Assistive Technology Competencies of Teachers of Students with Visual Impairments: A Comparison of Perceptions

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Abstract: This study surveyed teachers of students with visual impairments in Texas on their perceptions of a set of assistive technology competencies developed for teachers of students with visual impairments by Smith and colleagues (2009). Differences in opinion between practicing teachers of students with visual impairments and Smith's group of educational experts are presented and discussed.

The importance of assistive technology for individuals with visual impairments to live good-quality lives can never be overemphasized. In recognition of its essential benefit, the Individuals with Disabilities Education Improvement Act (2004) continues to demand that students' Individualized Education Programs include a consideration of assistive technology. However, evidence has shown that assistive technology is underutilized with students with visual impairments. For example, in a survey of the use of assistive technology among primary and secondary students with visual impairments in Illinois, Kapperman, Sticken, and Heinze (2002) found that 33.3% of students with visual impairments in nonitinerant placements and 73% of those in itinerant placements did not use assistive technology. They noted that "60% of the students who, in the authors' judgment, could benefit from the use of assistive technology were not given the opportunity to use it" (p. 107). 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.

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What are the barriers that hinder the use of assistive technology by students who are visually impaired? Although there are many, mounting evidence shows that a major reason is that teachers of students with visual impairments lack adequate knowledge to provide effective instruction in assistive technology (Abner & Lahm, 2002; Edwards & Lewis, 1998; Kapperman et al., 2002; Lee & Vega, 2005; Parker et al., 1990; Zhou, Parker, Smith, & Griffin-Shirley, 2011). A contributing factor to teachers' gap in knowledge may be the lack of training in assistive technology in current teacher training programs. For example, many teacher training programs for special educators do not yet include courses or even class sections on assistive technology (Lahm, 2003; Lee & Vega, 2005; Wahl, 2004) or do not require assistive technology courses for certifying teachers (Judge & Simms, 2009). In many graduate-level programs, there is a significant discrepancy in the integration of assistive technology on the basis of the program coordinators' perceptions (Michaels & Mcdermott, 2003).

Recognizing that one possible reason for inadequate preservice preparation in assistive technology for teachers of students with visual impairments was that a separate set of assistive technology competencies did not exist to guide programs on which assistive technology content to teach, Smith, Kelley, Maushak, Griffin-Shirley, and Lan (2009) conducted a Delphi study to develop a set of assistive technology competencies that teachers of students with visual impairments should possess upon completion of their teacher training programs. A panel of 34 experts in the field of visual impairment, representing all major geographic regions in the United States with various professional viewpoints, participated in the study. Building on a high level of consensus among these experts, Smith et al. developed a set of 111 assistive technology competencies and determined the expected levels of expertise upon completion of a program. These 111 competencies were divided into 10 domains: (1) foundations of assistive technology, (2) disability-related assistive technology, (3) use of assistive technology, (4) assistive technology instructional strategies, (5) learning environments, (6) access to information, (7) instructional planning, (8) assessment, (9) professional development, and (10) collaboration.

Recognizing certain limitations of the Delphi technique, Smith et al. (2009) recommended that future studies be conducted to validate their findings, including a large-scale survey of teachers of students with visual impairments. Agreeing to the importance of and need for a valid set of competencies in assistive technology for the preparation of high-quality teachers of students with visual impairments, we conducted the study presented here to compare previous experts' opinions with the opinions of practicing teachers of students with visual impairments regarding what levels of expertise in assistive technology that teachers of students with visual impairments should possess. In our study, 6 of the 10 original assistive technology knowledge domains were examined (domains 2, 3, 4, 5, 6, and 9), which contained 74 of Smith et al.'s original 111 competencies. The previous sequence and order numbers of these 74 competencies, such as competence 13 (C13), remained unchanged. The selection of the 6 domains was made with Smith et al.'s agreement by focusing on those competencies of less global and more specific knowledge of and skills in assistive technology, such as using specific assistive technology devices in domain 3.

Specifically, our study attempted to answer the following questions:

1. For each of the 74 assistive technology competencies, what was the level of expertise that the teachers of students with visual impairments perceived were necessary to meet the daily demands of their jobs?
2. For each competence, was there a significant difference in the perceived level of expertise between the original expert group and the current group?
3. For each competence, was there a significant difference in its ranking among all 74 competencies on the basis of its perceived level of expertise between the two groups?
4. Was there a difference between the two groups in their perceptions of the relative importance of the six assistive technology knowledge domains that were investigated?

Method

Participants and procedure

Approval for this study was obtained from the Texas Tech University Protection of Human Subjects Committee. A web-based survey method was used to collect data. Informed consent was obtained from the participants before they turned to the survey pages. The participants were certified teachers of students with visual impairments in Texas. Initial calls were made to administrators at the Texas School for the Blind and Visually Impaired to obtain the contact information of all 20 Regional Service Centers in Texas. All the educational leaders of these centers were contacted by telephone and e-mail to disseminate the e-mail invitation containing the survey link to all teachers of students with visual impairments within their regions. Reminder e-mail messages were sent out once to the teachers of students with visual impairments through these educational leaders at the midpoint of a two-month survey period. The original data for the fifth round of Smith et al.'s Delphi study (2009) were retrieved from the researchers to make comparisons with the data of our study. These original data were not provided to the current participants.

Questionnaire

The survey questionnaire contained two parts. The first part addressed basic demographic information. In the second part, for each of the 74 assistive technology competencies, the participants were asked to rate the level of expertise they thought a teacher of students with visual impairments should possess. The four-level Likert scale used in Smith et al.'s (2009) study (1 = novice, 2 = basic, 3 = proficient, and 4 = advanced) was again used to guarantee comparability between the two sets of data.

Data analysis

All the data were analyzed using the Statistical Package for the Social Sciences, version 17.0. For Question 1, the means of the previous experts' and the current participants' perceived level of expertise for each competence were calculated. For Question 2, one two-tailed independent-samples *t*-test was conducted for each of the 74 competencies to examine if there was a significant difference in the perceived levels of expertise between Smith et al.'s group of experts and our participants. To avoid the influence of unequal sample sizes, 34 participants were randomly selected from all the participants to be compared with the 34 experts in Smith et al.'s (2009) study. To control for Type I errors for this set of 74 *t*-tests, the *p* values were adjusted using the sequential Dunn-Sidák method (Sokal & Rohlf, 1995). The family-wise alpha for this set of 74 *t*-tests was set at .05.

For Question 3, comparisons of the rankings of the responses were made between the 34 experts and the 34 participants. First, each of the 74 responses of both groups, which were their 74 perceived levels of expertise in the 74 assistive technology competencies, were transformed into ranks (assigning rank 1 to the lowest value and assigning the mean rank to ties). Then, for each competence, one two-tailed Mann-Whitney *U*-test was conducted to examine if there was a significant difference in its ranking among all 74 competencies between the two groups. The sequential Dunn-Sidák method was again used to adjust the *p* values. The family-wise alpha for this set of 74 *U*-tests was set at .05.

For Question 4, for each domain we examined, the mean of the ranks of the participants' responses to all the assistive technology competencies in that domain was calculated. Then for both participant groups, the domains were prioritized on the basis of the means.

Results

From 19 (95%) of the 20 regional service centers in Texas, 172 teachers completed the survey. Responses from 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 working in Texas were included in the data analysis, representing 23.54% of all the 701 practicing 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 ($M = 48.25$, $SD = 8.85$), and their years of teaching ranged from 1 to 43 ($M = 19.42$, $SD = 8.83$). With regard to certification, 41 (24.85%) participants were dually certified in both visual impairments and orientation and mobility, and the other 124 (75.15%) were solely certified as teachers of students with visual impairments. These teachers of students with visual impairments were working as itinerant teachers (80.61%), as resource room teachers (2.42%), as both itinerant and resource room teachers (3.64%), at educational service centers (6.06%), in supervisory or administrative roles (3.03%), and in other roles (4.24%), such as educational diagnosticians.

Regarding the perceived levels of expertise, for each of the 74 competencies, the means of the responses of the 165 participants and Smith et al.'s (2009) 34 experts are presented in Table 1. The range of the means across all 74 competencies was 1.41 (2.09–3.50) for the experts and 0.44 (2.73 − 3.17) for the teachers of students with visual impairments. The results of the *t*-tests comparing the perceived levels of expertise (Table 1) indicated significant differences between the two groups in 7 (9.46%) of the 74 competencies (the competencies with an

Table 1
Comparisons of perceived levels of expertise and relative rankings between previous group of experts ($n = 34$) and current group of teachers of students with visual impairments ($n = 165$).

	Perceived level of expertise		Relative ranking	
Domains and competencies	Means	*t*-tests *t*/*df*/adjusted *p*	Means	*U*-tests *z*/adjusted *p*
Disability-related assistive technology				
C11. The visual, auditory, tactile, motor, and cognitive skills necessary to access various types of assistive technology.	2.85/3.02	1.283/48.60/1.000	37.84/40.18	−0.295/1.000
C12. The effects of low vision on the use of assistive technology (such as lighting, contrast, size, and glare).	3.50/3.17	−2.376/66/.722	57.26/45.03	−3.706/.014*
C13. Braille literacy and its application in providing effective assistive technology services.	3.35/3.15	−0.842/66/1.000	52.94/44.52	− 1.767/.945
C14. The effects of deaf-blindness on the use of assistive technology.	2.24/2.85	3.753/54.24/.029*	17.65/34.08	−3.725/.013*
C15. General assistive technology for individuals with disabilities other than visual impairments (like switches, software that provides scaffolding supports, augmented communication devices, and picture-based symbols).	2.09/2.84	4.835/55.99/.001*	14.37/33.78	−3.656/.017*
C16. Use of assistive technology as part of the expanded core curriculum, including independent living devices.	3.03/3.00	0.623/57.66/1.000	43.24/39.28	−0.835/.999
C17. Use of effective evaluative practices in collaboration with a multidisciplinary team to determine what technology would best assist the student in accessing the educational curriculum.	3.00/3.06	1.953/62.85/.956	41.94/41.37	−0.834/.998
C18. State the advantages and disadvantages of assistive technology for potential users with various degrees of vision.	3.03/3.08	1.623/62.42/.996	43.16/42.22	−0.460/1.000
C19. Identify a variety of assistive technology devices (such as software, hardware, and peripheral devices) for students with various visual abilities, ages, and cognitive abilities.	3.03/3.07	1.775/48.26/.989	43.21/41.82	−0.166/.998
Use of assistive technology				
C20. Use screen-reading software and make adjustments to its basic features.	2.85/3.01	0.927/66/1.000	36.90/39.71	−0.288/.999
C21. Use screen-magnification system software and make adjustments to its basic features.	2.88/3.01	1.055/66/1.000	37.63/39.45	−0.043/.999
C22. Use braille-translation software and make adjustments to its basic features.	2.91/2.95	1.054/66/1.000	38.96/37.67	−0.184/1.000
C23. Use braille-translation software for Nemeth code translation.	2.59/2.91	3.098/66/.172	27.78/36.16	−2.841/.227
C24. Use various closed-circuit television systems or video magnifiers.	2.91/2.98	0.700/66/1.000	38.63/38.43	−0.460/1.000

Table 1
(Cont.)

Domains and competencies	Perceived level of expertise: Means	Perceived level of expertise: t-tests t/df/adjusted p	Relative ranking: Means	Relative ranking: U-tests z/adjusted p
C25. Use various personal digital assistants or braille notetakers.	2.85/2.95	0.755/66/1.000	36.91/37.56	−0.951/.998
C26. Use digital recorders and make adjustments to their basic features.	2.56/2.88	2.216/66/.830	26.84/35.09	−1.227/.997
C27. Use digital Talking Book players and digital e-book recorders (including downloading e-books) and make adjustments to their basic features.	2.91/2.95	0.217/66/1.000	39.09/37.27	−1.804/.940
C28. Use braille embossers and make adjustments to their basic features.	2.88/2.83	0.192/66/1.000	38.01/33.66	−1.602/.975
C29. Use scanners and OCR software systems and make adjustments to their basic features.	2.91/2.81	−0.366/66/1.000	38.90/32.67	−2.276/.662
C30. Use a refreshable braille display and its accompanying software (screen-reader software).	2.82/2.85	0.383/66/1.000	35.94/34.30	−0.957/.999
C31. Use common technology skills (those practiced by the general population) as they support learning of students with visual impairments.	3.00/3.02	0.770/66/1.000	42.09/39.92	−1.117/.998
C32. Use a standard braille writer, a unimanual braille writer, and extension keys.	3.15/3.07	0.000/66/1.000	46.54/41.41	−1.638/.971
C33. Use electronic braille devices.	2.91/2.95	0.888/66/1.000	39.34/37.65	−1.111/.997
C34. Use tactile graphic devices.	2.62/2.84	2.364/66/.720	29.19/33.68	−1.534/.976
C35. Use a talking four-function calculator, a talking scientific calculator, and a software-based talking calculator.	2.53/2.82	1.675/66/.994	25.59/33.16	−1.405/.987
C36. Operate a talking dictionary and a software-based talking dictionary.	2.41/2.81	2.997/66/.221	21.78/32.54	−2.786/.251
C37. Make modifications to general education technology (like a microscope or telescope) for students with visual impairments.	2.50/2.85	2.238/66/.819	24.99/34.03	−1.166/.998
C38. Use handheld magnifiers, stand magnifiers, monoculars, and telescopes.	3.00/3.01	−0.206/66/1.000	42.78/39.63	−2.976/.156
C39. Identify various nonoptical devices available for students with low vision.	2.94/2.95	−0.217/66/1.000	40.74/37.43	−2.736/.281
C40. Describe the advantages and disadvantages of various types of lighting devices.	2.91/2.95	0.000/66/1.000	39.03/37.54	−2.258/.664

Table 1
(Cont.)

Domains and competencies	Perceived level of expertise		Relative ranking	
	Means	*t*-tests *t*/*df*/adjusted *p*	Means	*U*-tests *z*/adjusted *p*
C41. Produce simple tactile graphics using the following methods of production: collage, tooled, Thermoform, microcapsule paper and heat fuser, and computer-generated graphics.	2.74/2.81	0.418/66/1.000	32.99/32.41	−1.123/.998
Assistive technology instructional strategies				
C42. Teach concepts related to the basic installation of assistive technology devices, including managing cords and plugs.	2.50/2.91	2.478/66/.633	24.79/36.32	−1.975/.868
C43. Teach concepts related to the basic maintenance of assistive technology devices.	2.50/2.93	2.376/66/.716	24.93/37.00	−1.840/.934
C44. Provide instruction in assistive technology devices in purposeful ways and in authentic environments.	3.03/2.99	0.216/51.81/1.000	42.91/38.85	−1.822/.937
C45. Teach the student to use troubleshooting techniques.	2.94/2.89	0.000/66/1.000	40.35/35.29	−2.264/.666
C46. Provide sequenced instruction regarding technology as it relates to transition and employment.	2.85/2.93	0.927/66/1.000	38.28/36.72	−1.061/.998
C47. Teach students with visual impairments about resources for obtaining assistive technology devices and services.	2.62/2.95	2.510/66/.608	29.24/37.53	−1.558/.975
C48. Use appropriate educational strategies for the development of age-appropriate concepts and motor development appropriate for the use of assistive technology.	3.15/2.96	−1.283/66/1.000	46.50/37.77	−2.995/.150
C49. Develop lesson plans that incorporate the use of assistive technology.	3.18/2.98	−1.007/66/1.000	47.75/38.43	−3.264/.068
C50. Know the differences in assistive technology instruction for students with visual impairments and other disabilities.	3.03/2.92	−0.888/44.36/1.000	43.00/36.35	−3.049/.129
C51. Teach students with visual impairments in one-on-one situations, small groups, and large groups.	3.09/3.05	0.478/66/1.000	44.85/40.92	−1.319/.993
C52. Collect formative data and adjust lessons accordingly on the basis of the students' needs.	3.09/3.04	0.244/66/1.000	44.66/40.69	−1.589/.975
Learning environments				
C53. Articulate the visual features of learning environments as they affect instruction and the use of assistive technology.	3.03/2.98	0.216/66/1.000	42.54/38.47	−1.571/.975
C54. Assess and recommend assistive technology devices for specific learning environments (such as the classroom and gymnasium).	3.00/2.97	0.466/50.56/1.000	42.32/38.04	−1.767/.949

Table 1
(Cont.)

Domains and competencies	Perceived level of expertise		Relative ranking	
	Means	*t*-tests *t*/*df*/adjusted *p*	Means	*U*-tests *z*/adjusted *p*
C55. Analyze the visual (such as lighting and glare), auditory (like sound distractions and noise pollution), and physical environment to determine appropriate modifications of assistive technology devices.	3.18/3.03	−0.703/66/1.000	47.69/40.27	−2.786/.255
C56. Teach the student to adapt the learning environment to his or her needs.	3.09/3.04	−0.277/66/1.000	44.65/40.58	−2.191/.719
C57. Teach the appropriate social skills when using technology in various environments.	2.97/2.99	0.000/66/1.000	41.10/38.62	−2.491/.473
C58. Provide the least restrictive environment and the use of assistive technology in different placements.	2.94/3.01	0.529/66/1.000	40.13/39.51	−1.669/.967
C59. Know the strategies for involving the student with visual impairments in the class while using assistive technology.	3.12/3.05	−0.941/66/1.000	45.97/40.76	−1.688/.965
C60. Understand the dynamics of the physical arrangement of the classroom (including ergonomic issues) and their impact on the use of assistive technology.	2.97/3.00	0.767/66/1.000	41.49/39.12	−1.516/.976
C61. Know how to use assistive technology across environments.	2.97/3.01	1.294/60.06/1.000	41.24/39.45	−0.638/1.000
C62. Understand the need for portability and limitations of portability of specific assistive technology devices for students in various environments.	2.97/2.95	0.239/46.40/1.000	41.56/37.31	−2.399/.556
Access to information				
C63. Teach students with visual impairments the use of assistive technology for access to information in the classroom.	3.09/3.04	0.000/66/1.000	44.90/40.51	−2.332/.616
C64. Teach students with visual impairments to produce files in a readable format, including braille, large print, or an electronic format.	3.26/3.05	−0.790/66/1.000	49.88/40.85	−2.497/.474
C65. Teach students problem-solving techniques for the use of assistive technology in the classroom when materials are not in an accessible format.	3.29/3.02	−1.889/66/.971	51.34/39.84	−4.258/.001*
C66. Teach students with visual impairments to use the Internet.	3.44/3.00	−1.762/66/.989	55.44/39.16	−3.479/.032*
C67. Teach students with visual impairments to transfer files to appropriate assistive technology devices.	3.18/2.95	−0.825/66/1.000	47.74/37.59	−3.142/.099
C68. Teach the student to stay current with new technology, access online manuals, and obtain technical assistance from vendors.	2.97/2.88	0.000/66/1.000	41.22/35.13	−2.049/.823

Table 1
(Cont.)

Domains and competencies	Perceived level of expertise: Means	Perceived level of expertise: *t*-tests *t*/*df*/adjusted *p*	Relative ranking: Means	Relative ranking: *U*-tests *z*/adjusted *p*
C69. Identify and use a variety of sources for braille and large-print materials.	3.03/3.01	−0.494/66/1.000	43.25/39.76	−2.792/.255
C70. Identify and use a variety of sources for electronic and recorded materials.	3.06/2.98	0.426/66/1.000	44.16/38.60	−1.467/.982
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.	3.03/2.97	0.000/66/1.000	43.29/38.02	−2.565/.417
C72. Provide assistive technology services that allow a student to participate at the same level of involvement in learning activities as their nondisabled peers.	3.24/3.01	−1.200/66/1.000	49.49/39.67	−3.056/.128
C73. Know PC computer and Apple computer accessibility options (universal options menu, accessibility wizard, and display settings) for individuals with visual impairments.	2.94/2.98	0.748/66/1.000	39.72/38.42	−0.939/.997
Professional development				
C91. Know the funding mechanisms for professional development in assistive technology.	2.21/2.73	4.019/66/.010*	16.01/29.96	−3.558/.024*
C92. Know the resources for local, state, and national professional development training programs.	2.24/2.82	4.317/66/.004*	17.32/32.82	−4.454/.001*
C93. Know the federal, state, and local agencies that provide technology assistance to individuals with visual impairments.	2.26/2.95	5.374/66/.000*	17.21/37.30	−5.245/.000*
C94. Attend assistive technology conferences (such as Closing the Gap, CSUN, CTEVI, and AER).	2.24/2.78	4.280/66/.004*	17.46/31.48	−3.902/.007*
C95. Know the major assistive technology manufacturers and vendors.	2.68/2.82	1.762/66/.988	32.37/32.93	−0.006/.995
C96. Know the local, state, and national consumer organizations (such as the National Federation of the Blind, and the American Council of the Blind).	2.65/2.88	2.179/65.17/.852	30.09/35.28	−0.988/.999
C97. Know how to obtain assistive technology to assist families through service organizations (like the Lions Club and the Association of the Blind).	2.26/2.84	4.119/66/.008	17.21/33.36	−3.902/.007
C98. Engage in professional development activities to demonstrate continual growth in current and emerging assistive technology services.	2.94/2.98	1.693/61.21/.993	40.25/38.54	−0.344/1.000

asterisk after their adjusted *p* values in Table 1, including C14, C15, C91, C92, C93, C94, and C97). For all 7 competencies, the levels of expertise rated by the current participants were significantly higher than those rated by the experts.

According to the results of the *U*-tests comparing the relative rankings of the competencies (see Table 1), significant difference between the two groups were found in 10 (13.51%) of the 74 competencies (the competencies with an asterisk after their adjusted *p* values in Table 1). Specifically, the teachers of students with visual impairments ranked C12, C65, and C66 significantly lower than did the experts. In contrast, they ranked C14, C15, C91, C92, C93, C94, and C97 significantly higher than did the experts.

With regard to the participants' perceptions by domains, the means of the ranks of participants' responses in all six domains and then the priorities of the domains based on the means are presented in Table 2. In terms of the priority order of the six domains, the two groups agreed on four (66.67%). The major difference was that the previous expert group rated the "access to information" domain as the most important, but the current group of participants viewed the "disability-related assistive technology" domain as the most important.

Discussion

A comparison of perceptions

According to the results of the *t*-tests and *U*-tests, there were no statistically significant differences in opinion with regard to both levels of expertise and relative rankings by the two groups for 64 (86.49%) of the 74 competencies. In addition, the two

***Table 1* (Cont.)**

Domains and competencies	Perceived level of expertise: Means	Perceived level of expertise: *t*-tests *t*/*df*/ adjusted *p*	Relative ranking: Means	Relative ranking: *U*-tests *z*/ adjusted *p*
C99. Access resources, such as journals and websites.	2.65/2.93	2.022/66/.934	31.66/36.60	−0.571/1.000
C100. Advocate for professional development in assistive technology.	2.32/2.82	3.369/66/0.081	19.41/32.90	−3.239/.073
C101. Engage in reflective practice and evaluate one's own attitudes toward the application of assistive technology services.	2.79/2.87	0.530/66/1.000	37.40/34.61	−2.178/.723

* $p < .05$ after the sequential Dunn-Sidák correction.

Table 2
Priorities and means of the six knowledge and skill domains in assistive technology.

Assistive technology knowledge and skill domains	Priorities and means of the ranks of the previous group of experts	Priorities and means of the ranks of the current group of teachers of students with visual impairments
1. Disability-related assistive technology (C11–C19)	3rd/39.07	1st/40.25
2. Use of assistive technology (C20–C41)	5th/35.48	5th/36.43
3. Assistive technology instructional strategies (C42–C52)	4th/38.84	4th/37.81
4. Learning environments (C53–C62)	2nd/42.87	2nd/39.21
5. Access to information (C63–C73)	1st/46.40	3rd/38.87
6. Professional development (C91–C101)	6th/25.13	6th/34.16

groups agreed with the priorities of four of the six domains. Thus, for the majority of the 74 assistive technology competencies in the six domains, the participants in our study had the same opinions as the experts in Smith et al.'s (2009) study.

However, the 10 competencies with significantly different levels of expertise or relative rankings given by the two groups revealed some important areas that the two groups did not agree on. By giving both significantly higher levels of expertise and significantly higher relative rankings in comparison with the previous experts, the participants in our study placed more emphasis on knowledge of and skills in assistive technology for students with multiple disabilities (C14 and C15), and professional training and support resources (C91, C92, C93, C94, and C97). On the other hand, by giving significantly lower relative rankings, the participants put less emphasis on knowledge of and skills in the effects of low vision on the use of assistive technology (C12), teaching students problem-solving techniques when materials are not in an accessible format (C65), and teaching students the use of the Internet (C66). It was not the aim of this study to suggest whose opinions better reflect the needs of teachers of students with visual impairments in teaching assistive technology to these students. Rather, the identified differences in opinion between the two groups clearly indicated 10 areas of competence for which further investigation is necessary to develop a valid set of assistive technology competencies for teachers of students with visual impairments.

The participants' opinions on assistive technology

A close examination of the means for the groups in Table 1 revealed that, for the perceived levels of expertise, 10 of the 11 competencies in the "access to information" domain (C63–C73) were rated lower by the teachers of students with visual impairments. In terms of relative rankings, all 11 of those competencies were ranked lower by the teachers of students with visual impairments, with 2 of them being significantly lower, including having the ability to teach students to deal with inaccessible materials (C65) and to use the Internet (C66). The "access to information" domain as a whole was rated lower by the participants than by the experts (see Table 2), which indicates that the practicing teachers of students with visual impairments put less emphasis on accessing information than did the experts. This finding may be of concern when one considers that a major benefit of the use of assistive technology by individuals with visual impairments is the broadened accessibility of information. Given that these competencies focus on cultivating students' ability to seek information proactively, it is not difficult to understand why the experts particularly emphasized this domain over the others (see Table 2). Additional research is needed to examine the extent of accessing information skills that are being included in instruction in assistive technology to determine whether it is necessary to call for an increase in attention by practicing teachers of students with visual impairments to this area.

One interesting finding is that, when compared with the experts, the practicing teachers of students with visual impairments thought it was more important to know about assistive technology for students with visual impairments and additional disabilities like deaf-blindness (C14), such as switches and augmented communication devices (C15). This finding may be partially explained by the assumption that, within the context of inclusive education, practicing teachers of students with visual impairments are increasingly likely to encounter students with multiple disabilities. In fact, Griffin-Shirley et al. (2004) found that practicing teachers of students with visual impairments were just as likely to have students with deaf-blindness in their caseloads as they were to have students who read braille. This finding provides some additional insights into the responses of our participants regarding the need for increased training in assistive technology options for students with multiple disabilities.

Examining the means in Table 1 also showed that for all 11 competencies in the domain of "professional development" (C91–C101), the teachers of students with visual impairments, in comparison with the experts, gave higher levels of expertise to 7 competencies and higher rankings to 8 competencies. Five competencies were ranked significantly higher in both terms, including possessing the knowledge of funding mechanisms for professional development in assistive technology (C91), resources of professional development training programs (C92), agencies that provide assistance in assistive technology (C93), information from assistive technology conferences (C94), and possessing the capability to obtain assistive technology from service organizations (C97). Thus, the teachers of students with visual impairments thought it was more important for teachers to be able to find professional development resources for assistive technology. This finding is in concert with the findings from other studies that it is difficult for teachers to find support for assistive technology and that the lack of adequate teacher training is one of the major obstacles to the wider use of assistive technology by students with visual impairments (Abner & Lahm, 2002; Kapperman et al., 2002; Yeunjoo, Vega & Ashton, 2005).

In regard to the expected levels of expertise in the assistive technology competencies, 20 of the 61 participants who made comments at the end of the questionnaire expressed similar opinions that teachers' expertise in assistive technology was often determined by the particular needs of the students in their caseloads. As two participants said:

> It is important to remember that teachers often work with a huge variety of students. . . . This is relevant in that many teachers become experts in one area and are novices in another.

> Although I hear of new technologies, until I have a student who needs that area of assistive technology, I don't pay attention or learn the equipment.

Eight other participants provided a specific suggestion. Because of the great diversity of the population of students with visual impairments, the high diversity and rapid advancement of assistive technology, and the often narrow concentration of a teacher's caseload, it is unnecessary and unpractical for a teacher of students with visual impairments to be knowledgeable about every aspect of assistive technology. Instead, a reasonable assistive technology training and supporting system should give all teachers of students with visual impairments the most central and fundamental knowledge and skills about the use of assistive and then provide them with adequate support when they encounter specific problems in their work. For example, one participant commented:

> The problem I have found with assistive technology is that if I do not have a student who uses that technology, I get rusty on the equipment. . . . I think if a teacher has the basic knowledge and knows where to go to get the support that is needed, that is the most important.

Another participant wrote:

> I've answered "basic" for many of the entries because I believe that if a teacher of students with visual impairments has basic knowledge and awareness, she will be able to recognize when additional information, training, and support are necessary. There is too much information for one individual to know. I believe it is more important to have basic knowledge and have an idea where to start looking for additional support and assistance.

Such a system seems to be attractive because focusing on the most central and fundamental knowledge makes it easier for teacher preparation programs to include assistive technology content in their existing curricula. The participants' comments suggest the need for further investigation because they offer a field-based response to the challenges of both heterogeneity in the students served in the teachers' caseloads and the evolving array of technologies that may be useful in providing access and supporting learning for students. Inherent in acknowledging these challenges are the seeds of ideas that will lead to appropriate solutions.

Limitations

Two limitations of the study should be considered when interpreting the findings. First, the inadequate representation of teachers of students with visual impairments working in nonitinerant settings limits the generalizability of the findings to all teachers of students with visual impairments working in Texas. In addition, the questionnaire did not allow the teachers of students with visual impairments to revise the existing competencies or add or delete competencies, which may have limited the expression of their opinions.

Future studies

To get a reliable and practical set of assistive technology competencies for the preparation of assistive technology–capable and confident teachers of students with visual impairments, we suggest that further investigation is needed into the 10 identified areas of competence that the teachers of students with visual impairments and experts disagreed on. Opinions from different angles, such as what individuals with visual impairments think about assistive training, should be examined. Differences among geographic regions countrywide in regard to the expertise in assistive technology that is expected for teachers of students with visual impairments may also need to be taken into consideration.

Conclusion

This study surveyed practicing teachers of students with visual impairments in Texas on their opinions regarding a set of assistive technology competencies that Smith et al. (2009) developed for the preparation of teachers of students with visual impairments. It found that, for all the 74 competencies that were investigated, the participants agreed with the majority of Smith et al.'s group of experts. However, differences in opinion between the two groups were identified regarding 10 specific competencies, for which further investigation is recommended. The findings of our study reflect the opinions of practicing teachers of students with visual impairments, which are useful for teacher preparation programs in guiding instruction and assessment in assistive technology. The use of assistive technology has great potential to benefit students who are visually impaired. With research findings continuously finding that preparation of assistive technology–capable teachers is one major barrier to the use of assistive technology by students with disabilities, greater efforts are expected to make a difference.

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