

---

# Preferences and Practices Among Students Who Read Braille and Use Assistive Technology

Frances Mary D'Andrea

---

**Structured abstract:** *Introduction:* Students who read braille use assistive technology to engage in literacy tasks and to access the general curriculum. There is little research on the ways in which technology has changed the reading and writing practices and preferences of students who use braille, nor is there much research on how assistive technology is learned by students with visual impairments. *Methods:* This article describes the first phase of a mixed-methods study that was conducted to investigate the current use of paper braille and assistive technology among students aged 16–22, and the students' attitudes toward braille and technology as tools for classroom learning in high school and college. The first phase of the study consisted of 12 structured interviews of students from across the United States, which were transcribed, analyzed qualitatively, and coded for themes reported here. *Results:* The practices used by students fell into three broad themes, (1) the wide variety of devices used for reading and writing, (2) the types of tasks they performed using specific devices, and (3) the ways students learned practices for using braille and technology. Their attitudes fell into three themes as well: (1) preferences about braille and of technology tools, (2) how students chose to use those tools for specific tasks, and (3) the role teachers played in learning to use technology. *Discussion:* Results of the study indicated the changing nature of how students use various tools and how they select approaches to completing their class work, and the importance for students of being able to make choices regarding tools and strategies. *Implications for practitioners:* These themes suggest that for students to take advantage of the many choices available to efficiently complete school tasks, they must be proficient in multiple methods and tools for learning.

---

A defining characteristic of American life is a rapid and accelerating change of pace in the use of technology. People use technology to communicate, to work more efficiently, and to engage in leisure activities. Seventy-seven percent of American households have a computer (Kennedy, Smith,

Wells, & Wellman, 2008), and half of Americans report frequent use of the Internet during a typical day—and that number is growing (Morales, 2009).

The use of technology has had a significant impact on the lives of students with visual disabilities as well. The wide

---

variety of assistive technology devices now available means that students can more easily use computers to communicate, to access information, and to produce written and multimedia materials. Electronic devices can be used for taking notes, downloading books from the Internet, composing written assignments, and sending and receiving e-mail, among other tasks. The promise of assistive technology in the lives of students who are blind has led to new opportunities and new challenges. Many digital practices are finding their way into schools, and are sometimes termed “multiliteracies” (Anstey & Bull, 2006).

For all of its importance, there is little research on the ways that technology has changed literacy acquisition or the reading and writing practices of students who use braille (Ferrell, 2007). There are no data that indicate the extent to which paper braille is used by young people who are blind, or whether electronic and audio formats have become more prevalent. Studies indicate that students who are blind use assistive technology to access computers for various classroom tasks (Corn & Wall, 2002; Farnsworth & Luckner, 2008; Fellenius, 1999), but it is unclear for what purposes young people are using electronic devices as opposed to paper braille for completing classroom assignments and how they are learning to use those devices.

This study investigates the use of technology by students who are blind and use braille, and students’ practices and attitudes regarding both braille and assistive technology devices to complete schoolwork. The following research questions were addressed in this study:

1. How do young adults (ages 16–22) who are braille readers use braille, audio, and electronic materials and tools for educational purposes?
2. How do young adults who are blind learn new literacy practices (such as using the Internet for research, using electronic books, etc.) using assistive technology?
3. What are the attitudes of young adults toward hardcopy (paper) braille, and toward access technology?

A mixed-methods approach linking qualitative and quantitative data was used to clarify and deepen the information gained in two phases of this study. Qualitative information was first gathered from students who use both braille and technology, and then this information was tested quantitatively by a larger number of students. This article discusses only the qualitative phase of the study, the structured interviews.

## Method

The first phase of the project investigated how advances in technology have influenced literacy practices for young adults who are blind and who use braille and assistive technology by the use of elaborated case studies (Rubin & Rubin, 2005) through focused interviews. This portion of the study was descriptive in nature (Bogdan & Biklen, 2007). The interview protocol was designed to investigate specific issues but to be open-ended enough that new areas of investigation could be explored. The use of such semi-structured interviews is helpful in cases where the researcher knows enough about the subject to develop questions but not enough to foresee the responses (Morse &

---

Richards, 2002). The Institutional Review Board at the University of Pittsburgh approved the study.

The interviews were conducted by telephone during the fall of 2009. The students were asked to describe the devices they used and how they used them, as well as their preferences for using braille and their assistive technology devices, how they learned these skills, and from whom. The interviews focused on classroom learning practices as opposed to social or recreational activities. Questions also probed students' experiences with multiliteracies in the classroom, such as participation in shared document writing, preparing multimedia presentations, blogs, and so forth. Finally, students were asked to give their advice to peers about braille and technology, as well as what advice they would give to preservice teachers of students with visual impairments.

During the interviews, the researcher (the author) took notes, and constant comparison of responses to each question was used to monitor whether novel responses were being given, or if students were giving similar responses to specific questions. Digital recordings of each interview were transcribed and annotated following each of them. The final data record was analyzed through a systematic, inductive process of coding (Bogdan & Biklen, 2007). This process began with open coding of the entire data set to explore the themes and ideas that emerged from the data. Following this coding, a set of broad themes was established and more focused coding occurred. Patterns were examined and subthemes and topics coded and identified. As additional interviews were recorded, coded, and analyzed, compari-

sons were made between the patterns and themes that emerged from them (Rubin & Rubin, 2005).

Responses to specific interview questions were put into tables that enabled the researcher to compare answers that could be probed in subsequent interviews. The tables were also useful in designing the survey used in the second phase of the study.

## **PARTICIPANTS**

Students between the ages of 16 and 22 who were enrolled in an academic school program, either high school or college, used braille as their primary medium, and who also used at least one assistive technology device were invited to participate in both phases of the study. A convenience sample of students was recruited through teachers of students with visual impairments known to this researcher, and through existing electronic mailing lists for teachers and for blind consumers.

A database was developed that also served as an initial screening tool to ensure that the volunteer participants fit the study criteria for both phase 1 and phase 2. Interviewees were selected in an attempt to reflect as much diversity as possible as far as sex, age, location (state and whether urban, suburban, or rural), and type of school (that is, whether they attended a specialized school for the blind or their neighborhood public school). The list of 12 interviewees is presented in Table 1.

The responses to the question, "How long have you read braille?" illustrate the heterogeneity of this population of students and captures the complexities of defining a primary reading medium for many students. All of the students

**Table 1**  
**Interview participants.**

Sex	Age	State	Area	School	Type
M	20	NY	Urban	College	Public
F	19	NY	Urban	High school	Specialized
M	18	NY	Rural	High school	Public
F	19	NY	Rural	College	Public
F	18	IN	Urban	High school	Specialized
M	16	IN	Urban	High school	Specialized
M	17	MD	Suburban	High school	Public
F	19	NC	Suburban	College	Public
F	20	CA	Rural	College	Public
M	19	WV	Rural	College	Public
F	17	UT	Suburban	High school	Public
M	18	PA	Urban	High school	Specialized

reported that they had learned to read and write braille from a teacher of students with visual impairments. Eight of the students interviewed had learned braille in preschool or kindergarten. One student reported that she did not really “learn” braille until fourth grade, when she finally had a teacher of students with visual impairments who provided daily instruction. Three students lost vision after starting with print and thus learned braille in elementary or early middle school grades. One student started braille instruction at the age of nine and considered herself a proficient but slow braille reader but a very fast braille writer. One student had always used paper braille with difficulty because of damage to the nerve endings in his fingers, so he preferred to read on thermoform paper (a plastic substance that creates sharper dots) or with a refreshable braille display.

All of the students recalled learning to write braille around the same time they learned to read it. All but one started with the Perkins Braille; one student who started braille instruction at age 12 began writing with a Braille n’ Speak. Most of

the students started technology instruction in elementary school and described using a progression of tools of greater complexity as they got older. One 16-year-old student had not been taught to use any assistive technology until he started attending a specialized school for the blind the year before. All the students but one reported learning to use the slate and stylus but only one student reported ever using it for functional tasks.

## Results

The interview protocol was based on the research questions, but the responses fell more naturally into two categories: (1) the students’ practices and (2) preferences for completing school work using braille and technology.

### STUDENT PRACTICES FOR READING AND WRITING

Three themes emerged from an analysis of the interviews conducted regarding the category of practices that students who are blind used in conducting school tasks:

## Tools used by students to complete schoolwork

BrailleNote	OCR scanner	Books on tape
Braille Plus	Electronic braille	Books on CD
Computer with Jaws	embosser	Large Print
Computer with WindowEyes	Brailiant 24	Talking Calculator
Computer with MAGIC	Cell phone with Mobile Speak	Electronic books from BookShare
Victor Reader	Digital recorder	RFB&D and WebBraille
Victor Wave	GPS system	Franklin Language
Victor Stream	Perkins brailier	Master/Talking
Victor Vibe	Braille label maker	Dictionary
BookPort	Cassette tape player	

### *Box 1*

1. the devices or tools they used for reading and writing;
2. the tasks they performed using specific devices and tools; and
3. the way they learned those practices.

### ***Devices or tools currently used for reading and writing***

All of the students interviewed reported using a multiplicity of tools in the classroom to complete their work, including braille on paper. No student listed fewer than four devices; some listed up to eight tools they used to complete school work. A list of tools mentioned is found in Box 1.

All 12 of the students reported using computers that had screen-access software, and most students used some type of braille-compatible portable data assistants (PDAs). The tools most frequently mentioned were the BrailleNote ( $n = 10$ ) and JAWS screen reading software ( $n = 8$ ). Several students commented that their mobile phone was a device they turned to for assistance with class work, citing features such as the calendar and notes found on many mobile phones. Eight of the students reported

using electronic textbooks and specific devices designed to access those.

There appeared to be differences between high school and college students for some practices, and reading braille on paper is one example. All of the high school students in specialized schools reported having most of their textbooks in embossed braille, although some also had electronic books as well. However, all of the college students stated that they used very little paper braille; most of their textbooks and other instructional materials were electronic. Some of the college students reported having paper braille for charts and tables created by themselves or by staff members at the disability office on campus.

The subjects in which the students overwhelmingly used paper braille materials, or wished to, were for mathematics, science, and foreign languages. Even the college students who reported using little paper braille preferred, if at all possible, to have those subjects in embossed braille. Two college students reported postponing courses in foreign language or math until they could

---

ascertain how to get the books in braille. Several students expressed the need for math in hard-copy braille in visual terms, that they had to “see it” rather than use the computer.

The language students used as they talked about their practices was notable in its complexity. It became clear to this researcher that when students said they “read braille” it did not necessarily mean “braille on paper” but could be braille on a refreshable display as well; when students said “read” they may be talking about reading braille (on paper or electronically) or using speech to access the text. “Books” could be both physical books and books they accessed electronically.

### *Tasks performed by students using braille and technology*

The students’ writing practices tended to be complex. The students as a whole reported producing very little paper braille except for personal uses such as labeling and studying. This was particularly true of the college students.

The students primarily produced print on paper for school tasks. Most students used their computers or devices with refreshable braille displays to write papers to turn in to their teachers, either on paper or through the use of portable drives (for example, thumb drives). Whether a student used the braille PDA or the computer seemed to depend on his or her personal preference, level of expertise with the device, and how much formatting the paper needed. The high school students tended to be less concerned or perhaps less aware of how their papers looked as far as headings and special styles that are available in word processing software. The college

students, on the other hand, showed a more sophisticated level of understanding about formatting their print papers, and reported having more demanding instructors who expected their papers to conform to certain standards. Several students mentioned communicating through e-mail with instructors and submitting homework and class assignments via e-mail.

All the students but one used the Internet for doing research for school tasks; the student who had just started using the computer had not yet gone online for research. Students were also asked to describe their experiences with multiliteracy activities, such as creating presentations, participation in interactive writing tasks such as wikis, using Google Docs, creating and using blogs for classroom tasks, and using the Internet. These students had few experiences to report. Only one student reported having to create a blog for a school assignment; other students stated they have created blogs, podcasts, or wiki pages for social purposes but not for school.

The one technology experience mentioned by most students ( $n = 10$ ) was using PowerPoint to create multimedia presentations either with a group or as an individual project. Most of the students felt they needed help from someone sighted to use PowerPoint to make the presentations visually appealing. Again, the college students seemed most concerned about this, stating they didn’t want their presentations to look “dumb” and would let their “artsy” peers design the slides.

### *How students learn to use technology for school tasks*

The interviewer asked questions to discover how the students learned to use

---

technology tools and what resources they used for learning more advanced technology tasks. Only one student mentioned learning to use technology primarily from a teacher of students with visual impairments, although some students reported being introduced to devices that way. Seven of the students stated they learned to use technology partly if not primarily on their own by using a built-in “help” file, or by “poking around” in the device menus. Eight of the 12 students reported learning to use technology from a center-based program outside of the school setting or from staff at a specialized school for the blind even if the student didn’t attend such a school. A third of the students named having blind friends who also use technology as a prime source of information and assistance.

#### **PREFERENCES AND OPINIONS ABOUT BRAILLE AND TECHNOLOGY**

While the students were discussing their practices, they simultaneously shared their opinions about braille and the devices they used. In fact, it was difficult to completely separate the practices from the preferences as the practices often derived from the students’ strong preferences of how they chose to get their work completed. Three themes evolved from the interviews:

1. preferences about their use of braille and of individual technology tools,
2. how they chose to use those tools for specific tasks and to access information, and
3. the role of teachers in learning to use technology.

#### ***Preferences about individual devices***

All twelve students had strong and very specific preferences for how they used

both braille and technology and could articulate their reasons quite clearly. A sub-theme in this area related to the use of proprietary vs. mainstream products. Students were aware that their assistive technology was more expensive than similar products that could be used visually, that is, without speech or refreshable braille, and that the latter were cheaper and easier to fix than their specialized technology. For those reasons, some students preferred to use “off-the-shelf” devices, like this student:

Notetakers are good but I personally recommend laptops over a notetaker just because . . . they’re a lot cheaper, I guess, and they’re a lot more accessible—like if something goes wrong you can have someone look at your computer and you can’t really do that with your notetaker.

Even students who preferred proprietary products mentioned that a disadvantage of using them was the difficulty of being without the devices when they are being serviced. Despite this, most of the students interviewed preferred to use specialized devices, particularly those with a braille display.

Another device that had widespread unanimity of opinion, although of a different kind, was the slate and stylus. Ten students stated that although they learned to use the slate and stylus, they did not actually use it and could not foresee that they ever would. Only one student reported using the slate, reporting that she used it to write people’s phone numbers. In addition to its disfavor as a braille-writing tool of choice, several students had quite strong

---

opinions when asked about their experiences writing with the slate and initially learning to use it:

I don't like it because it's a lot slower. And I would always get frustrated with it, so . . . I've not used it ever since then.

I HATE it.

Yet even among students who did not use the slate and stylus and did not plan to ever use it themselves, several still had an almost grudging respect for this inexpensive manual device, as evidenced by this comment:

I still own the devices but I don't use them anymore. But you'll never see me reject the importance of [the slate and stylus]. I think it's great. . . . It's really the closest thing to having a pen and paper with you. You know, sighted people, you know as long as they have a pen or something they can write on anything. Write on a Burger King napkin . . . anything. Not everybody is going to spend money on a digital recorder or not everybody's going to carry around a notetaker and you're not going to turn on a laptop to type somebody's phone number down.

### *Choosing tools for specific tasks*

The students were articulate about how they chose to do specific tasks, expressing awareness of the advantages and disadvantages for different tools and methods. All 12 of the students interviewed would advise other blind students to learn to use technology. Nine of the students stated

that a main advantage of using technology is that it is faster than using braille. Even the students who stated that they preferred to use braille if possible acknowledged that in some cases using technology, particularly speech access, allowed them to complete school tasks faster. The following quotes illustrate the students' opinions about using technology to complete work more efficiently:

I mean, the amount of high-volume material that I have to read in college is really not, it's not efficient to use braille unfortunately.

I think reading braille is a lot slower than using speech software, which you can crank the speed up very, very, very fast. And I do. You can just breeze through.

All the students but one specifically stated that a major disadvantage of braille books is their size and bulk. In their opinion, the convenience and portability of carrying one device or possibly two rather than hauling voluminous braille volumes was a definite advantage to using access technology. Using assistive technology tools had other advantages as well, including the convenience of having all their work in one place and being able to use special commands such as the "find" feature to search for particular sections of the text.

Other students acknowledged that electronic information was the wave of the future. Some students said their own personal use for paper braille would be limited in the future, particularly in school or on the job, as illustrated by this quote:

---

I would tell [other students] to definitely . . . least try [technology] because it is an advantage over braille. . . . When you go to college you're not going to be able to really access all your books in braille.

The use of technology had its disadvantages. Three-quarters of the students said a disadvantage of technology is that it can crash or just cease working properly, often at the most inopportune times. Almost every student had a story to tell of technology going awry.

Because of the pros and cons of both paper braille and technology, the ability to make choices for how to do school tasks was important to these students. The use of specific tools was a personal choice for these students, based on their preferences and prior experiences with both braille and technology. These students had specific and strong preferences for completing their work. A method that worked well for one student may not be appropriate or preferred for another.

Unfortunately for the college students, wanting to have a college textbook in braille can be very expensive. Several students reported trying to get a particular textbook in braille by working through their university's disability office and having a difficult time. As one student explained:

One of my science books, before we found it already produced . . . a transcriber was going to charge like \$8,000 to braille it, a biology book. That was kind of inaccessible to people, especially in college.

Despite the admitted disadvantages of bulkiness and expense, most of the stu-

dents still felt that braille reading and writing were important skills and would continue to be important in the future. For example, five of the students mentioned that reading braille was important for learning correct spelling and grammar, such as punctuation, sentence structure, and creating paragraphs, elements that are not obvious with speech access alone. Although most of the students interviewed recognized the importance of technology in their lives, they definitely felt that braille had a place as well. That duality of opinion about the role of braille within the context of an online society is illustrated in these quotes:

Don't totally depend on your technology because you never know when you might have to get it fixed or something. Make sure your braille reading skills are good. . . . Read it all the time.

I feel more equal with the world around me because [braille is] my pencil and paper. I don't have to have, you know, a big smart computer to do it. It's like a machine that's manual . . . I feel like it's our way to be equal.

### *Opinions about the role of teachers of students with visual impairments*

Students were asked if they had any advice they wanted to share with teachers of students with visual impairments and people studying to become such teachers about braille and technology. They had strong opinions about the importance of braille instruction as well as about technology, and about the role of the teacher of students with visual impairments in assistive technology instruction as well:

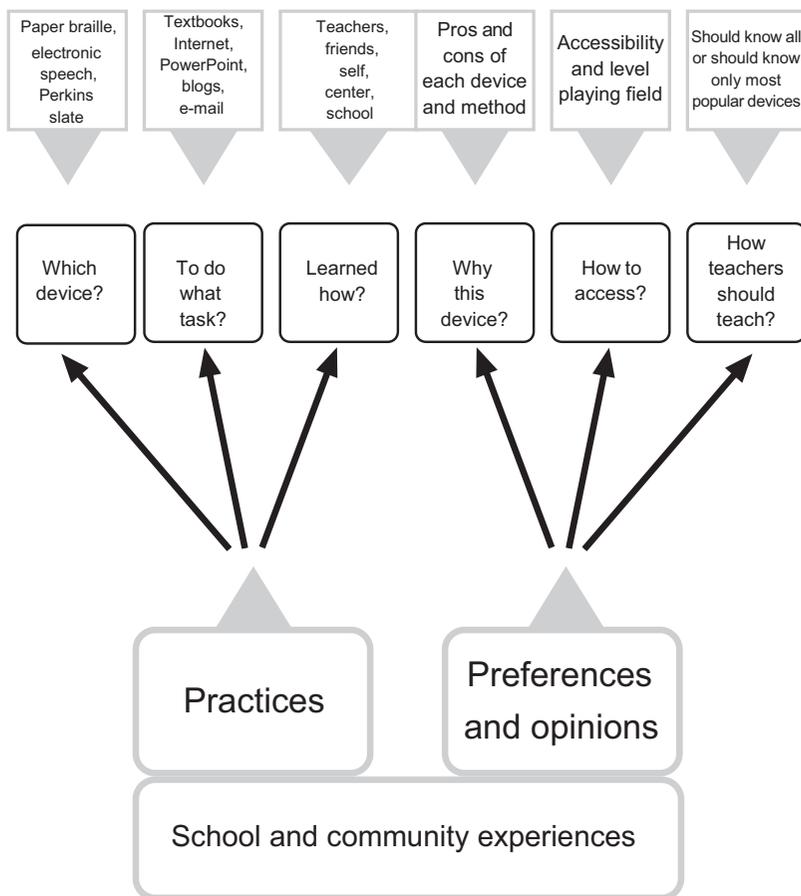


Figure 1. Themes from the interviews.

I think it's just important to be in tune with what the student needs and how they learn best as you would be with any other student. . . . It's a lot about timing and being able to plan ahead and . . . get them the material as they need it in the format that they can access the best.

See, I wasn't taught how to do all this stuff until my 10th grade year. . . . I just think you can always start early. The earlier the better, but I mean I think it's up to the students, up to the parents and teachers, to get really ready to get the braille taken away from them.

The students were asked specifically if they felt that teachers of students with visual impairments should know a little about a great number of technology devices, or if they should know a lot about the most popular devices. The students were evenly split in their opinions as far as what and how much teachers should know about assistive technology. Two students said their advice was simply "learn as much as you can."

Figure 1 illustrates the themes that developed from these coded interviews and how they interact with one another. These themes and subthemes were the focus of the survey that was developed after these interviews in phase 2 of the study.

---

## Discussion

Although students interviewed in this study acknowledged the importance of braille, the larger concept of “reading” appears to have expanded from simply words on paper. When students said they read “braille” it could mean paper braille or braille on a refreshable display. Unless they were asked specifically or if the context of their answer made it clear, it was nebulous when they referred to “braille” as to which format they meant. In addition, when students described how they “read,” they might be referring to reading braille on paper, on a refreshable display, or using speech to access the text on a computer or other device such as an audio book reader.

One implication of these findings is that the lines have blurred between the concepts of “reading” and “access,” and between “book” and “information.” The students valued the greater access to information they have compared to students who read braille in previous generations. Although the interviewed students continue to value the literacy opportunities that braille affords, particularly for specific subjects such as mathematics, they also appreciate the virtually unlimited access to information that technology allows.

Another major theme that emerged from these data is the importance of the ability to make choices. The differences in preferences between students illustrates why a one-size-fits-all approach (that is, assuming that students will need only speech access, or only paper braille, or only refreshable braille) would be considered detrimental by these students.

However, a distinction appeared when discussing the acquisition of reading and

writing skills as opposed to the use of literacy skills once they have become proficient readers. When speaking of younger children learning to read, the message from these participants was unmistakable: teach children to use braille. For these students, knowledge of braille increased the choices available to students, including the choice to use other methods such as speech access.

One implication of these results is that it has become critically important to provide students with as many tools as possible. To allow students to take advantage of the choices available to efficiently complete school tasks, they must be proficient in multiple methods and tools for learning.

## LIMITATIONS AND NEED FOR FURTHER RESEARCH

Although the researcher attempted to select interviewees of different ages from a variety of geographical areas, it is difficult to state whether these participants are a good representation of young adults who are blind and use both braille and assistive technology. The interviews included questions that required self-reported information that may be difficult for students to recall. Some questions, such as how old they were when they first learned to use assistive technology, would rely on students’ recollections of events that may have happened a number of years before.

The interviews in this first phase were coded by a single researcher, so no interrater reliability is available. All of these themes were explored with a larger group of students in phase 2 of this study. The survey in phase 2 was designed to triangulate the data and discover how wide-

---

spread those practices and preferences might be.

In a world where textbooks and other learning media for all students are increasingly available online or electronically, an investigation of the role of paper braille for students who are blind was timely. The multiplicity of viewpoints collected in this study reflect the heterogeneity of students in this age group as well as their varying needs, ability levels, and preferences. If one thing can be generalized from these results, it is that the students themselves cannot be generalized. Teachers of students with visual impairments must recognize their students' unique needs and provide a variety of opportunities and experiences for them.

## References

- Anstey, M., & Bull, G. (2006). *Teaching and learning multiliteracies: Changing times, changing literacies*. Newark, DE: International Reading Association.
- Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theories and methods*. Boston: Pearson Education.
- Corn, A., & Wall, R. (2002). Access to multimedia presentations for students with visual impairments. *Journal of Visual Impairment & Blindness*, 96, 197–211.
- Farnsworth, C. R., & Luckner, J. L. (2008). The impact of assistive technology on curriculum accommodation for a braille-reading student. *RE:view*, 39, 171–187.
- Fellenius, K. (1999). Computer-based instruction for young braille readers in mainstream education: An evaluation study. *Visual Impairment Research*, 1, 147–164.
- Ferrell, K. A. (2007). *Issues in the field of blindness and low vision*. Greeley, CO: University of Northern Colorado. Retrieved from [http://www.unco.edu/nccsd/resources/issues\\_bvi.shtml](http://www.unco.edu/nccsd/resources/issues_bvi.shtml)
- Kennedy, T. L. M., Smith, A., Wells, A. T., & Wellman, B. (2008). *Networked families*. Washington, DC: Pew Internet & American Life Project. Retrieved from <http://www.pewinternet.org/Reports/2008/Networked-Families.aspx>
- Morales, L. (2009). *Nearly half of Americans are frequent Internet users*. Washington, DC: Gallup. Retrieved from <http://www.gallup.com/poll/113638/Nearly-Half-Americans-Frequent-Internet-Users.aspx>
- Morse, J. M., & Richards, L. (2002). *Read me first for a user's guide to qualitative methods*. Thousand Oaks, CA: Sage.
- Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data*. Thousand Oaks, CA: Sage.

---

*Frances Mary D'Andrea, Ph.D., educational consultant, instructor; mailing address: 5714 Beacon Street, Pittsburgh, PA 15217; e-mail: <literacy2@mindspring.com>.*