DSP – Sound Synthesis and Educational Aims

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This paper describes a project that links interests within both the Norwegian educational system and the music community. Further, the paper presents a recently completed educational software package that has been tailored for teaching sound, sound processing and composition from the elementary school level to junior college level. Two projects that have been completed using this CD-ROM are also discussed.

The project was developed as a whole, and has already been realized in part. The following assumptions did form the basis for the project:

- There is a need for updating teachers' education within the field music and technology
- There is a need for an introduction to aesthetics related to the musical use of technology
- There is a wish to develop music education that has relevance to children's experiences outside of school
- The educational material itself should emphasize and mirror the aesthetic and academic content
- There is a desire to (re)establish creative projects for children and young people within music and composition
- The project should grow and develop over time
- There is a desire to anchor the project within the educational system and link the project to the professional music community

The Ministry of Education

The plans regulating the content of elementary school education have been altered recently (during the last four years) to include language stating that children *shall* use technology within music education, and that they *shall* compose as part of their music education. However, this does not necessarily mean that teachers have been sufficiently trained to teach either music technology or composition, or that adequate financing has been allocated in the fiscal budget for equipping classrooms. Nevertheless, the ambition is there, and NoTAM has viewed this as both an opportunity and a responsibility to assist in meeting these mandates.

The most significant obstacle seemed to be the lack of software that was both easy to use and that allowed the creative process as much free reign as possible. Typically, large international corporations have manufactured easy-to-use, follow-the-grid software. These are almost without exception MIDI-based, commercial sequencer or sequencer-like packages of varying complexity with no access to or

focus on the micro levels of sound and composition. While this approach is not necessarily wrong, it is insufficient for musical forms other than popular music because it hinders musical expression and creative activity. We were able to see this quite clearly during the jurying of submissions to a national composition contest that was established in 1990 for young people. As sequencers have become common tools, the musical submissions have become more similar, almost stereotypical. In short, a need for another kind of software was clearly apparent.

The Professional Music Community

A problem in fulfilling the task of teaching composition in the classroom is the lack of an arena for presenting the finished works; there is a need for the students to show their work. Children's activities and products are often placed on the sidelines and not considered important because they do not meet professional standards. NoTAM therefore chose to develop a model where the children's compositions would become part of the Norwegian festival scene. Their works have been integrated into local or national festivals as natural components in the program. Of course it is not possible to include all music that is made by pupils in schools, but these kinds of concerts show educators and pupils alike that their work is valued in the professional music community and thus serve as an important motivating element.

The composition workshop *Breaking the Sound Barrier* was originally conceived as a composition contest with submissions from school classes, which occasionally engaged in projects with visiting composers. Although *Breaking the Sound Barrier* was in place prior to this project, it was developed and radically changed through NoTAM's engagement. While student works were performed at specially promoted concerts, the composition project had deteriorated and suffered from a lack of focus for many years and there was no clear idea of how the project was to be developed in order to meet the new challenges of computer software. A revitalization of this potentially exciting project was crucial in order to maintain its aesthetic relevance as a creative program for children.

Nationwide attention was granted the project through collaboration with the public broadcasting system NRK, which provided TV and radio coverage of the events.

Partners in the Norwegian Music Community

Software development for the project was funded as part of NoTAM's normal operating budget, with additional funding provided by the Norwegian Council of Cultural Affairs and the National Center for Educational Resources.

NoTAM developed the concerts, which constitute an integral part of the project, in collaboration with the Ultima festival, The Concert Institute of Norway and the Norwegian Broadcasting Corporation (NRK). The Concert Institute of Norway and the National Center for Educational Resources will continue to support the project as collaborative partners.

Educational Goals

The purpose of the software on the CD-ROM is to teach electroacoustic music, that is, music that falls outside of the note paradigm. Music viewed (or listened to) as organized sound allows the listener to focus on aspects other than those prevalent in instrumental writing. The tools are simple to use but suited for advanced work as well, and encourage a learning process that is radically different from that found in traditional work with sequencers, samplers and synthesizers.

Since Norway is a relatively small country, it has also been important to cultivate a culture technology in the national language.

CD-ROM with Music Tools for the Educational System

The software developed by NoTAM is built on a model of non-linear teaching, based on student learning by means of personal investigation and creative activity. We did not want a specific emphasis on the *necessity* of theoretical knowledge, but we wanted a quite comprehensive collection of material to be available when and if students wanted it. We wanted the tools to look good when compared to game technology, with individual tools that were easy to use, self-instructional and integrated into a package that was easy to understand and intuitively accessible. These decisions were made out of concern for both students and teachers. It was also important to limit the number of choices that the students could make to not confuse creative impulse with tools that were too complicated.

This CD-ROM project is targeted for students from eleven to sixteen years of age, although the material relevant for students at higher levels as well.

DSP Contents

DSP programs written specifically for this CD-ROM include:

- Mixer with cassette player-type controls and breakpoint curves for amplitude and panoration.
- Sound Editor with the possibility of hard disk recording through the soundcard's input.
- Synthesis (Additive, FM, Plucked String, Buzz, Noise), Granulation, Time Stretch, Scratch, Sieve, Spectrum Shift, Algorithmic Composition, Delay (including Doppler), Harmonizer, Filter (Highpass, Lowpass, Bandpass and Bandstop), Reverb, Ring Modulation, Chorus (including Flanger)

Tutorial texts written especially for this CD-ROM have the following titles:

The History of Electroacoustic Music, What is Sound (simple acoustics, frequency and amplitude), Sound in the Environment, Harmonics and Spectra, Sampling (how sound is represented in the computer), Synthesis (musical signal processing), Working with Sound vs. Working with Notes, Algorithmic
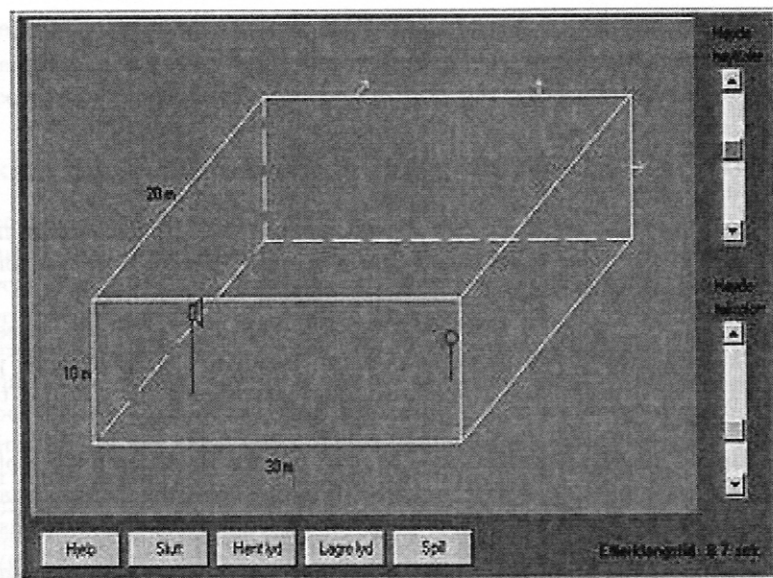
Composition, Composers' Section, Cross-Disciplinary Common Characteristics, Real-Time and other Performance Technology, Technology in Pop/Rock Music. The text Sound in Space includes a program for reverb, based on room simulation, where the students can move walls and ceiling to change parameters.

All tutorial texts contain hyperlinks to short explanations, illustrations, sound examples, etc. All signal processing programs are supported by help files, where one can view examples that call up the program as well as show the parameters that have been used in each specific example. The parameters are also available for the users to experiment with in this mode.

A demo consists of a short musical composition (approx. 2.5 minutes), with texts describing the composition and all sound material, as well as a detailed description of all the processing that has been done. The music has been executed using solely those programs found on the CD-ROM, and the tutorial text contains hyperlinks that call up the discussed sounds and programs, and the parameter settings that were actually used to create the sounds. The users can also change the parameter values in this mode to reassure themselves that they have understood the points made in the text, or to explore other approaches.

The music also exists as a mix file with all the sounds in it. The mix file can be changed, just like any other file, allowing students to learn through deconstruction or to just have fun with it. Finally, there is computer music animation, where the viewer follows the movement through the spectra that comprise the piece as it is being played.

The CD-ROM contains Internet links to contact addresses and NoTAM's website, which is loaded with cool sounding material, ideas for classroom projects,

results from previous use of the software, FAQ, etc. The site is maintained in all of the languages in which the CD-ROM has been published.

Functions and Options

Most Norwegian schools are equipped with PC equipment, so the choice of machine base was relatively simple: any PC running Windows 95 with a built-in or added soundcard is able to run the DSP programs included in the CD-ROM.

The user is first asked to name his/her project, and the mixer screen then appears. The mixer screen is the home domain for the project. One may proceed directly to the DSP programs to make sounds, investigate the tutorial texts or select the demo mode.

As mentioned above, the demo mode brings up a description of a piece of music, where each sound may be "opened" in a DSP program with the settings that made that particular sound. If a sound has been processed several times the user may follow the process backwards until reaching the initial starting point. At any point, the user may tweak the parameters. The user may also open the demo piece as a mix file and work on the sounds there, saving new sounds in the project and thus changing the composition.

After tweaking existing sounds, making new ones or treating one's own sounds, the project will contain enough sound files to make a piece of music. The mixing process works much the same as in the programs "Mix" for the SGI or ProTools for Macintosh. One can bounce the mix to disk and then process it with a reverberation program that teaches acoustics through room simulation; moving walls and ceilings, sound source and listener position.

Project Reports

The CD-ROM has been used in several contexts and is currently being used in the Norwegian school system. The most successful projects were the *Breaking the Sound Barrier* concerts in 1996 and 1997.

Breaking the Sound Barrier 1996

The composition workshop this year included very different approaches to working with composition. One was the development of a musical work by a composer in collaboration with two fifth grade classes, where the result was performed by the pupils at a huge concert in Oslo Philharmonic Hall. The other approach involved a seasoned composer to have three "apprentices" follow the composer's work on a concert program with a tape piece of their own, and to participate in the diffusion. The concert was engineered by GRM on the Acousmonium. The concert included these two works as well as a number of electroacoustic works that were directed towards a mature audience.

The evaluation of the project made note of the programming profile, and it was clear that most of the music did not sit well with the younger members of the audience, although the workshop composition was particularly well received.

Breaking the Sound Barrier 1997

Another model was adopted in 1997. The focus was limited strictly to the making of a concert by and for children, with professional elements used solely to provide framework and reference. Four separate projects were initiated, the first a workshop for acoustical instruments, where children developed a story combining music and movement, with a teacher. The other project was a largely self-developed contribution from a youth center – a video with techno-inspired soundtrack that was developed by three teenagers. The third project was a combination of three separate initiatives at the same school (fifth graders), one group working with images, another focusing on instrumental composition and the third making music with the CD-ROM. The output from the acoustic workshop and the electronic workshop were fused into a single piece of music, which was performed together with the visuals. This was the main piece of the concert. The fourth element consisted of small works commissioned from the three "apprentices" from the previous year, each of whom wrote a short piece that was performed at the concert.

The concert venue was organized as a multimedia space in two sections, and the format of the program was fast-paced and distinguished by interrupting and digressing multimedia elements. In a sense, it was tailored to mimic the current media reality, with diverse material drawn from a number of sources. It was interesting to note that this time the children liked the concert much more than the adults, and that the children from the workshops were more involved in the diffusion and performance aspects of their works. The attempt to make a concert on the children's premises seems to have worked, and it seemed to have a natural place in what is a major contemporary music festival.

Summary

While the CD-ROM project described above may be considered completed, this kind of work never really ends. There is a need to stay on top of technological and musical developments in order to ensure that the educational system is kept updated – in terms of both the technology and aesthetics. Work remains to be done to educate teachers and to provide good support for them. International publication of the CD-ROM is pending, and one may expect publication in German, Italian and English within 1999/2000. For more information about the present and future plans for the distribution of *DSP*, please refer to the Web page http://www.notam.uio.no/DSP.