Students with Visual Impairments and Assistive Technology: Results from a Cognitive Interview Study in Five States

TARA
Technology Assisted Reading Assessment

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Introduction

Societal advances rarely occur in a vacuum. Rather, advances in human thought and technology are often the result of urgent needs and demands by segments of the population. Assistive technology for persons with disabilities is an example of change prompted by human need. In schools, Assistive Technologies (AT) are tools used to promote access to the general education curriculum for students with disabilities. For students with visual impairments, assistive technologies may include low-technology devices for mobility such as walking canes, or high-tech academic tools such as computer or print magnification devices and screen readers (Cox & Dykes, 2001). Through the use of AT, students with visual impairments are better able to rise to the demands of challenging mainstream settings in schools.

While use of AT has provided students with visual impairments a more level playing field during instruction, use of AT in large-scale assessments has lagged behind. In an interview study of Teachers of the Visually Impaired (TVIs) conducted by Johnstone, Altman, Timmons, Thurlow, and Laitusis (2008), TVIs noted that statewide assessment practice has not caught up to classroom instructional practice for use of AT. TVIs reported that in some states, the *only* options available to students with visual impairments are braille, large print, and regular print tests. These options do not account for the variety of technologies students use in schools on a daily basis.

The gap between instructional and assessment practice is especially salient in reading content. In 2007, Thurlow, Johnstone, Timmons, and Altman found that students used a wide variety of magnifying, screen reading, refreshable braille, and other devices to assist with reading assignments. Yet, the authors' follow-up study in 2008 found that such devices are often not allowed on statewide assessments.

Large Scale Assessment, Technology, and Students with Visual Impairments

To date, little is known about the intersection of large-scale assessment, technology, and students with visual impairments. Five studies published between 2002 and 2007 investigated the use of computer administered tests for students with a variety of disabilities, but no consistent findings emerged (Johnstone, Altman, Thurlow, & Thompson, 2006; Zinesky & Sireci, 2007). Studies indicated that test validity may be compromised under certain accommodated conditions because of interaction effects for students with some disabilities (Fletcher, Francis, Boudousquie, Copeland, Young, Kalinowski, & Vaughn, 2006), or because accommodations had a positive scoring effect for *all* students (Leseaux, Pearson, & Siegel, 2006; Kettler, Niebling, Mroch, Feldman, Newell, Elliott, Kratochwill, & Bolt, 2005), thus negating the equalizing effect that technology-based accommodations are supposed to produce.

Despite the inconclusive nature of accommodations research, exploratory research on technology-enhanced assessments may provide some insights into future directions. Hansen, Lee, and Forer (2002) conducted a preliminary evaluation of speech output

technology for tests for individuals with visual impairments and found that 'self-voicing' testing systems (systems that provide audio cues on demand) have potential and may be capable of replacing human readers in certain testing situations. Likewise, researchers from the Center for Applied Special Technology (CAST) studied impact on student scoring when computer-based read-aloud testing accommodations were used (Dolan, Hall, Banerjee, Chun, & Strangman, 2005). Results of the study indicated a significant increase in scores when students read passages greater than 100 words using technological aids.

Higgins, Russell, and Hoffman (2005) demonstrated a possible trend in assessment using computer-based technology. Higgins et al. found that there were no significant differences in reading comprehension scores across testing modes compared to paper-based assessment. Another approach of accommodating students with visual impairments using multi-sensory approach aids was studied by Landau, Russell, Gourgey, Erin, and Cowan (2003). The Talking Tactile Tablet (a math tool with speech output) had a positive impact on the mathematics performance of students who were visually impaired or had difficulty visualizing graphics and diagrams. This study also found that students performed better on five of the eight items when using the Talking Tactile Tablet, and performed the same on the remaining three, indicating that a multi-sensory approach may be an effective approach for assessing students with visual impairments.

None of the studies summarized here "prove" that technology-enhanced large-scale assessments are more accurate measures of knowledge for students with visual impairments than traditional paper-based assessments, but all point to the importance of further exploration of technology assisted reading assessments for this population. One approach to better understanding the appropriateness of how students might use AT on a statewide reading assessment is through assessing their use and proficiency with assistive technologies. There currently are few models for assessing assistive technology proficiency that can be used for accountability purposes (Watts, O'Brian, & Wojcik, 2004), but the development of a standardized test that examines AT proficiency as it relates to reading may help inform accommodation and test format decisions for large-scale assessments in reading and language arts.

Study Methods

Overview

The purpose of this study was to better understand use of assistive technology in instruction and assessment by students with visual impairments. Our aim was to gather information that would be relevant to the creation of a new large-scale assessment that addressed reading as an activity that involved the use of a variety of technologies. In order to adequately determine assistive technology (AT) use, we interviewed and observed students themselves.

Sample

For this study, we targeted students with visual impairments in grades 6–10. We interviewed students in five states—two states in the northeast, one in the southwest, one in the upper midwest, and one in the south to ensure geographical representation. In addition, we sampled students from both general education school systems (n=9) and state schools for the blind (n=5). Four additional students were educated at state schools through general education classes in a nearby public school system. In total, we interviewed 18 students for this study. Of the total sample, 13 students had low vision and 5 students were totally blind. Two participants with low vision also had hearing loss, and four additional students had one other documented disability.

Instrument and Procedures

Students participated in "observational interviews" facilitated by three researchers on the project. Observational interviews were a hybrid between verbal interviews, where respondents describe phenomenon (Bogdan & Biklen, 1998) and cognitive interviews, where interviewees participate in an activity and describe their thoughts and actions (Ericsson & Simon, 1993). During these interviews, students were asked several questions about their use of reading AT in the classroom and home. Afterward, students were asked how they use AT in the reading process, including how to download files, retrieve information from printed material, and explain preferences when using AT. A protocol for interviews is found in the Appendix to this report.

Each interview lasted between 30 and 60 minutes. Interviewers worked alone or, when possible, in teams. The procedure for each interview was exactly the same. In each interview, the lead researcher confirmed that consent and assent forms were signed, introduced the study's purposes, then began asking questions. After answering several questions about AT use in general, students were asked to demonstrate how they use AT devices. Because AT devices and preferences are individualized, students often demonstrated how to use different devices and platforms during interviews. A complete listing of student technologies used is found in the "Results" section.

Analysis

After each interview, lead researchers created a summary report based on a model developed by Educational Testing Service researchers for their work with adult AT users. Each summary contained a brief narrative of the student's current educational functioning and AT use. Summaries also included notes on tasks that were very easy and very difficult for students, information on AT choices and why students select certain AT formats, level of independence of AT users, and descriptions of tasks completed by students.

After all 18 summaries were written, our research team analyzed each of the summary documents' contents for themes that emerged across interviewees. This process took place in two phases. First, one researcher examined data found in summaries and labeled

relevant trends and themes that emerged from summaries. Second, the research team analyzed these interpretations for possible errors and for additional perspectives from anecdotes or other information derived in the field. Final themes were agreed to by all research team members.

Results

This study sought to examine how students use assistive technologies in the areas of reading and language arts. Previous studies in the same overall research endeavor included a teacher survey (Thurlow, Johnstone, Timmons, & Altman, 2007) and teacher interviews (Johnstone, Altman, Timmons, Thurlow, & Laitusis, in press). This study focused on the students themselves and included both student observations and interviews. For the first phase of this study we labeled relevant trends and themes that emerged from the summaries. For the second phase we analyzed interpretations for possible error and perused additional perspectives and anecdotes.

Quantitative Results

The first step was to examine the characteristics of student learning and assistive technology use. We found that 17% of the participants (n=3) were able to read regular print. These students also read large print, and two of them also used audio books to read. Eight additional students read large print only bringing the total number of large print readers among participants to 11 or 61%. The next 7 students all read braille. The final student read using audio only.

Many of the students who read large print also read in braille. Of the 18 students in the study, 56% read braille (n=10). Many of the students also used audio books to access print regardless of their primary method of print reading (72%, n=13). Of these, 10 students had used JAWS in the past year for audio needs. ZoomText with audio was also used by 8 students (although some of these students also used JAWS).

Braille products also were used often by the participants. Eight of the ten students who read braille used some form of technology for reading Braille. The Braille Note device was used by 5 of the 8 students who used such technology. Two others used the Braille Sense or Braille Sense Plus, and one student used a Braille and Speak.

For magnification, students used a variety of technologies, from simple handheld magnifiers to computer-based products. Used frequently were both Zoomtext (most often also with speech) or a closed-circuit televisions (CCTV). Seven students used both types of technology depending on the reading situation. Two students used Zoomtext only, and two students used CCTVs only.

Students obtained their reading materials from a variety of sources including the Reading for the Blind and Dyslexic (RFB & D) catalog, Bookshare, and Braille Text from a state agency. Used most frequently was RFB & D which was used by six students. Bookshare was used by three students, and three students also accessed books from a state agency.

Qualitative Results

Student interviews and observations produced a wealth of qualitative information about student use of assistive technology. Many of the factors that emerged were related to student characteristics and independence. Students varied from completely relying on help from sighted teachers, para-professionals, and peers to being assertively independent. Most students described their dependence on others as situational. One student mentioned that he is not afraid to ask his friends or family to read things for him if the materials to be read are too far away or he does not have access to his CCTV or would rather not use it at that time. Another student, however, was visibly offended when the interviewer asked him what kind of sighted help he receives, replying that help is not needed at any time.

Various technologies were used by study participants in their daily school work and home lives (e.g., to complete assignments, take tests, research topics, read assignments, communicate with friends). Participants who were visually impaired but had some vision used multiple means of accessing texts, including large print, audio, and braille. Students who were legally blind were more likely to be braille readers and also use audio. However for all students, it appeared that there were some favored forms of technology, including Zoomtext, JAWS, and any number of CCTVs.

Decisions about which technology students were using appeared to be influenced by a variety of factors. Technology choices typically depended on student location and the availability of technology in that location. For example, students at a state school typically would have more access to technology than a student in a rural public school that did not serve a large population of students with visual impairments. Students also did not always have access to the same technologies at home as they did in school, especially if they did not have a computer at home. One student, who was on the academic honor roll at school, often stayed after school and came in before school every morning to finish homework. Other students may have had different versions of technology at home, for example, less expensive software, older versions, or trial memberships. Students also may or may not be able to transport CCTVs home depending on equipment size, portability, and student age.

We also found that decisions were impacted by the nature of the student's visual impairments. Changes in student vision and forecasts for future change often called for a change in products. For example, one student used a CCTV up until 6th grade but stopped using it because there was a decrease in his field of vision and it was no longer practical. Another student had very low vision at the time of the interview and was fore-

casted to have diminished vision in the coming years. For this reason she had not spent time learning how to use low-tech visual aids. A third student was spending a little less time learning the ins and outs of programs like Zoomtext because he was learning braille due to expected loss of all vision.

The students also had varied amounts of say in the specific technology to which they were exposed. The student's TVI or para-professional generally was very involved in the decision, along with school districts that set budgets on purchases. Some students were also very involved in the decision making about technology, with some even attending technology conferences or gaining access to new technology when vendors visited their schools. It is important to note that another person (teacher, parent, or para-professional) needed to learn the technology along with the student when the other person did not already have a knowledge base to draw on. TVIs had to be careful not to over-extend themselves with multiple new technologies all at once. The importance of the knowledge of the TVI was made evident in the case of one student who had limited time with the TVI; this limitation made learning how to use a computer and one assistive technology a priority over others that might have been desired.

Study participants also reported several problems or difficulties in using assistive technology in the classroom, or at home. One common theme was that the amount of time that must be dedicated to training and practice in using the equipment sometimes outweighed the potential benefit of the technology. For example, one student worked independently but was often slowed down by struggles in keeping the directions for his various technologies straight. Another student commented that it took an entire year to learn the commands for the program that was used. Many of these technologies also require a student to be a proficient keyboard user, and to have a fairly deep understanding of computer function. One student's TVI mentioned that the student's one-finger typing style was the reason he had not been upgraded from an Alphasmart to a laptop computer with technology. Another complication was consistent access to technology, especially a computer. Students were sometimes forced to share technology with several other students, including CCTVs, resulting in a situation where students were not able to use the device when it was needed. For some students this was not a problem, generally because they had their own computer at school, and access to their own technology.

There was also difficulty in transporting, setting up, and stowing equipment. These activities required their own set of skills, time, and pre-planning, all of which the student may or may not have had. For example, one student chose not to request large print books for school because of the cumbersome nature of organizing the volumes and knowing what to take home or to class on a given day. Another chose to use a CCTV if pressed for time, rather than other technologies because of the set-up time required for certain higher-tech options. On several occasions, we found that students learned a particular technology platform, then were hesitant to move to other platforms (even if the other platforms might improve their performance).

Equipment malfunction, general hang-ups, and glitches also were sometimes troublesome for students, teachers, and para-professionals alike. For example, one student spoke of an electronic version of an assignment that was nearly complete but was lost due to resetting the assistive technology after it froze. Other students noted that some Internet Web pages do not cooperate with JAWS and ZoomText in the manner desired. One student stated that the Web sites that contained many graphics can be most problematic. An additional comment touched on the variability in technology function with specific computer applications, specifically PowerPoint and its function using ZoomText.

The students reported using a variety of approaches in large-scale assessment, some of them effective and others that created a testing situation that was less than desirable. Multiple students reported using enlarged text to access the items and then having the para-professional fill in the bubble answer sheet. At least one student was able to take a math test using a computer; however, he was required to take the reading test using a paper and pencil version. Other students used standard question and answer forms, accessing them via CCTVs.

Conclusions: Implications for Technology Based Reading Assessments

The term "Opportunity to Learn" (OTL) has been used in a variety of educational contexts in the current era of accountability. The term often refers to student access to rigorous curriculum. For example, an English language learner may not have opportunity to learn content because of the language of instruction in a school. Likewise, a student from an under-resourced school may not have the opportunity to learn because of inadequate learning materials in the school. Conclusions drawn from large-scale test results are more valid when students have the opportunity to learn the constructs that are assessed.

Data from this study indicated that OTL may be an issue for students with visual impairments, but for different reasons. Although our sample demonstrated an adequate level of literacy with print and braille documents, the demands of a rigorous high school curriculum at times left students without enough time to explore and become proficient in new and possibly more efficient strategies.

Because of this, we theorize that students with visual impairments may be caught between competing agendas. The reading demands of a typical middle and high school curriculum are very time intensive. For students with visual impairments reading large print or braille, the time it takes to complete a task is often far greater than that for their peers with full functioning vision. In theory, assistive technologies are designed to help students fully participate in all grade-level activities. The challenge for students is that these assistive technologies are sometimes unreliable (e.g., not all formats work for internet-based text), take time to learn, and do not always accompany the student beyond the school walls (e.g., many students cannot bring AT devices home to assist with

homework). Because of breakdowns in the AT process, students with visual impairments do not always have the same opportunities to learn as their peers with normal vision.

Beyond this, we learned from our sample of students that the prospects of exposure to new technologies that may increase student efficiency were highly dependent on the knowledge of others. Our students reported that access to technologies came directly through teachers. In cases where teachers kept current on assistive technology platforms, students were able to experience and practice with a variety of tools. In cases where teachers were unfamiliar with emerging AT platforms, student AT access was greatly diminished.

In this study, the opportunity to learn and practice with different AT devices varied by student (in theory, there should be variability because AT is supposed to be individualized to match student need). Therefore, developing a standardized test to assess student AT knowledge may be difficult. Our task, to develop a technology-assisted reading assessment, is equally challenging.

Because student experience varies widely and because there are not standards on which types of platforms students may use, creating a test that allows for only one type of platform may be impossible. Rather, our data from this study indicate that while formats vary, end goals are the same. Meeting grade-level reading standards is the primary goal for all students, whether or not they use an AT format in the process of meeting standards. Therefore, based on conclusions of this study, a technology assisted reading assessment probably should be flexible in its allowances of what types of tools students could use, but should also clearly outline types of activities for students to complete. For example, opening files, locating information, and understanding the structure of literary or expository documents are all tasks that are necessary for students to access print.

The opportunity to learn and benefit from a rigorous curriculum depends on many factors outside the control of a student with visual impairment. Ocular functioning, access to technology, instruction in technology, and time demands all influence how much or little benefit a student with a visual impairment will gain from the curriculum. Therefore, creating a technology assisted reading assessment may be a lever that forces the issue of access on schools, making them ensure that students are provided maximal opportunity to access curriculum through high quality technology instruction, access to technology at all times, and support with time management. Technology assisted reading assessments may provide a more valid opportunity for students to demonstrate knowledge, but also act as a catalyst for ensuring that schools and districts are accountable for providing students with the AT they need to access grade-level curriculum.

References

Bogdan, R.C., & Biklen, S.K. (1992). *Qualitative research for education. An introduction to theory and methods*. Boston: Allyn and Bacon.

Cox, P. R., & Dykes, M. K. (2001). Effective classroom adaptations for students with visual impairments. *Teaching Exceptional Children, 33*(6), 68-74.

Dolan, R. P., Hall, T. E., Bannerjee, M., Chun, E., & Strangman, N. (2005). Applying principles of universal design to test design: The effect of computer-based read-aloud on test performance of high school students with learning disabilities. *The Journal of Technology, Learning, and Assessment, 3*(7). Retrieved August 5, 2006, from http://escholarship.bc.edu/jtla/

Ericsson, K., & Simon, H. (1993). *Protocol analysis: Verbal reports as data.* Cambridge: MIT.

Fletcher, J. M., Francis, D. J., Boudousquie, A., Copeland, K., Young, V., Kalinowski, S., & Vaughn, S. (2006). Effects of accommodations on high-stakes testing for students with reading disabilities. *Exceptional Children, 72*(2), 136–150.

Hansen, E., Lee, M. J., & Forer, D. (April 2002). A "self-voicing" test for people with visual and learning disabilities," *Journal of Visual Impairment and Blindness, 96*(4), 273–275.

Higgins, J., Russell, M., & Hoffman, T. (2005). Examining the effect of computer-based passage presentation on reading test performance . *The Journal of Technology, Learning, and Assessment*, *3*(4).

Johnstone, C. J., Altman, J., Thurlow, M. L., & Thompson, S. J. (2006). *A summary of research on the effects of test accommodations: 2002 through 2004* (Technical Report 45). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.

Johnstone, C., Altman, J.R., Timmons, J., Thurlow, M., & Laitusis, C. (2008). *Field-based perspectives on technology assisted reading assessments: Results of an interview study with teachers of students with visual impairments (TVIs)*. Princeton, NJ: Education Testing Service.

Kettler, R.J., Niebling, B.C., Mroch, A.A., Feldman, E.S., Newell, M.L., Elliott, S.N., Kratochwill, T.R., & Bolt, D.M. (2005). Effects of testing accommodations on math and reading scores: An experimental analysis of the performance of students with and without disabilities. *Assessment for Effective Intervention*, *31(1)*, 49–62.

Landau, S., Russell, M., Gourgey, K., Erin, J. N., & Cowan, J. (2003). Use of talking tactile tablet in mathematics testing. *Journal of Visual Impairment and Blindness*, *97*(2), 85–96.

Lesaux, N. K., Pearson, M. R., & Siegel, L. S. (2006). The effects of timed and untimed testing conditions on the reading comprehension performance of adults with reading disabilities. *Reading and Writing, 19* 21–48.

Thurlow, M.L., Johnstone, C.J., Timmons, J., & Altman, J.R. (2007). *Survey of teachers of students with visual impairments. Students served and their access to state assessments of reading.* Princeton, NJ: Educational Testing Service.

Watts, E. H., O'Brian, M., & Wojcik, B. (2004). Four models of assistive technology considerations: How do they compare to recommended educational assessment practices? *Journal of Special Education Technology, 19*(1), 43–56.

Zenisky, A. L., & Sireci, S. G. (2007). *A summary of the research on the effects of test accommodations: 2005–2006* (Technical Report 47). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.

Appendix

Protocol for Observational Interview

Thank you for agreeing to participate in this observational interview with us. My name is _____ and INTRODUCE OTHERS IN ROOM. We are working on a project to develop a test of student's ability to use assistive technologies to access grade level English language arts texts. I will start by asking you a few questions about your use of assistive technologies and then I will ask you to perform a few tasks while I/we watch. Then I may have a few more questions for you about why you selected a specific technology or procedure to accomplish the task. The entire interview should take about an hour. If at any time you would prefer to stop the interview you are free to do so. Do you have any questions before we begin?

Assistive Technology Type Questions:

What types of assistive technology do you use most often?

Why have you chosen this technology?

Assistive Technology Use Questions:

Can you tell us how (or if) you use assistive technology when doing homework?

Can you tell us how (or if) you use assistive technology in English class?

Do you get training from your TVI?

What kinds of things does your TVI teach you to do?

If in class and homework are different. Ask

"Why is there a difference in what you use in school and while doing homework?"

Opening question:

Can you show us some other things you have learned to do with your assistive technology that you think are really helpful or that you have had difficulty learning to do?

Tasks

Show us something you would typically do using [specific technology]

Show us how you would [open, navigate, locate text, locate graphic] in [textbook, literature, word file, pdf, Web site]

Specific Questions:

OPEN: Show us how you would open [textbook, literature, word file, pdf, Web site]

READ: Can you read page 10, chapter 2,

NAVIGATE: Can you go to page 10, chapter 2, the link X,

Can you speed up the speech or slow it down?

Can you

LOCATE GRAPHIC: Locate and report on information in graphic (possible idea is use of business letter, manual on using something)

LOCATE TEXT: Locate and report on information in text

Basic Multiple choice questions:

What is bookshare?

What are NIMAS textbooks?

Q: If you were asked to write a report on [Typical middle school author] and your teacher required you to use materials both online and in print, how would you find these materials in accessible format?

A: Ask teacher (what would you ask your teacher to do)

Go online (where would you go online)

Bookshare

Post test questions:

Question on does the student independently access text

Do you feel your skills in assistive technology are good enough for you to work independently now or do you need help from your teacher?

Do you feel your skills in assistive technology will be good enough for you to work independently once you go to high school?

1. What sorts of locating-tasks do students typically need to do? That is, do they need to find specific chapters, headings, paragraph, pieces of text?

2. In a classroom or related setting, how do teachers direct their blind or low-vision students to particular portions of text. That is, do they do it by chapter number, heading, page number, text string, or some combination?