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Multimedia Instruction for Students Who Are Deaf

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Multimedia Instruction for Students Who Are Deaf

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Education access and achievement for the deaf and hard of hearing is gaining attention as more students attend neighborhood schools, and educators are becoming more familiar with options and opportunities to improve instructional delivery. Multimedia materials and environments can provide multiple representations of concepts that are more meaningful to students who are deaf or hard of hearing.

This Research in Brief article builds on Parton's (2006) solid review of multimedia use across the curriculum for deaf students. Parton identified five ways that multimedia applications can promote learning for students who are deaf, including:

- improving accessible instructional design,
- creating communication bridges,
- promoting skill development,
- making distance education possible, and
- creating discovery learning experiences.

These five practices share a focus on ensuring that learning activities are designed for active engagement. Parton notes that, while active learning is important for all learners, it is critical for students who are deaf or hard of hearing. This article presents strategies for implementing multimedia for the deaf and hard of hearing to support literacy, mathematics, and communication. Also included are tips for creating your own materials, a description of relevant research studies, and links to resources.

Multimedia strategies for literacy development across the curriculum

Improving the English literacy skills of deaf and hard of hearing students is paramount to their ability to achieve higher education and gainful employment (Bowe, 2002). Fully addressing the early literacy stages of instruction for students who are deaf or hard of hearing is beyond the scope of this article. Rather, the focus here is on using multimedia to expand students' access and learning with print, assuming a foundation

of concepts of print and emerging literacy. Readers interested in more ideas for instruction for students who are deaf or hard of hearing are encouraged to consult the excellent work collected and disseminated through the Laurent Clerc National Deaf Education Center and the new handbook, "Meeting the Needs of Students Who Are Deaf or Hard of Hearing", from the National Association of State Directors of Special Education (2007).

Supported e-text

Researchers and educators have examined the effectiveness of embedding a variety of supports in digital text to make instructional materials more accessible to students who are deaf or hard of hearing. These include:

- video of American Sign Language (ASL) translation (Anderson-Inman & Horney, 1998);
- graphics, images, and video (Loeterman, Paul, & Donahue, 2002);
- display grids with combinations of words and ASL graphics (Nelson & Camarata, 1996); and
- embedded questions that prompt comprehension strategies (Dowaliby and Lang, 1990).

These various supports may be presented individually or in combination (Dowaliby & Lang, 1990; Gentry, Chinn, & Moulton, 2004). Studies evaluating these supports have centered on reading comprehension, and the results are varied. Getting the "mix" of supports and text right for particular students and particular tasks has been difficult (Nelson & Camarata, 1996). Although studies show that students at all grade levels enjoy these digital materials and are engaged by them, it is less clear that the materials improve reading comprehension. Read more about these studies in "Research Support".

Some of these technologies are still in the preliminary stages of development and evaluation. This is particularly true for signing avatars, animated characters that provide sign language translations. Digital avatars can be embedded in a multimedia product to provide ASL translation. They can be customized by the user with different "skins" personifying different characters and with adjustment of signing speed and viewing perspective. Because they are digital, they require significantly less bandwidth than does ASL video.

The Signing Science Dictionary, a project sponsored by the National Science Foundation, is an example of how the signing avatar technology can create dynamic and effective instructional materials. This digital dictionary presents the ASL signs for hundreds of science concepts using avatars created by VCom3D. A study evaluating the effectiveness of the dictionary in intermediate-grade classrooms, "Signing Science Dictionary: Benefits to Students and Teachers", demonstrated improvement of students' science achievement and vocabulary scores (Vesel, 2006). The researchers also found that the usability and appeal of the Signing Science Dictionary made it instructive for teachers and parents, many of whom do not know the signs for specialized science concepts. Thus, the dictionary helps to build a communication bridge that promotes learning.

Speech recognition software

Nationwide, a shortage of qualified interpreters has made it a great challenge to provide interpretive services to all students who need them. Thus, efforts to increase literacy achievement and access to specialized content among the deaf and hard of hearing also include strategic use of speech recognition software to supplement in-class interpreters.

Speech recognition software recognizes the user's speech and converts it to text. Initially, the software must be trained to accurately recognize and convert a particular user's speech. Errors can be corrected during the dictation process or after dictation is complete. A single user, such as a teacher, can obtain quite accurate recognition rates (85% or greater accuracy is fairly common).

Speech recognition software can supplement the interpretive experience by providing a print-based representation of words used in class that are difficult or unreasonable to fingerspell in ASL. Robison and Jensema (1996) found that secondary content classes, for example, anatomy, literature, and foreign language, contain many words for which there is no sign and/or that interpreters cannot correctly fingerspell. They propose that speech recognition software has great potential to address this problem by enabling the creation of a text-based record of such words on students' laptops.

The use of speech recognition as an alternative to interpreters and the posting of multimedia (speech, text, and visual media) notes on a class Web site is currently being researched by Liberated Learning, a global consortium of higher education institutions. Consortium members have found that all types of students use the posted

resources for studying and that this is becoming an increasingly viable alternative to live interpreters for both institutions and students.

The commercial speech recognition software iCommunicator (by Interactive Solutions) has been used in schools and the workplace. Unlike other programs, it is designed for use with the deaf. In particular, it is targeted toward bridging communication between non-signing and signing teachers, learners, and coworkers. The software can convert speech input to text or video clips of Signed English (the use of signs to translate English directly).

Distance learning options, especially in secondary and post-secondary settings, are also creating new avenues for learning for students who are deaf or hard of hearing. As long as embedded videos and chats are captioned or transcribed, distance learning portals can be very accessible. Some platforms, such as Elluminate! (by Elluminate, Inc.), can provide real-time transcriptions of a lecture or chat.

Multimedia strategies for mathematics achievement

Mathematics is another content area in which deaf students often underperform compared to their hearing peers (National Science Foundation, 1999) and for which specialized signs are required. With mathematics, as with science, many teachers, interpreters, and parents are unfamiliar with the specialized signs. Caccamise and Lang (1996) created a signed video demonstrating a set of signs for expressing specific mathematical concepts. Instructional materials with embedded digital signing avatars that teach these signs have been developed for a K-3 mathematics curriculum for deaf students and their teachers and parents. In ongoing research, these materials are being further developed and evaluated. Watch the work of Adarno-Villani (2005) and colleagues for progress on this research.

The development of speech recognition software designed specifically for mathematical dictation and symbol representation has the potential to fill a gap in the instruction of deaf students in higher level mathematics classes. Math Talk/Scientific Notebook (by Metroplex Voice), a commercially available product, brings dictation into other speech recognition programs, such as Dragon Naturally Speaking, or word processors, such as Microsoft Word, and greatly enhances the accuracy and vocabulary recognition of the equation editor. Supplementing interpreters with this product could facilitate development of more supportive curriculum materials.

Multimedia strategies for communication between hearing and deaf/hard of hearing populations

Communication between hearing and deaf/hard of hearing populations is often cumbersome or limited. Communication between signers at a distance is also challenging. Human interpreters are often necessary to translate in person; this is costly and sometimes inconvenient or infeasible. Use of the Internet, video phone, and e-mail have greatly improved the ability of deaf users to communicate at a distance. Numerous blogs, vlogs (video logs), bulletin boards, forums, listservs, and Web sites have formed to facilitate communication and build communities for the deaf. Deaf students are also seamlessly participating in mainstream online communities (Schirmer & Ingram, 2003).

The Internet has also allowed the world of sign language to be more accessible to those learning the language. Sign language and fingerspelling dictionaries, tutorials, and practice sites are now more interactive through streaming video or animation. See the Resource section below for links to online dictionaries that use video and/or animation. The commercial product, Signing Time! (by Two Little Hands Productions) teaches ASL to young children. The program matches video clips of a concept, e.g., "butterfly" or "friend", with a demonstration by a professional signer, various children signing the term, open-captioned text, and lots of singing and word play. It is available for purchase on DVD and is also broadcast on Public Broadcasting Stations across the country.

Tips for creating your own multimedia materials

The ability of teachers and students to create their own interactive instructional and communication materials can be very valuable to students with special needs by making materials immediately relevant, grounded in the classroom context, and personalized. Involving students in the design of their own learning materials is a particularly powerful means to increase their reflection on the topic and engagement.

ASL Clip and Create (by Institute for Disabilities Research and Training) is a commercially available package of sign illustrations that can be imported as clip art into many common word processing or desktop publishing applications, enabling the creation of bilingual or enhanced materials. Clicker5 (by Crick Software), another commercially available product made for young and/or emergent readers, can

produce materials with side-by-side text and ASL Clip and Create signs. Clicker5, like earlier versions, creates display grids to capture early writing. In a work area just outside the grids is an assortment of literacy resources such as related words and phrases, graphics, and punctuation. A user can drag and drop these literacy resources–which can include ASL images–to create simple sentences and stories. See the Resource section for links to these tools.

Captions have long been embedded into television broadcasts and videos, creating products that are more accessible to all viewers. Digital captioning programs are also available for production of digital video and animation. However, the process of creating captions is not straightforward translation as it must take into account the reading speed and literacy level of the viewers. The National Center for Accessible Media (NCAM) has tools, guidelines, and fact sheets available to learn more about media with digital captions and how to produce them. The Described and Captioned Digital Media Program, funded by the U. S. Department of Education, has a media library of over 4,000 open-captioned titles (videos, CD-ROM, and DVD). Deaf and hard of hearing persons, teachers, parents, and others may borrow materials free of charge. Several hundred titles are also streamed on the web site.

Supplementing ASL interpreters with speech recognition, as described above, produces a printed transcript that can then be used for further instruction and studying. A transcript of this kind can become an instructional resource for literacy, content area, or mathematics skill development. For example, within a Microsoft Word text document you could embed links to online ASL dictionary definitions for key vocabulary or insert Comment notes. Comment notes will also accept clip art images, such as those from ASL Clip and Create. Thus, these methods can be used to create supported digital text. Older students can take responsibility for creating supports themselves as part of studying.

A caution emergent the literature is that students need explicit instruction in *how* to use supports. Studies have repeatedly found that most students with a disability do not use available embedded supports strategically unless given adequate instruction, guidance, and practice (Anderson-Inman & Horney, 2007). Researchers in the LiteracyHI study (Anderson-Inman & Horney, 1998) found that students with hearing impairments used the various resources available in multimedia materials differently, relying on graphics and video signing more often than the text. To address these issues, it is important to observe students as they use materials and prompt them with

questions that draw their attention to the different media forms. Teacher-led think alouds can be used to demonstrate to students the value of an embedded support as a just-in-time resource, for example, stopping while reading to question the meaning of a word that can be looked up through an embedded support. To develop the habit of using supports, students needed to be guided and reminded to regularly use them as they interact with the materials.

Research Support

Nelson and Camarata (1996) studied the effects of teacher-facilitated multimedia learning environments on language and literacy acquisition by young students who were hard of hearing. Children created sentences and stories with a computer program. The texts were later "recast" in correct syntax during conversation (oral and interpreted) with a teacher and read aloud and animated by a computer program. Nelson and Camarata found that by individualizing this "tricky mix" of immediate representations in multiple modes – sign, text, oral English, and graphics – a powerful literacy learning environment could be created for the children.

Another study compared the effects of computer-based stories enriched with different types of materials for middle and secondary school students (Gentry, Chinn, & Moulton, 2004/2005). Twenty-five deaf students worked with computer-based stories in four conditions: print only; print and pictures; print and computer-generated ASL; and print, pictures, and ASL. Analysis of the students' retellings determined that the print-only format was least effective and the print and pictures format the most beneficial. The researchers were surprised by the lack of effectiveness of the ASL supports, which were fascinating to students, and hypothesized that this may relate to students' lack of familiarity with using it as a comprehension tool.

Dowaliby and Lang (1990) investigated the effectiveness of three kinds of supports embedded in digital text for improving the reading comprehension of college students who are deaf. They hypothesized that all three types of aids, questions, content movies, and sign movies, would benefit the students. They found that when using digital texts with embedded questions or all three supports, students with low reading scores performed as well as their peers with high reading scores. Dowaliby and Lang concluded that "either or both the sign and the content movies may have worked synergistically with the text and adjunct questions to benefit factual learning" (p. 280).

They encouraged further development of multimedia designs for improving the reading comprehension of students who are deaf.

Research into the use of speech recognition to supplement interpreters in classroom settings has primarily focused on secondary and post-secondary settings. Some but not all studies have found that the combination of text and interpreting is effective for improving student comprehension of content. Marschark et al. (2006) tested the effects of combinations of real-time interpreters and 2 text options on the comprehension of secondary and college students who are deaf (Marschark et al., 2006). Students listened to a lecture accompanied by real-time transcription or C-Print real-time captioning (a keyboarding system similar to court reporting that produces a meaning-for-meaning transcription, see "Resources" for more information) and completed a comprehension test immediately following the lecture and at delayed intervals. The results of four experiments were inconclusive as to the benefit of adding real-time captioning or transcription. The researchers were surprised by the mixed findings and urged additional applied research into options for supporting deaf students.

Online resources

Gallaudet Video Library

Gallaudet Video Library is an online repository of videos at Gallaudet University. You must register for a free account.

ASL Pro

ASLPro.com offers free online dictionaries, including an alphabetized dictionary as well as a conversational dictionary with categorical common phrases.

Lifeprint

Lifeprint is a site dedicated to teaching ASL. Here you can consult a dictionary or send a question to the community of users.

Handspeak


Handspeak is a subscription site that houses multiple dictionaries, resources, and tutorials. Their fingerspelling index is freely available.

ASL Video Dictionary and Inflection Guide


The ASL Video Dictionary and Inflection Guide was developed by the Rochester Institute for Technology and presents signs in sentences or phrases, allowing the user to understand how signs change with meaning and inflection. The CD-ROM can be ordered for $50.00; there are demonstration video clips available on the Web site.

ASL Browser


The ASL Browser was developed by the Michigan State University Communication Technology Lab. Online mini-videos create a free ASL glossary; a CD-ROM version is available for $19.95.

Other resources

Deaf Planet

DeafPlanet.com is an interactive Web site for children who are deaf. It offers forums, chat rooms, educational games and activities, literature, and more. The portal is available in ASL and in French LSQ.

Signing Science Dictionary

Signing Science Dictionary has information about the Signing Science Dictionary. The avatar software is needed to view the animation.

Liberated Learning Consortia

Liberated Learning Consortia is a global consortium of higher education institutions working with IBM's Via Voice research and development team. Together, they are implementing and studying the Via Voice speech recognition software program as an alternative accommodation to live interpreters for college students. Read a case study about the consortium.

Signing Time!

Signing Time! This is a child-friendly ASL tutorial video series with supplementary materials such as board books and letter cards. The videos match ASL demonstrations with video of the concept, children making the sign, and the open-captioned text. Check here for local PBS broadcasts. Videos, DVDs, and materials are available for purchase.

C-Print

C-Print is a system of delivering real-time captioning to one or more recipients from trained captionists who work with special software that helps reduce keystrokes by abbreviating common words. C-Print offers a meaning-for-meaning transcription, not a verbatim transcription. The system was developed and is maintained by the Rochester National Technical Institute for the Deaf.

Math Talk

Math Talk is a program that enhances Dragon Naturally Speaking voice recognition to accept complex mathematical equations, vocabulary, and notations.

iCommunicator

iCommunicator is a voice recognition program designed to be a communication bridge for the deaf, rendering oral English into signed English or ASL video.

ASL Clip and Create

ASL Clip and Create is available on 4 CD-ROMs, offering nearly 5,000 signs for $49.95.

PEPNet Centers

PEPNet Centers funded by the U.S. Dept of Education provide technical assistance and dissemination activities, personnel development activities, and technology use activities. There are four regional Centers to serve your district.

Clicker 5


Clicker 5 is a writing support and multimedia tool from Crick Software that uses display grids and word lists to enable young children to produce writing. Graphics and images can be used flexibly in the writing product.

Described and Captioned Digital Media Program

The Described and Captioned Digital Media Program houses a media library of over 4,000 open-captioned titles (videos, CD-ROM, and DVD). Deaf and hard of hearing persons, teachers, parents, and others may borrow materials free of charge. Several hundred titles are also streamed on the web site.

Cornerstones: Building Blocks of Literacy

Cornerstones is a technology-infused approach to literacy development designed for early elementary children who are deaf and hard of hearing. Language and literacy activities are based on three video-based stories and activities from the PBS show, Between the Lions.

References

Adamo-Villani, N., J. Doublestein, & Martin, Z. (2005). Sign language for K-8 mathematics by 3D interactive animation. *Journal of Educational Technology Systems, 33(3), 241-257*.

Anderson-Inman, L. & Horney, M. A. (1998). Transforming text for at-risk readers. In D.
Anderson-Inman, L. & Horney, M. A. (2007). Supported e-Text: Assistive technology through text transformations. *Reading Research Quarterly, 42* (1), 153-160

Bowe, F. G. (2002). Enhancing reading ability to prevent students from becoming "low-functioning deaf" as adults. *American Annals of the Deaf, 147*(5), 22 – 27.

Caccamise, F. & Lang, H. (1996). *Signs for science and mathematics: A resource book for teachers and students*, Rochester, NY: National Technical Institute for the Deaf.

Dowaliby, F. & Lang, H. G. (1990). Adjunct aids in instructional prose: A multimedia study with deaf college students. *Journal of Deaf Studies and Deaf Education, 4*(4), 270-282.

Gentry, M. M., Chinn, K. M., & Moulton, R.D. (2004/2005). Effectiveness of multimedia reading materials when used with children who are deaf. *American Annals of the Deaf, 149*(5), 394-403.

Loeterman, M., Paul, P.V., & Donahue, S. (2002, February). Reading and deaf children. *Reading Online, 5*(6). Retreived July 28, 2007, http://www.readingonline.org/articles/art_index.asp?HREF=loeterman/index.html.

National Association of State Directors of Special Education (2007). *Meeting the needs of students who are deaf or hard of hearing: Educational services guidelines.* Alexandria, VA.

Marschark, M., Leigh, G., Sapere, P., Burnham, D., Convertino, C., Stinson, M., Knoors, H., Vervloed, M. P. J., and Noble, W. (2006). Benefits of sign language interpreting and text alternatives for deaf students' classroom learning. *Journal of Deaf Studies and Deaf Education, 11*(4), 421-437.

National Center to Improve Practice (NCIP). (no date). *Interactive video, hypermedia & deaf students.* Retrieved April 24, 2007, from http://www2.edc.org/NCIP/library/v&c/Alive.htm.

National Science Foundation, (1999). *Preparing our children: Math and science education in the national interest*. Washington, D.C: National Science Task Force on Mathematics and Science Achievement.

Nelson, K. E. & Camarata, S. M. (1996). Improving English literacy and speech-acquisition learning conditions for children with severe to profound hearing impairments. *Volta Review, 98*(2), 17-41.

Parton, B. S. (2006). Snapshots of interactive multimedia at work across the curriculum in deaf education: Implications for public address training. *Journal of Educational Multimedia and Hypermedia, 15*(2), 159-173.

Robinson, J. & Jensema, C. (1996). Computer speech recognition as an assistive device for deaf and hard of hearing people. In Proceedings from Seventh Biennial Conference on Postsecondary Education for Persons who are Deaf or Hard of Hearing. Knoxville, Tennessee: Postsecondary Education Consortium.

Schirmer, B. R., & Ingram, A. L. (2003, July/August). Using online chat to foster the written language development of students who are deaf. *Reading Online, 7* (1). Retrieved July 28, 2007, from http://www.readingonline.org/articles/art_index.asp?HREF=schirmer/index.html

Vesel, J. (2006). *The Signing Science Dictionary research study report of findings*. Washington, D.C.: National Center for Technology Innovation.