest is the ninth ITPS standard that addresses AT. Developed

collaboratively by professionals across disciplines at ISU, the learning experiences associated with the ITPS-9 system are crafted to reflect sensitivity to the wide range of teacher candidates' experiences with working with students with disabilities while also insuring development of a basic foundational knowledge in the variety of assistive technologies available and ways that AT can be used to enhance student performance.

The ITPS 9 system, designated the 'Alternative System' (see Figure 1), is designed to provide elementary, middle school, and secondary education majors (approximately 600 teacher candidates each semester) with a basic awareness level regarding AT. The system employs a blended learning approach incorporating two stages: (a) online instruction and an objective evaluation, and (b) hands-on experiences and a performance based evaluation. In Stage 1, each teacher candidate accesses six online AT modules. The modules are organized around the following topics: (a) An Introduction to Assistive Technology; (b) Assistive Technology Used for Common Academic Tasks; (c) Assistive Technology to Aid in Communication; (d) Assistive Technology to Aid in Mobility and Positioning; (e) Assistive Technology Commonly Used by Students who are Deaf or Hard of Hearing; and (f) Assistive Technology Commonly Used by Students with Visual Impairments.

The first module provides basic information such as a legal definition of AT devices and services, a functional definition of AT, a rationale as to why AT is an integral part of the classroom, and a discussion comparing assistive and instructional technologies. Each subsequent module is designed to provide the teacher candidate with topical information about the characteristics about the potential users of the AT, a variety of ATs available,

and potential ways that the assistive technology can be used in the classroom. Each module combines textual descriptions with images or short video clips/vignettes depicting AT use in educational environments as well as hyperlinks to a variety of web based resources. In addition to the modules, a series of 'help sessions' are offered throughout the semester to assist teacher candidates who have questions or need clarification of module content. The modules serve to provide teacher candidates with a foundational knowledge of the variety of ATs available and their applications.

Once teacher candidates complete the online modules, an online exam related to the modules must be passed. The test consists of 30 multiple-choice questions. The questions are randomly drawn from a stratified bank of questions that balance questions related to characteristics of assistive technology users and the array of available ATs and their use in educational environments across each of the topical areas. Teacher candidates are offered two exam opportunities to achieve the passing criterion of 90%. In the case that a teacher candidate has failed to achieve criterion on the first two attempts, he or she is encouraged to review his or her first two exams and take advantage of a help session prior to attempting the exam for a third time. If the teacher candidate is still unable to pass the exam after the third trial, an alternate exam is made available to the student. The alternate exam consists of a series of fill in the blanks based on the module content. The criterion for mastery on the alternate exam is 100%. Finally, should the teacher candidate not achieve criterion on the alternate exam, he or she is required to enroll in a semester long course focusing on assistive technology (part of the traditional system discussed below).
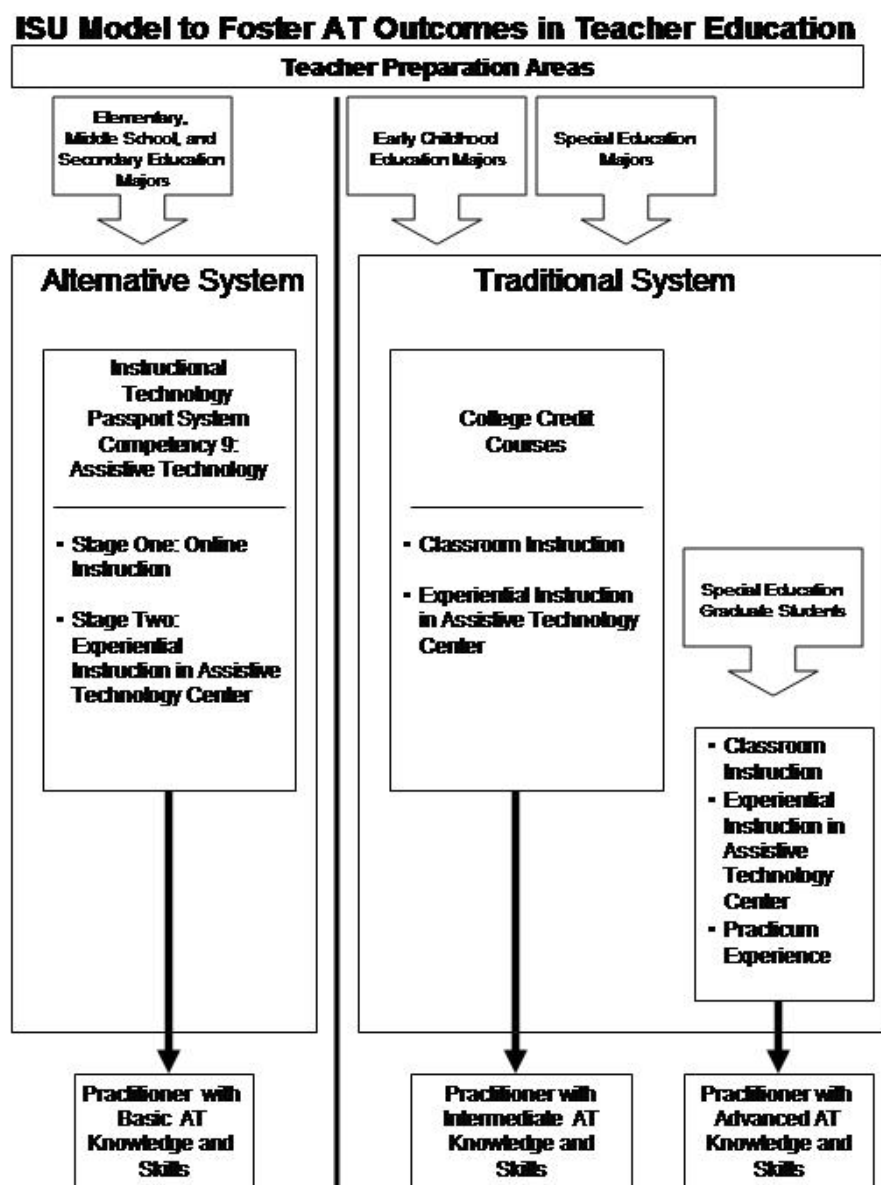
ISU Model to Foster AT Outcomes in Teacher Education

Teacher Preparation Areas

Elementary, Middle School, and Secondary Education Majors

Early Childhood Education Majors

Special Education Majors

Alternative System

Instructional Technology Passport System Competency 9: Assistive Technology

- Stage One: Online Instruction
- Stage Two: Experiential Instruction in Assistive Technology Center

Traditional System

College Credit Courses

- Classroom Instruction
- Experiential Instruction in Assistive Technology Center

Special Education Graduate Students

- Classroom Instruction
- Experiential Instruction in Assistive Technology Center
- Practicum Experience

Practitioner with Basic AT Knowledge and Skills

Practitioner with Intermediate AT Knowledge and Skills

Practitioner with Advanced AT Knowledge and Skills

Figure 1. ISU model to foster AT outcomes in teacher education.

The second stage emphasizes using AT in ways it might be used in the classroom. Each teacher candidate visits the Special Education Assistive Technology (SEAT) Center, a centralized location on campus developed to facilitate learning about AT. The SEAT Center began operation in Fall, 2001, with the mission of supporting teacher preparation and professional development, research in various areas of AT, and service to schools and families. For more information on the SEAT Center, please visit http://www.coe.ilstu.edu/seat.

When the teacher candidate visits the SEAT Center, he or she participates in a variety of self-paced activities using various ATs. The activities are designed to provide experience in using common AT tools and strategies. After the teacher candidate has completed the activities, he or she is assessed using a performance checklist. Specifically, each candidate needs to demonstrate competence in the following: The teacher candidate (a) adapts text (size, contrast, audio, mp3) to create accessibility and foster the student's learning; (b) demonstrates proficiency in operating various equipment to ensure accessibility (e.g., close captioning, FM/IR listening systems, sound field amplification, etc.); (c) demonstrates proficiency in using visual strategies to aid in the instruction of students with disabilities; and (d) demonstrates proficiency in using common built-in accessibility options in current operating systems. Successful completion of these task areas results in mastery of Stage 2 and subsequent completion of the alternative system within the ISU model.

The Traditional System – Coursework & Experiential Activities

The second system, designated as the traditional system, targets all teacher candidates enrolled in special education or early childhood preparation programs culminating in attainment of intermediate knowledge and performance skills. It also prepares practicing teachers returning to ISU to obtain advanced AT knowledge and skills (see Figure 1). This is accomplished through using traditional coursework, and hands-on experiences using AT at the SEAT Center. Students participating in this system take intensive AT courses and participate in other courses or field-based experiences in the sequence having AT content. Graduate students, seeking advance knowledge and skills related to assistive technology, complete

a 3-semester hour professional practice that requires (a) completion of a comprehensive student-centered AT evaluation and assessment, and (b) designing and conducting AT professional development activities.

Outcomes and Benefits

The Alternative System for preparing general education students represents the more innovative component of the preparation model and is the focus of this preliminary report. These systems were fully implemented in Fall, 2003, and thus, only limited data are currently available. However, these data support the potential of this approach for preparing general educators to engage in the 'consideration' of AT. The data described here is presented in Tables 2, 3, and 4. During this period, 503 preservice teachers participated in the Alternative System. By December, 2003, a majority of students (n=437; 86.9%) had passed on stage 1 (knowledge); an additional 66 (13.1%) had not yet completed this stage. Of those who had passed stage one, 164 students (35.2%) passed the on-line exam on their first attempt, having spent an average of 26.35 minutes in on-line examination, while an additional 270 passed the exam on their second (45.5%) or third (12.4%) attempt. An additional three students completed the exam in an alternate form. A total of 465 students (92.4%) completed Stage 2 (see Table 5), experiential lab-based activities with all students passing in an average of 70.9 minutes. Of the 503 students eligible to participate, 432 (85.9%) successfully passed both stages and therefore reached mastery on the ITPS-9 competency. Of the 71 students who did not reach mastery (see table 6), 28 (5.6%) did not begin the modules, 14 (3%) did not finish either Stage 1 or 2 after they had begun, and 29 (5.9%) failed Stage 1 and could not advance to or complete stage two.

TABLE 2

Pass/Fail Rates by Attempt for Stage One of Alternative System

Attempt	M Score (out of 30)	M Time (out of 40 mins)	Pass		Fail	
			N	% of Attempt	N	% of Attempt
First	24.9	26:21	184	35.2	302	64.8
Second	27.2	31:24	212	72.4	81	27.6
Third	28.1	29:24	58	80.6	14	19.4
Fourth	100 %	N/A	3	100	0	0

TABLE 3

Percentage of Persons Not Completing Attempt on Stage One Exam of Alternative System

Attempt (Not Yet Taken)	Total Pending	
	N	% of Total
First	37	7.4
Second	9	1.8
Third	9	1.8
Fourth	11	2.2
TOTAL	66	13.1

TABLE 4

Percentage of Persons Passing Exam at Each Attempt Level for Alternative System

Attempt	Cumulative Pass		
	N	Students Who Have Taken Exam	Total Eligible Students
		%	%
First	164	35.2	32.6
Second	376	80.7	74.8
Third	434	93.1	86.8
Fourth	437	93.8	86.9

TABLE 5

Pass/Fail Rates and Related Statistics for Stage Two of Alternative System

N	% Passing	% Failing	M Attempts	M Time to Completion	% Completed	% Not Completed
465	100	0	1	70.9 min.	92.4	7.6

TABLE 6

Reasons Candidates Did Not Complete Entire Alternative System

Reason for Deficiency	N	% of Total
Stage One Not Done	10	2
Stage One Failing Status	20	4
Stage Two Not Done	4	< 1
Stage One Failing Status; Stage Two Not Done	9	1.9
Stage One Not Done; Stage Two Not Done	28	5.6
TOTAL	71	14.1

A pre- and post-survey of students across six areas revealed an increase in the percentage of students rating themselves as having *functionally adequate* AT knowledge or skills in: (a) the range of AT devices ([pre]17.1% to [post] 50.5%); (b) AT options for academic areas ([pre]11.7% to [post]42.9%); and (c) AT for persons who are deaf/hard of hearing or have communication, physical, or visual disabilities being similarly reported. However, traditionally delivered courses do not typically incorporate such pre- and post-participation measures. Therefore, no equivalent data is available for special education for students who participated in the Traditional System. None the less, at this point in time, the implementation of these two systems seems to indicate that preservice teachers are, indeed, making gains in their AT knowledge and skills. However, additional and more long-term information will be needed to document these gains and to evaluate the effectiveness of these systems within the ISU Model.

Future Directions

Thus far, standards have provided the framework for a system of instructional delivery, traditional courses of study and practicum, field-based and student teaching experiences. As a result, ISU and the Department of Special Education are among the first to receive full accreditation in 2003 under both the NCATE and Illinois State Board of Education (ISBE) standards for teacher preparation. However, the ISU model represents only a beginning component of a process for producing and evaluating meaningful AT outcomes for teacher education graduates. To determine outcomes and benefits of a model for measuring AT outcomes in teacher education programs, systematic efforts in data collection related to individual student outcomes (e.g., preservice teachers, inservice teachers, K-12 students), program evaluation, and research are needed. Furthermore, to meet the needs of teachers already in the field, exploration into expanding the scope of this model to foster continuing personnel development and capacity building should be undertaken.

Measuring AT Outcomes

For those who participate in the Alternative System, additional information and research are needed regarding changes in: (a) values and attitudes toward students with disabilities, (b) willingness to use AT, and (c) degree of AT applications in their teaching. Time periods for the collection of this data could occur during their student teaching experiences as well as during their first years of teaching. For special education majors who participate in the Traditional System, there is a need to develop and validate criteria for evaluating: (a) occurrences of AT consideration in student-centered planning, (b) the integration of AT into students' with disabilities educational programs, and (c) the use of AT in the measurement of students'

educational progress and in district and state assessments. Additionally, case-study based repeated measures of performance should also be developed to measure progress toward proficiency and application of AT knowledge and skills. Also, follow up data are needed from graduate students on their perceptions of their role as AT specialists and how they are fulfilling their role.

Measuring educational and social outcomes for K-12 students may include investigating: (a) the extent of AT integration into academic, vocational, or life skills instruction, (b) the changes in student performance, (c) the extent and nature of participation with typical peers, (d) the participation and performance in state and district assessments, (e) quality of life, and (f) the changes in intensity of supports needed by the student to achieve independence. K-12 student outcomes specifically related to AT acceptance or abandonment may include determining: (a) the factors in the decision making process that lead to a specific AT device or service, (b) extent of device usage, (c) cultural and familial expectations and assumptions about AT and acceptance by others, and (d) degree to which training related to the AT occur. Measures such as these can be modified and refined when recommendations about nationally recognized outcomes indicators are disseminated by the ATOMS and CATOR projects in 2004.

Expanding the Model

The ISU Model was developed in response to the needs of preservice training of teachers with regard to AT. However, the need for continuing professional development in AT for current practicing special and general education teachers suggest that the Alternative System should be expanded beyond pre-service education. A pilot project (Peterson-Karlan & Parette, n.d.) is underway to assess the feasibility of training general and special education teachers, paraprofessionals, and

administrators to attain the basic knowledge and performance competencies. In the pilot project, the web-based, interactive learning module from the Alternative System will be available to approximately 250 teachers, paraprofessionals, and administrators across Illinois. Using an existing state-wide coalition of school districts and social service agencies, the hands-on learning and performance evaluation activities will be provided through a series of regional workshops for the school-based staff. The pilot will also explore the outcomes of this training over time on teachers' use of AT, future AT training, and direct student outcomes. The exploratory study will examine such initial outcomes as: (a) degree of professional and family involvement in AT planning, (b) integration of AT into students' individual educational plans, (c) frequency of student AT usage in educational environments (d) documentation of educational progress associated with AT use and (d) reductions in costs associated with AT recommendations. If feasible and successful, continued expansion of the model could result in a structure for a comprehensive, partnership-based system focused on improving professional development outcomes related to AT based on best practice recommendations.

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