Towards SYnthia II: An Assessment of Design Strategies for Computer Assisted Learning of Sound Synthesis

Matthew S. Padden* m.s.padden@hud.ac.uk
Michael Clarke* j.m.clarke@hud.ac.uk
Alan J. Dix+ alan@zeus.hud.ac.uk
Mark A. R. Kirby+ CL0671P@hud.ac.uk

*Department of Music
University of Huddersfield
England HD1 3DH

+School of Computing and Maths
University of Huddersfield
England HD1 3DH

Abstract

Research has been carried out as part of an investigation into more efficient ways of teaching the principles of sound synthesis using Computer Assisted Learning (CAL). The research concentrates on the navigation methods used to access the teaching material. Emphasis is placed on active and communicative teaching methods, with the aim of encouraging self-structured, autonomous learning. Details of the testing procedure and projected results are given, together with descriptions of the program structure.

1 Background

Sound synthesis as a curricular subject does not benefit from traditional lecturing methods. Clarke and Smith [1993] call for a more active, 'hands-on' approach. This requirement is, however, at odds with the limited contact time that is available between teachers and students, a problem compounded by the increasing numbers of students taking an interest in the field.

Previous work at Huddersfield's Music Department addressed this conflict by using CAL software to teach the fundamentals of sound synthesis. Students learnt autonomously, putting new concepts immediately into practice using context sensitive synthesis controls embedded within the teaching material. SYnthia [Clarke and Hunter 1992] (SYnthesis Instruction Aid) achieved international recognition and is used as part of the Electroacoustic course at the Department.

2 Knowledge Representation

An individual learning a body of knowledge constructs their own unique mental representation, or schema, of that knowledge in order to understand it [Jonassen 1991]. In many teaching situations, however, the material is presented in a manner based upon the teacher's personal knowledge representation. Students are forced to try and accommodate this structure into their own mental schemas. The results are often a poor understanding of the subject, coupled with low motivation [Whalley 1993].

Sound synthesis represents a particularly difficult learning challenge; many different concepts connected via a complex web of relations. It requires a teaching style in which the learner can construct their own mental representations of the knowledge, whilst preserving the original learning goals.

3 Access Structures and Learning

Learners must be given some control over the sequence of knowledge if they are to construct their own knowledge schemas [Laurillard 1988]. The access structures of a learning system (such as a contents page, road map, hypertext) govern this control. Too little control and the learner is forced into an ill-fitting learning style. Too much freedom leads to vague, unstructured learning and a tendency to browse knowledge [Whalley 1993].

Access structures and knowledge content have traditionally been kept largely separate. The introduction of hypertext [Beeman *et al* 1987] embedded the access system within the content. This embedded access is usually limited, however, to other closely related knowledge. Combining the content with an overall access system in the same contextual space reduces the cognitive switching required between 'learning' and 'searching'.

Allinson and Hammond [1993] proposed a metaphor-based access system using the idea of 'guided tours' through a knowledge base. The system combined disciplined, progressive paths to particular learning goals with the ability to leave the 'tour' and navigate freely around the knowledge base. Learners can thus supplement the suggested learning path with additional material to better fit their own mental schemas.

4 Testing

A CAL software package was developed to evaluate the guided tour access system. The package covered the principles of subtractive sound synthesis. The evaluation hypothesis was that the system would contribute to a deeper understanding of subtractive synthesis in allowing learners to more easily construct their own knowledge schemas. Synthesis controls embedded in the teaching content operated a Yamaha SY99 synthesiser to provide sound.

Three versions of the package were implemented, differing in the access tools available to the learner. All three versions provided a 'road map' of the overall content which was visible at all times. The road map gave route history and current position through the use of colour cues. Learners could Quit the package at any time.

One package provided only Proceed/Go Back buttons. Learners moved sequentially through the course, with the ability to repeat sub-sections at certain points. Another used the road map as the only means of navigation, allowing freedom with no imposed learning sequence. The third combined the attributes of the other two; Proceed/Go Back buttons were used to progress through the 'tour', but the road map could also be used to jump to any point in the knowledge base. A further control returned the learner to the tour at the point where they left it.

Three groups of first-year music undergraduates were selected. The groups were matched for motivation, gender, previous knowledge of sound synthesis and previous experience with computers. Each participant was interviewed to ascertain their previous knowledge of, and confidence in, subtractive synthesis.

After a brief introduction to the software and its hardware platform, a Power Macintosh, the participants were given a fixed amount of time on the system. Data recorded during the sessions included how far the participants progressed through the tour, and their route through the material. The use that participants made of the available access tools and features was also analysed.

Following the session, a post test was conducted to assess the participant's confidence in their new knowledge and their attitudes towards the user-friendliness of the system. A further post test was conducted a week later to measure the participants' recall of their new knowledge.

5 Results

Examination of the test results will be used as the basis of further work. This will concentrate on further integration of the access system with an increased knowledge base, with the aim of creating a holistic, autonomous learning environment for multiple forms of sound synthesis.

6 Conclusions

It is hoped that guided tour access tools will ease the learning task in conceptually complex subjects such as sound synthesis. The system preserves disciplined paths toward the learning goals. Learners should find it easier to accommodate the knowledge into their own mental schemas.

References

[Allinson and Hammond 1993] L Allinson and N Hammond. A Learning Support Environment: the Hitch-hiker's Guide. In R McAleese (Ed.): *Hypertext: Theory into Practice*, Intellect.

[Beeman *et al* 1987] W O Beeman, K T Anderson, G Bader, J Larkin, A P McClard, P McQuillan and M Shields. Hypertext and Pluralism: from Lineal to Non-lineal Thinking. In *Hypertext '87 papers*, Association for Computing Machinery.

[Clarke and Hunter 1992] Michael Clarke and Stuart Hunter. The 'SYnthia' teaching package. *University of Huddersfield.*

[Clarke and Smith, 1993] Michael Clarke and Geoff Smith. Electroacoustic Music in Higher Education. *B. J. Music Ed.*, **10**, pp85-90.

[Jonassen 1991] D Jonassen. Objectivism Versus Constructivism: Do We Need a New Philosophical Paradigm? *Educational Technology* **39**, 3, 5-14.

[Laurillard 1988] Diana Laurillard. Computers and the Emancipation of Students: Giving Control to the Learner. In Paul Ramsden (Ed.): *Improving Learning: New Perspectives*, Kogan Page, London.

[Whalley 1993] P Whalley. An Alternative Rhetoric for Hypertext. In C. McKnight, A. Dillon, J. Richardson (Eds.): *Hypertext, a Psychological Perspective*, Ellis Horwood.