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ASSISTIVE TECHNOLOGY FOR COMPUTER-BASED MUSIC INSTRUCTION

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This article provides information and resources about assistive technology that may be helpful to developers and educators using computer-based music instruction. A brief overview of pertinent federal legislation is followed by a general explanation of adaptive devices for computer access behaviors. A selective group of Web sites are presented for additional exploration of the topic. Web sites of governmental departments, organizations, and engineering schools with centers devoted to accessibility issues and the development of assistive devices provide extensive background information and resources for networking possibilities. Another group of Web sites provides a sampling of assistive devices currently available for overriding or simplifying standard computer access behaviors that may be problematic for individuals with and without specific disabling conditions. The final group of Web sites is primarily for developers and provides information for evaluating and designing accessible Web pages and adding descriptive video and audio captioning for multimedia presentations.

Most people probably would agree that in this day and age the enjoyment of some form of music is available to everyone regardless of age, cultural settings, developmental abilities, and education. Campbell (2000) explains the very personal, yet social, nature of music experiences, particularly for children:

> Each child brings his or her unique perspective to a song, instrument, or musical event, so that its meaning is based on who the child is and what his or her experience has been. . . . Through music, they examine themselves, their experiences, and the relationships that they have with their friends and members of their family. (p. 35)

Few would argue that similar statements could be made, with perhaps even more emphasis, about adolescents and adults. Music is available and adaptable to individual needs and preferences, and is reinforced within a social context.

Is music instruction available to everyone? Through collaborative efforts of many educators, public school formal music education experiences are becoming more available to all students through increased funding, the offering of general music classes at different levels, and the impetus toward inclusion. Efforts by music educators, for example, to include all learners in music education usually result in identifying students on the basis of prerequisite abilities for participation in specific music experiences, rather than stereotypical assumptions about apparent disabling conditions (Hughes

& Robbins, 1996). In a similar vein, this paper addresses the availability of computer-based music instruction for all learners by focusing on prerequisite access behaviors—those behaviors that allow all people to use computers or to use them more efficiently. Current legislation and engineering developments suggest that assistive technology may play an important role in increasing the availability of music instruction, particularly if the instruction relies on accessing a computer.

Legislative Connections

Reauthorization of two federal laws during the last three years has strengthened state efforts to increase the availability and application of assistive technology (AT). The original Technology-Related Assistance for Individuals with Disabilities Act of 1988 (PL 100-407) was updated and reauthorized ten years later in 1998 as the Assistive Technology Act or "Tech Act" (PL 105-394). The primary purpose at that time was to increase the availability of funding for AT devices and services to states programs. Another indication of the recent interest in assistive technology can be seen in a comparison of the 1990 version of the Individuals with Disabilities Education Act (IDEA) (PL 101-476) and the more recent reauthorization in 1997 (PL 105-17). Wording in the original IDEA legislation mildly promoted the use of assistive technology for students with special needs. The IDEA reauthorization, however, mandated that individualized education and transition planning conferences include the evaluation of a student's needs for assistive technology devices and services. The recent reauthorizations of the Tech Act and IDEA coincide with the current interest and support of music instruction technology. What are the connections?

The legal definition of assistive technology in the Tech Act includes any tool that increases the independent functioning of an individual. Low- and high-tech devices have equal value and are judged as appropriate and necessary based on results from users' applications. The AT ideal was articulated by Bowe in his preface to *Living in the State of Stuck: How Assistive Technology Impacts the Lives of People with Disabilities* (Scherer, 2000): "An individual with a disability plus the right device can function as a person without limitations" (p. vii). Some assistive devices, therefore, apply to mobility, posturing, environmental control systems, and augmentative and alternative communication (McNairn & Shioleno, 2000). The single AT category in the Tech Act that pertains to technology-based music instruction is the computer—with and without adaptive devices.

A computer without adaptation that is running standard music software provides many alternatives for music participation. An excellent example is the task of writing music notation. Technological keyboarding of notation allows music to be written by pressing selected keys. This activity may be a luxury for some students but it may be consequential for students with temporary or permanent physical limitations. Writing legible music notation with a pencil may not be an option. By pressing keys, students circumvent the complex visual/motor task of writing and produce screen displays

and printouts of music notation to share with instructors and other students. This example illustrates how a computer without adaptation is *the* assistive device. Other computer-based music instruction tasks, however, may be less accessible if users cannot respond with the typical access behaviors.

What are prerequisite abilities for using computers? Typical operations require vision, manual dexterity, and reading or recognizing images. Computer access behaviors that are often taken for granted, such as reading a screen, moving a mouse, typing on a keyboard, and receiving information through multimedia presentations obviously become problematic for many students and teachers. The computer without adaptation in these cases would be inaccessible. Does the inability to type and recognize text or images therefore prohibit the use of computers in education for some learners? Or are there assistive devices that can use a person's non-computer abilities (for example, the user can talk, can fix eye gaze, can recognize speech) with the demands of typical computer operations and thereby promote accessibility?

Engineering Developments

Engineers have developed many medium- and high-tech assistive devices to override, compensate for, or circumvent standard computer access behaviors. Many of the devices engage nontraditional computer behaviors to simplify the process or expand the applications of computers. In fact, the target consumer group for many of the devices is the general public. Other devices are obviously designed for specific accessibility applications. The lists in Tables 1 through 3 provide Web sites that present a representative sample of alternatives, adaptations, or assistive devices for the typical computer access behaviors such as reading the screen text, activating the mouse, and using the keyboard. In most cases the URL for the Web site presents the main page of the site for readers to explore, not only the link for the specific device, but also to find other devices of interest[1]. Video clips demonstrating some of the devices can be found on The Rochester Institute of Technology's Alternative Output Hardware and Software Web page (2001). A product clearinghouse site representing many manufacturers is located at the Exceptional Computing Web site (2001). The proliferation of assistive devices increases the importance of product review links on Web sites such as ABLEDATA (Macro International, 2001).

Many organizations and engineering schools have been at the forefront of assistive technology for several decades. Their Web sites are excellent primary resources for general information and documents referring to the Tech Act and IDEA and related funding programs. Table 4 lists several Web sites that were selected for their extensive arrays of content, their highly quoted status in the literature, and the abundance of practical information. The address and contact information for each state's Tech Act program is available on ABLEDATA's Tech Act Projects Web page (Macro International, 2000). Locating a local or state professional AT representative may be the first step in collaborative efforts among schools, parents, and educators.

Table 1

Adaptations and Devices to Facilitate Reading Screen Text

Magnifies screen text:
1. In Microsoft Windows click *Control Panel - Accessibility - Contrast* 2. Freedom Scientific. MAGic screen magnifie.r http://www.freedomscientific.com/fs_products/software.asp (800) 444-4443
Converts screen text to Braille:
1. Thomas. Enabling Technologies. http://www.brailler.com/tom.html (561) 225-3687 2. Duxbury Braille Translator. http://www.duxburysystems.com/dbt.asp (978) 692-3000
Converts MIDI output to Braille music:
Duxbury Systems. GOODFEEL Braille Music Translator. http://www.duxburysystems.com/recproducts.asp (978) 692-3000
Converts screen text to speech:
1. DECtalk Express Speech Synthesizer. A.D.A. Worklink: http://www.worklink.net/products/dectalk.html, (925) 932-3076 2. Kurzweil 1000/3000. Scanning and reading. http://www.kurzweiledu.com/products.asp, (800) 894-5374 3. ZoomText. Ai Squared. http://www.aisquared.com/products/products.htm, (802) 362-3612

Table 2

Adaptations and Devices to Facilitate Cursor Movement and Switching

Adaptations and devices for using a computer mouse
1. In Microsoft Windows click *Control Panel - Accessibility - Serial Keys* 2. Mice of Different Sizes Contour Design. http://www.contourdesign.com, (800) 462-6678 3. No Hands Mouse (Foot Controls). Hunter Digital. http://www.footmouse.com (800) 57MOUSE
Joysticks
Gravis. http://www.gravis.com, (800) 235-6708
Switches (head, hands, Ffeet)
1. Clickit! Intellitools. http://www.intellitools.com/index.htm, (800) 899-6687 2. TouchFree Switch. Edmark.com. http://www.riverdeep.net/support/product_support/t/tchfrswt11101.jhtml, (617) 995-1000 3. Switch Software. Soft Touch. www.funsoftware.com/softtouch/index.htm, (877) 763-8868
Eye gazing
Eye Tech Digital Systems, Inc. http://www.eyetechds.com, (480) 610-1899
Touchpads
1. Easycat. Cirque Corporation. http://www.cirque.com/products/index.shtml, (800) 454-3375 2. Graphics Tablet. K B Gear. http://www.jamonline.com/products/jamstudio_prod.asp, (Telephone number not provided) 3. Versapad. Interlink Electronics. http://www.interlinkelec.com/indexf.html, (800) 340-1331

Table 3

Adaptations and Devices for Using a Computer Keyboard

Speech recognition – synthesize speech to text
1. Scansoft Dragon NaturallySpeaking. http://www.scansoft.com/naturallyspeaking/, (978) 977-2000
2. IBM Via Voice. http://www.ibm.com/viavoice, (888) SHOP-IBM
Enlargements or simplified keyboard overlays
1. Madentec. Discover:Board. http://www.madentec.com/, (877) 623-3682
2. Intellitools. Intellikeys and Overlay Maker. http://www.intellitools.com, (800) 899-6687
Touch screens
1. Keytech, Inc. Add-On Ki.: http://www.magictouch.com/addon.html, (800) MAGIC89
2. EdMark. TouchWindow. http://www.riverdeep.net/products/special_needs/touch_window.jhtml;$sessionid$NQFIEHA2DQZ5ECQFAGLSFEQKAUAZQI5G, (800) 691-2986

Software developers can solve many accessibility problems, particularly when designing Web pages and multimedia presentations. Several Web sites are available for learning about accessibility regulations and solutions to problems (Table 5). One particularly helpful resource is the online accessibility Web page evaluation Bobby (CAST, 1999-2000). After the user types a Web page URL, the program provides immediate feedback about the page including the format, image labels, and table organization that may or may not be conducive to text-only presentations and the use of assistive devices such as text-to-speech synthesis. Solutions to problems surrounding multimedia presentations can be investigated in the Web sites devoted to descriptive video (adding an audio track to describe video for students who have vision difficulties) and audio captioning (adding a text narrative of audio material for students with hearing difficulties). These solutions expand a developer's alternatives for designing creative accessible multimedia presentations.

Most of the Web resources in the tables are merely gateways to exploring more general and specific information about assistive technology. Telephone numbers are provided in the event a URL changes or is no longer available. Although some organizations and university centers have been operating

Table 4

General Resources for Assistive Technology Information, Legislation, and Issues

Organizations:

1. RESNA (Rehabilitative Engineering Society/North America) http://www.resna.org (703) 524-6686
2. Ability OnLine Support Network. http://www.ablelink.org (416) 650-6207
3. Alliance for Technology Access. http://www.ATaccess.org (415) 455-4575
4. Center for Applied Special Technology. http://www.cast.org (978) 531-8555

University Centers and Engineering Schools:

1. Stanford. http://archimedes.stanford.edu, The Archimedes Project (650) 725-3774
2. UCLA. http://www.dcp.ucla.edu, Disabilities and Computing Program (310) 825-6635
3. Wisconsin. http://www.trace.wisc.edu, Trace Center (608) 262-6966
4. Delaware. http://www.udel.edu/chep/cds, Center for Disabilities Studies (302) 831-6974
5. Rochester Institute of Technology. http://www.rit.edu/~easi, Equal Access to Software and Information (716) 244-9065

Journals:

1. *Assistive Technology Journal.* http://www.catsca.org/news/index.html
2. *Journal of Special Education Technology.* http://jset.unlv.edu
3. *Technology and Disability.* http://www.iospress.nl/site/html/10554181.html
4. *Information Technology and Disabilities.* http://www.rit.edu/~easi/itd.html

Table 5

Evaluating and Writing Accessible Web Pages, Audio Descriptions and Video Captions for Multimedia Accessibility

1. Auditory Access to Web and Internet Resources. http://www.prodworks.com/issound/catalog/catalog_pwWebspeak.html, (609) 637-0099
2. Writing Accessible HTML. http://www.trace.wisc.edu/docs/wings, (608) 262-6966
3. HTML-audio/video programming. http://www.w3.org/TR/WAI-WEBCONTENT-TECHS
4. Descriptions for videos and DVDs services. http://www.wgbh.org/dvs, (617) 300-3490
5. Captions. The Caption Center Online. http://www.wgbh.org/wgbh/pages/captioncenter/services.html, (617) 300-5400
6. Synchronized Accessible Multimedia Exchange. http://www.microsoft.com/enable (Subscribe to Accessibility Newsletter)
7. Captioned Media Productions. http://www.cfv.org, (800) 237-6213
8. National Center for Accessible Media. http://ncam.wgbh.org/, (617) 300-3400

for approximately 20 years, most of the sites are more recent and document the current emphasis on using available technology for assistive purposes and developing technology that is more accessible.

Conclusion

If current practice is any indication of the future, it is safe to assume that engineers will continue to develop user-friendly hardware to retrofit the standard computer for all people. In the meantime, how can music educators and software developers promote accessibility to computer-based music instruction? Perhaps the awareness of accessibility issues and knowledge of available devices will provide assistance in selecting and designing instructional software. In addition to meeting pedagogical criteria, software requirements would include minimal adaptation for access behaviors. Music educators can also provide helpful information to local AT evaluation teams about necessary devices for individual student access to computer-based music instruction.

Likewise, designers of music instruction software who consider accessibility questions during the creation of new materials or revisions of existing resources simultaneously may broaden the user base and minimize the need for adaptations or assistive devices. In fact, the multisensory approach of seeing and hearing text (notation), and seeing and hearing audio has been a standard practice in music instruction. The application of traditionally noncomputer behaviors such as touch, speech, and eye gaze as adaptive computer access behaviors seems totally consistent with the instructional principle of providing multiple input and output options for all interactive learning processes, particularly music education.

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