Assistive Technology for Students with Visual Impairments: Challenges and Needs in Teachers' Preparation Programs and Practice

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Abstract: This article reports on a survey of 165 teachers of students with visual impairments in Texas to examine their perceptions of their knowledge of assistive technology. The results showed that they had significant deficits in knowledge in 55 (74.32%) of the 74 assistive technology competencies that were examined and that 57.5% of them lacked adequate confidence about teaching assistive technology to students.

Since the 1997 amendments to the Individuals with Disabilities Education Act, there has been a considerable demand for assistive technology to be included in the Individualized Education Programs (IEPs) of all students with disabilities (Osborne & Russo, 2007), and assistive technology has played an increasingly important part in the education of these students. For individuals with visual impairments (that is, those who are blind or have low vision), there is no debate that assistive technology benefits their education, employment, and daily lives (Cooper & Nichols, 2007; Gerber, 2003; Strobel, Fossa, Arthanat, & Brace, 2006). However, research has found that assistive technology is being significantly underutilized by students who are visually impaired. For example, Kapperman, Sticken, and Heinze (2002) found that in Illinois, 33.7% of primary and secondary students with visual impairments in non-itinerant placements and 73% of those in itinerant placements did not use assistive technology. Similarly, Kelly (2009) found that nationwide, 59% to 71% of the primary and secondary students with visual impairments who were most inclined to benefit from assistive technology did not have the opportunity to use it from 2000 to 2004.

What are the barriers that hinder the use of assistive technology by students who are visually impaired? Mounting evidence has attributed this nonuse of assistive technology, at least partially, to the

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lack of adequate knowledge and skills of teachers of students with visual impairments in this area (Abner & Lahm, 2002; Edwards & Lewis, 1998; Kapperman et al., 2002; Lee & Vega, 2005; Parker et al., 1990). For example, in the study Edwards and Lewis (1998) conducted in Florida, over half the 113 participating teachers of students with visual impairments admitted that they were not familiar with many of the assistive technology devices that were examined in that study and thus lacked the expertise to teach their students how to use the devices. Similarly, Abner and Lahm (2002) found that in Kentucky, 49% of the 72 teachers of students with visual impairments who completed their survey reported a lack of confidence in teaching assistive technology. The majority of these 72 teachers thought that they were at either the apprentice level (51%) or the novice level (24%) in terms of their teaching skills related to assistive technology. In Kapperman et al.'s (2002) study in Illinois, 43 teachers of students with visual impairments failed to provide valid responses to questions about assistive technology because they lacked enough background knowledge about such technology.

To address the gap in knowledge of assistive technology among teachers of students with visual impairments and to increase the teachers' instructional skills, one must understand their specific deficits in knowledge or skills in this area. Do these teachers have difficulty familiarizing themselves with the use of a variety of assistive devices or lack the strategies for helping students develop assistive technology skills? Do they have difficulty collaborating with other members of students' IEP teams to make appropriate assistive technology evaluations and prescriptions? A clear awareness of the specific assistive technology knowledge or skill areas in which teachers of students with visual impairments have significant deficits is critical for finding ways to close the gaps in knowledge. However, little research has been conducted to determine teachers' specific needs empirically. Therefore, the purpose of this study was to identify specific assistive technology competencies in which teachers of students with visual impairments lacked adequate expertise to provide effective services to students with visual impairments. We hope that the findings of this study may promote the development of these teachers' expertise in assistive technology by describing which areas need to be particularly emphasized. Specifically, the research question of this study was for an existing set of assistive competencies: For which assistive technology competencies did the certified teachers of students with visual impairments in Texas perceive that they lacked adequate expertise?

Method

Procedure and questionnaire

A web-based survey was used to collect the data. Initial telephone calls were made to administrators at the Texas School for the Blind and Visually Impaired, from which the contact information for all 20 Regional Education Service Centers in Texas was obtained. The administrators of all 20 centers were contacted by telephone or e-mail to disseminate the invitation e-mail message containing the link to the survey to all teachers of students with visual impairments in their regions. Reminder e-mail messages were sent out once to the teachers of students with visual impairments through these administrators at the midpoint of the two-month survey period.

The survey questionnaire contained two parts. The first part addressed basic demographic information, including age, gender, regions in which the teachers worked, years of teaching, years of working with students with visual impairments, location of teaching assignment (such as itinerant), type of certification (for example, as a teacher of students with visual impairments or an orientation and mobility specialist), whether they were visually impaired, and whether they used assistive technology regularly. This section also included a question on the participants' perceptions of their overall level of confidence in their knowledge of and skills in teaching and supporting the use of assistive technology for students with visual impairments.

The second part of the questionnaire consisted of 74 assistive technology competencies for teachers of students with visual impairments that were selected from a set of 111 competencies that were developed by Smith, Kelley, Maushak, Griffin-Shirley, and Lan in 2009 (see Table 1). These 74 competencies were chosen by focusing on less global and more specific knowledge and skills in assistive technology. The sequence and order numbers of these 74 competencies, such as competence 13 (C13), remained the same in this study as they were in Smith et al.'s study.

Smith and colleagues divided their 111 assistive technology competencies into 10 knowledge and skill domains. The 74 competencies that we used in our study included all the competencies of 6 domains, such as the "access to information" domain. For each of the 74 competencies, the participants were asked to rate the level of expertise that they thought they currently possessed and the level of expertise that they thought that teachers of students with visual impairments in general should have. The 4-point Likert scale used in Smith et al.'s study (1 = novice, 2 = basic, 3 = proficient, or 4 = advanced) was used in our study. An optional comment field was added at the end of the questionnaire.

Data analysis

Descriptive statistics were generated, including means, standard deviations, and percentages, for the demographic variables, and Pearson *r* correlation coefficients were generated for the relationships between the participants' overall confidence in teaching assistive technology and their age, years of teaching, and years of working with students with visual impairments. For each of the 74 assistive technology competencies, a two-tailed paired-samples *t*-test was conducted to examine if there was a significant difference between the participants' current and expected levels of expertise. To control for the Type I error of this set of 74 *t*-tests, the sequential Dunn-Sidák method (Sokal & Rohlf, 1995) was used to adjust the *p* values, and the family-wise alpha was set at .05. All the statistics were conducted using the Statistical Package for the Social Services, version 17.0.

Results

Nineteen (95%) of the 20 Regional Education Service Centers in Texas participated in the study, with 172 teachers completing the questionnaire. Responses from

Table 1
Comparison between the participants' perceived possessed and expected levels of expertise.

Competencies	Possessed level of expertise *M* (*SD*)	Expected level of expertise *M* (*SD*)	*t* tests (two tailed) t/df/adjusted p^{a}
C11. Know the visual, auditory, tactile, motor, and cognitive skills necessary to access various types of assistive technology.	2.93 (0.677)	3.02 (0.643)	$-1.466/164/p_{62} = .869$
C12. Be aware of the effects of low vision on the use of assistive technology (such as lighting, contrast, size, and glare).	3.10 (0.627)	3.17 (0.591)	$-1.145/164/p_{69} = .827$
C13. Know braille literacy and its application in providing effective assistive technology services.	2.9 (0.751)	3.15 (0.611)	$-3.52/164/p_{49} = .014^{*}$
C14. Know the effects of deaf-blindness on the use of assistive technology.	2.18 (0.783)	2.85 (0.738)	$-8.762/164/p_{10} = .000^{*}$
C15. Be familiar with general assistive technology for individuals with disabilities other than visual impairments (such as switches, software that provides scaffolding supports, augmented communication devices, and picture-based symbols).	2.58 (0.805)	2.84 (0.689)	$-3.55/164/p_{47} = .014^{*}$
C16. Use assistive technology as part of the expanded core curriculum, including independent living devices.	2.62 (0.675)	3.00 (0.644)	$-5.174/164/p_{33} = .000^{*}$
C17. Use effective evaluative practices in collaboration with a multidisciplinary team to determine what technology would best assist a student in accessing the educational curriculum.	2.83 (0.677)	3.06 (0.622)	$-3.592/164/p_{46} = .012^{*}$
C18. State the advantages and disadvantages of assistive technology for potential users with various degrees of vision.	2.77 (0.729)	3.08 (0.638)	$-4.419/164/p_{39} = .001^{*}$
C19. Identify a variety of assistive technology devices (such as software, hardware, and peripheral devices) for students with different visual abilities, ages, and cognitive abilities.	2.65 (0.721)	3.07 (0.649)	$-5.69/164/p_{28} = .000^{*}$
C20. Use screen-reading software and make adjustments to its basic features.	2.35 (0.840)	3.01 (0.653)	$-8.122/164/\mathrm{p}_{15} = .000^{*}$
C21. Use screen magnification system software and make adjustments to its basic features.	2.62 (0.777)	3.01 (0.658)	$-4.74/164/p_{38} = .000^{*}$
C22. Use braille-translation software and make adjustments to its basic features.	2.32 (0.923)	2.95 (0.723)	$-7.29/164/p_{19} = .000^{*}$
C23. Use braille-translation software for Nemeth code translation.	1.88 (0.837)	2.91 (0.772)	$-12.038/164/p_{2} = .000^{*}$
C24. Use various closed–circuit television systems or video magnifiers.	2.92 (0.893)	2.98 (0.671)	$-0.795/164/p_{72} = .813$
C25. Use various personal digital assistants or braille notetakers.	2.10 (0.899)	2.95 (0.731)	$-9.553/164/p_{6} = .000^{*}$
C26. Use a digital recorder and make adjustments to its basic features.	2.25 (0.858)	2.88 (0.675)	$-8.43/164/p_{12} = .000^{*}$
C27. Use a digital Talking Book player and a digital e–book recorder (including downloading e–books) and make adjustments to their basic features.	2.21 (0.779)	2.95 (0.656)	$-9.712/164/p_{5} = .000^{*}$
C28. Use a braille embosser and make adjustments to its basic features.	2.28 (0.954)	2.83 (0.712)	$-6.161/164/p_{25} = .000^{*}$

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Competencies	Possessed level of expertise *M* (*SD*)	Expected level of expertise *M* (*SD*)	*t* tests (two tailed) *t*/*df*/adjusted p^a
C29. Use a scanner and OCR software system and make adjustments to their basic features.	2.12 (0.893)	2.81 (0.732)	$-8.262/164/p_{14} = .000$*
C30. Use a refreshable braille display and its accompanying software (screen-reader software).	1.81 (0.808)	2.85 (0.726)	$-12.686/164/p_{1} = .000$*
C31. Use common technological skills (those practiced by the general population) as they support learning of students with visual impairments.	2.94 (0.722)	3.02 (0.584)	$-1.259/164/p_{66} = .880$
C32. Use a standard braille writer, a unimanual braille writer, and extension keys.	2.86 (0.772)	3.07 (0.655)	$-3.107/164/p_{54} = .046$*
C33. Use electronic braille devices.	2.18 (0.850)	2.95 (0.705)	$-9.303/164/p_{7} = .000$*
C34. Use tactile graphic devices.	2.12 (0.837)	2.84 (0.707)	$-8.802/164/p_{9} = .000$*
C35. Use a talking four-function calculator, a talking scientific calculator, and a software-based talking calculator.	1.98 (0.815)	2.82 (0.715)	$-10.631/164/p_{3} = .000$*
C36. Operate a talking dictionary and a software-based talking dictionary.	2.19 (0.915)	2.81 (0.689)	$-7.918/164/p_{16} = .000$*
C37. Make modifications to general education technology (such as a microscope and a telescope) for students with visual impairments.	2.27 (0.912)	2.85 (0.701)	$-7.13/164/p_{21} = .000$*
C38. Use handheld magnifiers, stand magnifiers, monoculars, and telescopes.	3.08 (0.776)	3.01 (0.605)	$1/164/p_{70} = .853$
C39. Identify various nonoptical devices that are available for students with low vision.	2.77 (0.778)	2.95 (0.642)	$-2.598/164/p_{58} = .160$
C40. Describe the advantages and disadvantages of various types of lighting devices.	2.59 (0.796)	2.95 (0.670)	$-4.973/164/p_{35} = .000$*
C41. Produce simple tactile graphics using the following methods of production: collage, tooled, Thermoform, microcapsule paper and heat fuser, and computer-generated graphics.	2.17 (0.915)	2.81 (0.680)	$-7.221/164/p_{20} = .000$*
C42. Teach concepts related to the basic installation of assistive technology devices, including managing cords and plugs.	2.68 (0.854)	2.91 (0.652)	$-2.928/164/p_{56} = .071$
C43. Teach concepts related to the basic maintenance of assistive technology devices.	2.66 (0.837)	2.93 (0.636)	$-3.704/164/p_{44} = .009$*
C44. Provide instruction in assistive technology devices in purposeful ways and in authentic environments.	2.67 (0.829)	2.99 (0.625)	$-4.126/164/p_{42} = .002$*
C45. Teach students to use troubleshooting techniques.	2.44 (0.865)	2.89 (0.605)	$-5.747/164/p_{27} = .000$*
C46. Provide sequenced instruction regarding technology as it relates to transition and employment.	2.27 (0.905)	2.93 (0.668)	$-7.905/164/p_{17} = .000$*

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Competencies	Possessed level of expertise *M* (*SD*)	Expected level of expertise *M* (*SD*)	*t* tests (two tailed) *t*/*df*/adjusted p^a
C47. Teach students with visual impairments about resources for obtaining assistive technology devices and services.	2.50 (0.846)	2.95 (0.670)	$-5.645/164/p_{29} = .000$*
C48. Use appropriate educational strategies for developing age-appropriate concepts and motor development appropriate for use of assistive technology.	2.72 (0.739)	2.96 (0.598)	$-3.416/164/p_{50} = .020$*
C49. Develop lesson plans that incorporate the use of assistive technology.	2.76 (0.766)	2.98 (0.584)	$-3.076/164/p_{55} = .048$*
C50. Be aware of differences in assistive technology instruction for students with visual impairments and other disabilities.	2.68 (0.723)	2.92 (0.653)	$-3.312/164/p_{52} = .026$*
C51. Teach students with visual impairments in one-on-one situations, small groups, and large groups.	3.06 (0.669)	3.05 (0.561)	$0.184/164/p_{74} = .855$
C52. Collect formative data and adjust lessons accordingly on the basis of the students' needs.	2.96 (0.697)	3.04 (0.567)	$-1.203/164/p_{67} = .877$
C53. Articulate the visual features of learning environments as they affect instruction and the use of assistive technology.	2.88 (0.688)	2.98 (0.579)	$-1.607/164/p_{61} = .804$
C54. Assess and recommend assistive technology devices for specific learning environments (such as a classroom and gymnasium).	2.70 (0.775)	2.97 (0.609)	$-3.603/164/p_{45} = .012$*
C55. Analyze the visual (such as lighting and glare), auditory (such as sound distractions and noise pollution), and physical environment to determine appropriate modifications of assistive technology devices.	2.89 (0.757)	3.03 (0.589)	$-1.997/164/p_{60} = .518$
C56. Teach a student to adapt the learning environment to his or her needs.	2.97 (0.666)	3.04 (0.534)	$-1.19/164/p_{68} = .848$
C57. Teach the appropriate social skills for using technology in various environments.	2.97 (0.728)	2.99 (0.574)	$-0.277/164/p_{73} = .953$
C58. Determine the least restrictive environment and the use of assistive technology in different placements.	2.96 (0.693)	3.01 (0.574)	$-0.838/164/p_{71} = .873$
C59. Know strategies to involve a student with visual impairments in the class while still using assistive technology.	2.96 (0.689)	3.05 (0.572)	$-1.326/164/p_{65} = .873$
C60. Know the dynamics of the physical arrangement of the classroom (including ergonomic issues) and their impact on the use of assistive technology.	2.85 (0.712)	3.00 (0.584)	$-2.245/164/p_{59} = .345$
C61. Know how to use assistive technology across environments.	2.73 (0.805)	3.01 (0.625)	$-3.73/164/p_{43} = .008$*

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Competencies	Possessed level of expertise *M* (*SD*)	Expected level of expertise *M* (*SD*)	*t* tests (two tailed) *t*/*df*/adjusted p^a
C62. Be aware of the need for portability and the limitations of the portability of specific assistive technology devices for students in various environments.	2.85 (0.735)	2.95 (0.613)	$-1.397/164/p_{64} = .861$
C63. Teach students with visual impairments the use of assistive technology for access to information in the classroom.	2.85 (0.746)	3.04 (0.588)	$-2.758/164/p_{57} = .110$
C64. Teach students with visual impairments to produce files in a readable format, including braille, enlarged print, or an electronic form.	2.42 (0.849)	3.05 (0.582)	$-8.536/164/p_{11} = .000$*
C65. Teach students problem-solving techniques for using assistive technology in the classroom when materials are not in an accessible format.	2.52 (0.816)	3.02 (0.610)	$-6.728/164/p_{23} = .000$*
C66. Teach students with visual impairments to use the Internet.	2.58 (0.797)	3.00 (0.625)	$-5.77/164/p_{26} = .000$*
C67. Teach students with visual impairments to transfer files to appropriate assistive technology devices.	2.13 (0.866)	2.95 (0.642)	$-10.306/164/p_{4} = .000$*
C68. Teach students to stay current with new technology, access online manuals, and obtain technical assistance from vendors.	2.22 (0.872)	2.88 (0.657)	$-8.359/164/p_{13} = .000$*
C69. Identify and use a variety of sources for braille and large-print materials.	2.77 (0.778)	3.01 (0.605)	$-3.343/164/p_{51} = .024$*
C70. Identify and use a variety of sources for electronic and recorded materials.	2.61 (0.785)	2.98 (0.610)	$-5.095/164/p_{34} = .000$*
C71. Identify and use a variety of options for accessing information presented on chalkboards, whiteboards, DVDs and other video sources, overhead projectors, and computer projector systems.	2.59 (0.818)	2.97 (0.599)	$-5.248/164/p_{32} = .000$*
C72. Know assistive technology services that allow students to participate at the same level of involvement in learning activities as non–disabled peers.	2.65 (0.762)	3.01 (0.574)	$-4.973/164/p_{36} = .000$*
C73. Know PC and Apple computer accessibility options (universal options menu, accessibility wizard, and display settings) for individuals with visual impairments.	2.42 (0.877)	2.98 (0.634)	$-7.104/164/p_{22} = .000$*
C91. Be aware of funding mechanisms for professional development in assistive technology.	1.95 (0.875)	2.73 (0.750)	$-8.914/164/p_{8} = .000$*
C92. Be familiar with the resources for local, state, and national professional development training programs.	2.37 (0.899)	2.82 (0.709)	$-5.58/164/p_{30} = .000$*
C93. Be aware of federal, state, and local agencies that provide technology assistance to individuals with visual impairments.	2.49 (0.809)	2.95 (0.701)	$-6.299/164/p_{24} = .000$*
C94. Attend assistive technology conferences (such as Closing the Gap, C-SUN, CTEVI, and AER).	2.19 (0.855)	2.78 (0.684)	$-7.295/164/p_{18} = .000$*
C95. Know the major assistive technology manufacturers and vendors.	2.46 (0.837)	2.82 (0.683)	$-4.938/164/p_{37} = .000$*

(cont.)

Table 1
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Competencies	Possessed level of expertise *M* (*SD*)	Expected level of expertise *M* (*SD*)	*t* tests (two tailed) *t*/*df*/adjusted *p*[a]
C96. Be aware of local, state, and national consumer organizations (such as the National Federation of the Blind and the American Council of the Blind).	2.67 (0.799)	2.88 (0.648)	$-3.122/164/p_{53} = .046^{*}$
C97. Obtain assistive technology to assist families through service organizations (like the Lions Club).	2.44 (0.783)	2.84 (0.656)	$-5.275/164/p_{31} = .000^{*}$
C98. Engage in professional development activities to demonstrate continual growth in current and emerging assistive technology services.	2.73 (0.842)	2.98 (0.643)	$-3.521/164/p_{48} = .015^{*}$
C99. Access resources such as journals and web sites.	2.83 (0.786)	2.93 (0.640)	$-1.419/164/p_{63} = .873$
C100. Advocate for professional development in assistive technology.	2.48 (0.888)	2.82 (0.689)	$-4.373/164/p_{40} = .001^{*}$
C101. Engage in reflective practice and evaluate one's attitudes toward the application of assistive technology services.	2.58 (0.805)	2.87 (0.654)	$-4.31/164/p_{41} = .001^{*}$

[a] The subscript *i* in p_i ($i = 1$ to 74) denotes the order of adjusted *p* values during the sequential Dunn-Sidák correction.
* $p < .05$ after the sequential Dunn-Sidák correction.

7 participants (4 were not certified teachers of students with visual impairments, and 3 were working outside Texas) were excluded from the data analysis. Therefore, responses from 165 teachers of students with visual impairments who were working in Texas were included in the data analysis, or 23.54% of all 701 in-service teachers of students with visual impairments in Texas in 2009 (Dignan, 2010).

Of the 165 participants, 160 (96.97%) were women. The participants ranged in age from 25 to 66 ($M = 48.25$, $SD = 8.85$), had been teaching from 1 to 43 years ($M = 19.42$, $SD = 8.83$), and had worked with students with visual impairments from 1 to 40 years (1 participant did not answer this question; $M = 11.21$, $SD = 8.34$). Of the 14 (8.48%) participants who were visually impaired, 10 (6.06%) regularly used assistive technology themselves. Forty-one (24.85%) participants were dually certified as teachers of students with visual impairments and orientation and mobility specialists, and the other 124 (75.15%) were certified solely as teachers of students with visual impairments. The 165 participants were working as itinerant teachers (80.61%), as resource room teachers solely or both as itinerant teachers and resource room teachers (6.06%), at educational service centers (6.06%), as supervisors or administrators (3.03%), and in other roles (4.24%) like educational diagnosticians.

The participants' ratings of their overall levels of confidence in their knowledge of and skills in teaching and supporting the use of assistive technology for students with visual impairments are shown in Table 2. The correlations between their overall level of confidence

Table 2
The participants' overall level of confidence in teaching assistive technology.

Level of confidence	Percentage of responses (n = 165)
Not confident that I can teach most or all forms of assistive technology	2.4
Limited confidence that I can teach most or all forms of assistive technology	20.6
Somewhat confident that I can teach most or all forms of assistive technology	34.5
Confident that I can teach most or all forms of assistive technology	34.5
Very confident that I can teach most or all forms of assistive technology	7.9

and their age, years of teaching, and years of working with students with visual impairments were examined. A small positive relationship was found between the participants' years of working with students with visual impairments and their confidence level ($r = +.23$, $n = 164$, $p = .003$, two tailed).

According to the t-test results after the sequential Dunn-Sidák correction (Table 1), there were significant differences between the participants' perceptions of their current and expected levels of expertise in 55 (74.32%) of the 74 assistive technology competencies. For all 55 competencies, the participants reported that their current levels of knowledge and skills were significantly lower than they thought teachers of students with visual impairments in general should have.

Discussion

The participants' evaluations that their own levels of expertise in a variety of assistive technology competencies were significantly lower than their expected levels of expertise not only indicates a perceived deficit of knowledge and skills, it suggests that more competence is necessary to fulfill the requirements of educating students who are visually impaired. If it can be assumed that all 74 assistive technology competencies that were examined in the study are indispensable for teachers of students with visual impairments to meet their work demands and that the participants' self-evaluations accurately reflect their current knowledge of and skills in this area, the occurrence of such a deficit in 55 (74.32%) of the 74 competencies reveals a dismal picture about the current level of knowledge of assistive technology by practicing teachers of students with visual impairments.

Perhaps, then, it is not surprising that 57.5% of the 165 participants lacked adequate confidence in teaching assistive technology (including those with no, limited, and some confidence; see Table 2). This finding is consistent with Edwards and Lewis's (1998) finding in Florida (more than 50%) and Abner and Lahm's (2002) finding in Kentucky (49%), which indicates that this lack of confidence occurs across states and has not improved much over the past decade. Given the importance of assistive technology, the fact that more than half the practicing teachers of students with visual impairments lack confidence in their ability to teach assistive technology is anything but acceptable. Such findings seem to support the argument that the gap in these teachers' knowledge and skills in assistive technology is one important factor in the inadequate use of assistive technology by students who are visually impaired. It is natural to assume that if a teacher does not know what types of assistive technology are appropriate for a particular student in a particular environment to achieve success or does not know how to retrieve or teach the use of those technologies, the chance for a student to benefit from the use of those appropriate technologies will be minute.

What are these teachers' specific deficits in knowledge of assistive technology? According to the results of the study, the lack of knowledge or skills occurred mainly in the following areas: braille literacy and its application in providing assistive services (C13); assistive technology for students with multiple disabilities (C14 and C15); prescribing assistive technology devices (C16–C19); the use of almost all assistive technology devices listed in the questionnaire except closed-circuit televisions, handheld and stand magnifiers, telescopes, and common technologies used by the general population (C20–C41 but not C24, C31, C38, and C39); strategies for teaching specific aspects of assistive technology to students who are visually impaired, such as assistive technology–related concepts and motor skills (C43–C50); assessing and recommending assistive technology for specific environments and using assistive technology in different environments (C54 and C61); teaching students to access information, such as dealing with inaccessible materials and using the Internet (C64–C73); and professional development, including the knowledge of funding mechanisms, training resources, supportive agencies, manufacturers and vendors of assistive technology, consumer organizations, and the skills to help families obtain assistive technology, to engage in professional development activities with regard to assistive technology, to advocate for professional development in assistive technology, and to engage in reflective practices (C91–C98, C100, and C101).

The competencies for which the participants perceived deficits in knowledge or skills existed in all six domains included in the study. Except for the "learning environments" domain, these deficits were found in most competencies (72.73%–90.91%) in each domain. These findings indicate that the gap in these teachers' knowledge of and skills in assistive technology is comprehensive. If there is no debate on the importance of assistive technology to students with visual impairments and the responsibility of teachers of students with visual impairments to prescribe and teach the use of assistive technology, attributing the lack of adequate capacity in assistive technology to teachers of students with visual impairments cannot avoid questioning the quality of current training programs for teachers of students with visual impairments.

More than a decade after it became legally required to consider the use of assistive technology in students' IEPs, are current teacher preparation programs preparing assistive technology–capable teachers of students with visual impairments? The answer seems to be pessimistic, as one participant commented: "I believe that technology was the least-covered subject in training prior to becoming a teacher of students with visual impairments and the most-used component when working with students." Just to give a snapshot, Smith and Kelley (2007) found that of 30 participating universities in the United States and Canada that had programs to prepare teachers of students with visual impairments and deaf-blindness, 15 did not provide a specific course in assistive technology for teachers of students with visual impairments. Even among those programs that provided specific courses, each program was teaching different technologies and at different levels. If teacher preparation programs fail to give assistive technology systematic and adequate coverage, how can future teachers of students with visual impairments be adequately prepared to meet the assistive technology needs of their students?

In concert with describing the gaps in personnel preparation in assistive technology, one must also recognize the current constraints in higher education. Policy makers routinely criticize teacher preparation programs for not adequately preparing students and, at the same time, because of the demand for teachers, specifically in special education, states are increasingly allowing alternate routes to certification that result in less instructional time for preservice teachers (Pogrund & Wibbenmeyer, 2008). Specifically in the field of visual impairments, states like Texas allow teachers to test out of course work and require only two courses at the university level before allowing students to take a state certification examination (Pogrund & Wibbenmeyer, 2008). Although many preservice teachers choose to continue with course work after they become certified by testing, there are some who become completely dependent on on-the-job training to meet the needs of their students. With teacher preparation programs under greater pressure to reduce course work, there are real challenges to offering adequate instructional time for preparing future teachers of students with visual impairments to provide instruction in assistive technology.

Recommendations

How can the field respond to the gap in the knowledge of assistive technology by teachers of students with visual impairments? Obviously, self-learning activities should not be the only solution because the gap is so general among teachers of students with visual impairments and so comprehensive across many aspects of assistive technology. Neither should one expect that the accumulation of teaching experience can make these teachers automatically capable in assistive technology, given the finding in this study that the number of years of work experiences is not largely related to the development of confidence in teaching assistive technology. It seems that strengthening training in assistive technology is a must to tackle this problem. Preservice teacher preparation programs for teaching students with visual impairments need to include assistive technology as a fundamental component and reflect such awareness in both the design of their curricula and the evaluation of their training outcomes.

We strongly suggest that programs that do not yet have courses in assistive technology should provide them. In this regard, initial progress has been made in determining which assistive technology content should be taught and at what level (Smith et al., 2009). Because of the demand for teachers of students with visual impairments in the field and the pressure within states to reduce required university course work, the field must continue to advocate with policy makers for the need for comprehensive teacher preparation programs. Research that addresses the context of the needs of preservice teachers and the comprehensive assistive technology needs of students with visual impairments may help the field to make a more data-based argument to policy makers and administrators.

Considering the gap in knowledge of assistive technology among practicing teachers of students with visual impairments, training in assistive technology should also be provided at the in-service level, which, according to the participants' comments, should provide teachers with adequate hands-on experiences with assistive technology devices. The 55 specific knowledge and skill deficits that were identified in this study can serve as a reference for which areas in-service assistive technology training should emphasize. In addition, efforts should be made to establish an assistive technology support system that can give practicing teachers of students with visual impairments timely and adequate assistance.

Ideally, in-service training and support and preservice preparation should work in concert to address the myriad instructional needs in assistive technology of those who teach students who are visually impaired. Particularly because of the low incidence of students with visual impairments, advocacy with state and national policy makers should emphasize the need for a strong and well-funded in-service infrastructure. As the participants' comments indicated, the pace of technology is rapid, while the needs of the students are diverse. Even if preservice teachers are well prepared, assistive technology devices, innovations, and teaching strategies will be constantly evolving, thus necessitating a dynamic and responsive in-service system.

The recommendations just presented are based on the assumption that teachers of students with visual impairments will continue to take the responsibility for prescribing and teaching assistive technology. In this regard, we do not go further and recommend that assistive technology services should be provided by separate assistive technology specialists, as Kapperman et al. (2002) suggested. However, we believe that with the increasing recognition of the importance of using assistive technology with individuals with visual impairments, the development of assistive technology specialists as a new type of professional in the field of visual impairments will ultimately be necessary.

In future studies, we recommend using qualitative methods, such as interviews or focus groups, to obtain an in-depth understanding of the attitudes of teachers of students with visual impairments toward instruction of and training in assistive technology. It is compelling that 58 participants offered meaningful additional comments to this survey probe. But it is beyond the scope of this article to analyze the data from these comments. It would also be helpful to repeat this study in other states to examine whether the findings in Texas are typical across the United States. All these efforts will contribute to a clear picture of the readiness of teachers of students with visual impairments to provide instruction in assistive technology.

Limitations

First, inadequate representation of teachers of students with visual impairments working in nonitinerant settings limited the generalizability of the findings to all teachers of students with visual impairments working in Texas. Second, using teachers' self-perceptions as the sole data source limited the validity of the findings. Finally, except for an optional comment box at the end of the questionnaire, the survey did not include any open-ended questions, which precluded a more in-depth understanding of the researched issue.

Conclusion

Using an existing set of assistive technology competencies designed for teachers of students with visual impairments, this study surveyed certified teachers of students with visual impairments in Texas to identify their specific deficits in knowledge of and skills in assistive technology. We found that the participants had deficits in knowledge in most of the competencies examined in the study and that more than half of them lacked adequate confidence in teaching assistive technology. These results seem to indicate the unsatisfactory provision of assistive technology services to students with visual impairments in Texas. The rapid advancement of technologies holds the power either to widen or to narrow the gap between the general population and the population with visual impairments in their ability to participate in society. It is the way teachers of students with visual impairments deal with the challenge that will determine the future of students with visual impairments.

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