Title: Interactive Audio as a Resource for Music Courseware Development

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It is with pleasure that we inaugurate the reprint of the entire seven volumes of The Quarterly Journal of Music Teaching and Learning. *The journal began in 1990 as* The Quarterly. *In 1992, with volume 3, the name changed to* The Quarterly Journal of Music Teaching and Learning *and continued until 1997. The journal contained articles on issues that were timely when they appeared and are now important for their historical relevance. For many authors, it was their first major publication.* Visions of Research in Music Education *will publish facsimiles of each issue as it originally appeared. Each article will be a separate pdf file. Jason D. Vodicka has accepted my invitation to serve as guest editor for the reprint project and will compose a new editorial to introduce each volume. Chad Keilman is the production manager. I express deepest thanks to Richard Colwell for granting VRME permission to re-publish* The Quarterly *in online format. He has graciously prepared an introduction to the reprint series.*

Interactive Audio as a Resource for Music Courseware Development

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Computer courseware designed for teaching music theory, ear training, music fundamentals, sight-singing, keyboard skills, instrumental fingerings, music history, and music terminology is available at all levels. While many music teachers have found such programs to be useful supplements to their curricula, there are many more who remain unconvinced of the value of technology and continue to teach entirely by traditional means.

These traditional teachers have based their concerns about mixing technology and music instruction on hardware and software systems developed several years ago. The inferior sound quality, poor screen resolution, and cumbersome user interfaces of such systems were indeed problematic. Recent systems, however, are user-friendly, provide high-resolution graphics, and have good to excellent sound-reproduction capabilities. With the addition of MIDI, which allows for the integration of computers and synthesizers, not only is there good sound production quality, but the student can interact with the computer through means familiar to musicians (e.g., by playing notes on a MIDI keyboard or wind controller, or by using a MIDI microphone). These technical improvements have made the ideas of computer-assisted instruction palatable to a wider audience of music instructors. Still, there are those who argue—legitimately—that, despite such improvements, the educational approach or content of the available programs does not complement their own curricular approach, and therefore they remain hesitant about purchasing and using this technology.

Recent developments in interactive multimedia, however, will likely win many new converts to technology-based music instruction. Interactive multimedia refers to computer systems that allow for integration of text, graphics, animation, audio, and/or full-motion video. The advantage of interactive multimedia is that the content of instruction can be presented in a truly musical context rather than in the more familiar artificial sonic environment provided by most music courseware.

Interactive video (IAV) has been available for several years, and several excellent projects have been developed. The University of Delaware Videodisc Music Series is a noteworthy example. The only drawback of interactive video is the development costs of such projects, as the shooting and editing of both video and audio materials are time-consuming and costly. Use of IAV has also been limited because the hardware system required to use these materials is expensive. For certain situations that are beyond the scope of this article, the cost of the system is justifiable, and the development of new music-related interactive videodisc materials should be continued.

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An approach which has greater potential for application to music instruction is

interactive audio. Unlike interactive video, interactive audio projects can be built around any existing audio recordings, thus eliminating a major portion of development time and cost.

Currently there are two viable approaches to interactive audio: digitized audio played directly by the computer, and audio CDs coupled with a computer. With digitized audio, the computer itself is used as an audio-recording device. Through the process of digital sampling, sounds are converted into numerical representations and stored on the computer's disk drive. Once stored, these sounds can be played at any time through the computer's own speaker system, or, for better sound quality, through an external speaker system.

Adams (1989) used digitized audio to teach interpretive aspects of wind-instrument notation to high school freshmen. "Interpretive aspects" refer to those elements of notation, other than pitch and rhythm, that a student might encounter in a typical band part: tempo markings, dynamics, articulations, ornamentation/special effects, and indications of form. The only computer programs which previously dealt with these concepts were verbally based. In these programs, no attempt was made to provide students with an aural image of the concepts; they were expected to derive musical meaning from written definitions.

In Adams's program, the visual/verbal information was reinforced with aural feedback through the use of digitized interactive audio. Musical examples incorporating the interpretive concepts were recorded by professional musicians on wind instruments and stored on the computer's hard-disk drive. Students were presented with music notation on the computer screen, and they could ask that each example be played on their own instrument. Since the program was used in a practice-room setting, the students could then try playing the examples. Achievement scores from a pilot study indicated that such an approach was an effective means to teach interpretive concepts.

Digitized audio did present some technical problems, however. The greatest problem was that of storing sounds on the computer's hard-disk drive requiring an enormous amount of disk space. There is a direct relationship between the quality of sound produced in such systems and disk storage. The higher the degree of sound quality desired, the more disk space is required. In an attempt to conserve available disk space, Adams accepted a moderate sound fidelity, roughly equivalent to that of AM radio broadcasts. Even with this compromise, an entire 20-megabyte hard disk was required to house the program of some 20 examples for each instrument.

With such storage requirements, it is obvious that there are inherent problems with distribution of such extensive programs. And even if it could be easily distributed, most instructors would not have the means or the inclination to devote an entire hard disk to a single program. Until more efficient, cost effective, and transportable mass-storage systems are available, digitized audio courseware is not likely to enjoy widespread commercial application.

The digitized audio approach is, however, quite useful for self-developed music courseware. The process of audio digitizing is quite simple, and integrating these audio materials into courseware developed with programs like HyperCard for the Macintosh or LinkWay for the IBM is equally simple. Neither HyperCard nor LinkWay requires extensive programing experience to develop elegant, useful instructional materials. Such ease of development makes it possible for teachers to produce their own music courseware, thus tailoring their designs to the needs of their students.

The second type of interactive audio—integrating audio CDs and computers—has greater potential and is even more exciting. A relatively new format for storing computer information is CD-ROM, an acronym for "compact disc read-only memory". In this format, computer data are stored on the same medium used to produce audio CDs. Because it is a read-only format, the user is unable to store new data on the compact disc; it is only possible to retrieve the information that is initially stored on the disc by the commercial developer. The advantage of CD-ROM

is that large amounts of data can be stored on each disk. One CD can hold approximately 650 megabytes of information, the equivalent of over 300,000 pages of text.

While such storage capacity holds tremendous promise for dissemination of information in new and creative ways, what is most exciting about CD-ROM from a music-courseware developer's standpoint is that the CD-ROM drive will also allow the user to play standard audio CDs controlled by the computer. The advantage of computer control is that any point on the audio CD can be accessed nearly instantly with precision to 1/75th of a second. This audio control can be combined with text and graphics on the computer screen, providing students with carefully guided listening activities for training in any number of aural skills. Since the system uses CDs for the sound source, the audio output is of the highest quality. The virtually infinite selection of audio CDs currently available provides teachers with an endless supply of musical resources for courseware development. As with the digital-audio approach, interactive CD materials are relatively easy to create, and self-developed CD courseware is within the grasp of many educators.

An excellent example of one type of material that can be developed with this approach is a commercially available program written by Robert Winter using Beethoven's *Ninth Symphony.* The program integrates a fine CD recording of the symphony (Hans Schmidt-Isserstedt conducting the Vienna Philharmonic with soloists Joan Sutherland, Marilyn Horne, James King, and Martti Talvela) with computer-coordinated text, graphics, and animation. It was developed for the Apple Macintosh computer using HyperCard and the CD-ROM drive. There are five sub-programs: "Pocket Guide", "Beethoven's World", "The Art of Listening", "A Closer Reading", and "The Ninth Game".

The "Pocket Guide" provides a sectional analysis of the four movements of the symphony. The user can "point and click" with the computer's mouse at any of the sectional headings displayed on the screen, and that portion of the music will immediately be played from the disk.

"Beethoven's World" is designed to give the user background information on the composer's life and the culture in which he lived. The opening screen consists of an outline of the contents. The user can skip to any section of the text by using the mouse to point to the desired section heading, or one can proceed systematically through the 124 different screens of materials. Each screen contains textual information as well as high-quality digitized graphics,[1] providing portraits of the composer and others as well as a reproduction of one of Beethoven's musical sketches. Certain words in the text are marked with bullets; clicking with the mouse on such words will provide a definition or further explanation. Interspersed throughout the text are buttons which can be clicked to play the section of the music that relates to the selected topic of discussion.

"The Art of Listening" is a detailed analysis of the symphony, presenting thematic materials and compositional approaches employed in the work. Once again, buttons are used to access the portions of the CD under examination. These audio examples vary in length from a few notes to several bars. In many cases, music notation is displayed on the screen as the music is heard.

"Close Reading" is perhaps the most impressive subprogram. Once begun, the symphony is played from beginning to end, while synchronized descriptive text and graphics are displayed on the screen. Again, key words and phrases in the text are marked with bullets and various detail-providing buttons are included, making it possible for the user to stop and explore further at any point. Once the extra exploration is complete, a click of the mouse restarts the music at the point it was stopped.

"The Ninth Game" is a quiz game for one to four players that is designed to test acquired knowledge about the music and the accompanying information. The questions are multiple-choice, and some are based on audio examples played from the CD. Humorous animation and digitized audio sounds provide feedback for correct and incorrect answers.

The style of prose and analysis provided by this program makes it appropriate for a wide variety of instructional settings. The most apparent application is for the undergraduate music history student, but music appreciation students and serious home users would also benefit from the wealth of information and instruction that is in the program.

While the method of presentation employed in the Beethoven program is new, the materials presented are traditional in scope and content. It is likely that such powerful technological tools as interactive audio will also spawn the development of completely new models for understanding music. What is most encouraging is that as technology improves, the potential increases for using it in ways that are truly musical in nature rather than artificial or sterile. If new technology stimulates new ways of thinking about musical meaning and its instruction, it will serve to broaden the palette of resources available to music educators. ❑

Notes

1. Digitized graphics are reproductions in the computer of any visual image (e.g., a photograph or a manuscript). The images are put into the computer with a device called a digital scanner.

References

Adams, S. (1989). *The development of a computer-based interactive multimedia program for teaching interpretive aspects of wind instrument notation.* Unpublished doctoral dissertation, University of Southern California, Los Angeles.

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