Understanding harmony and technology in music education

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INTRODUCTION

This study set out to evaluate the use of a particular computer interface for the teaching of musical harmony to school children aged between 13 and 14 years. The study looked at a number of specialised technical issues concerning music education and human computer interaction, but in this paper we will focus on some of the broader issues that emerged. One general hypothesis the study tested was that an appropriate computer interface can encourage students to discover harmony by empirical enquiry, within a conventional classroom setting. We believed that the computer software could become incorporated into the music lesson and be seen by the pupils as just another instrument which assisted with the learning of harmony. In general, the use of computers in music education can in some respects have advantages over the "real instruments" in that lack of instrumental fluency need not impede progress and hence decrease motivation of the less musically able students. A secondary advantage may be that computer enthusiasts take music lessons more seriously.

The innovative computer interface which we particularly wished to evaluate was a piece of software known as Harmony Space, (devised by Simon Holland 1989, 1994). It allows students almost immediately to try out a variety of harmonic strategies using an extensive harmonic vocabulary via a simple, uniform spatial metaphor. The interface has been used by adult complete beginners with very little tuition to create and analyse harmonic sequences, including complex ones, more or less irrespective of previous instrumental skill, knowledge of music theory, or music notation. Many of the properties of the interface derive from its strong theoretical underpinnings in the cognitive psychology of music and its good human computer interaction properties. The development of Harmony Spacewas influenced by Longuet-Higgins' (1962) theory of perception and harmony, and the related work of Bolzano (1980). The interface uses the fact that the way people perceive tonal harmony can be represented elegantly and concisely using a three dimesnional spatial arrangement. We have found with adults that the interface is indeed easy to use and requires no user knowledge of the psychological and mathematical theories (Howard et al 1994). The Harmony Space interface runs on an Apple Macintosh and connected to MIDI acts as a mouse-driven musical instrument with a visual display.

In order to critically evaluate the use of Harmony Space in the teaching of harmony to school children it was necessary to teach three separate groups of subjects (of comparable ages and ability) by introducing them to three different learning conditions. One group of subjects used the Harmony Space interface as outlined above. The second group used a piece of software known as Midi Grid.
The same concepts and relationships, using the same theoretical basis, were taught to this group as to the first group. However Midi Grid is a general purpose tool, whereas Harmony Space is expressly designed to reflect consistently the theoretical basis in question. The purpose of these two conditions was to distinguish between the use of the theory in teaching per se, as against the use of the theory in combination with a purpose-designed interface. Both tools made it uneccessary for students to develop instrumental fluency on a keyboard, though all students had access to a keyboard during teaching. The final condition was to teach harmony to children using a high quality current approach based on a traditional view of the theory of harmony. This condition was supported with appropriate music software and electronic keyboards. The software in this case was a good commercial music sequencer. This latter condition allowed us to compare Harmony Space and its underlying theoretical basis with good quality current teaching practice.

Although the subjects were given different learning conditions they were focusing on the same learning objectives and were seeking the same learning outcomes. In fact all the children were taught in the same classroom during normal lesson periods. A course was specifically constructed for this purpose and was designed to instruct pupils in simple composition, analysis, accompaniment and music theory skills, by engaging in an eight-strand teaching programme. This programme was devised and taught by our consultant Nigel Morgan who is also a composer and highly experienced music teacher. We liaised closely with the classroom music teacher who was present throughout. The eight strand teaching programme was composed of analysing simple harmonic tasks, discussing chord sequences, modifying chord sequences, answering questions about harmonic concepts, playing a modulatory chord sequence specified in Roman Numerical notation, completing music theory tasks, executing simple accompaniment tasks and carrying out simple compositional tasks.

METHOD

This project involved students working in single sex, pairs or triads solving simple harmonic problems with a computer or a keyboard. Subjects (n=51) were pretested and paired according to musical ability and computer literacy. We chose to study single sex groups as this was the current practice within the school. The behaviour of the subjects was videotaped throughout the sessions (five in total). A post-test was administered one week after the final teaching session and assessed the progress made by the subjects in each teaching condition. Observations were made of the behaviour of the whole class during each session. While one pair from each condition (i.e. the Harmony Space System, the Midi Grid System and pupils using keyboards and sequencers) were closely observed and videotaped for each session. Hence supplementing our qualitative data (i.e. the test change scores) with qualitative findings.

RESULTS

Despite the fact that pupils who used the Harmony Space programme did better in the post-test than the other students an analysis of variance revealed no significant difference between change score and method of empirical enquiry. However, subjects using Harmony Space were more successful in the modulation exercises than the other students.

Table 1: Synopsis of results from a case study with subjects using Midi Grid.

GIRLS	BOYS
1. Used computer with difficulty	Used computer easily
2. Repeated exercises wanted high degree of accuracy	Satisfied lower degree of accuracy
3. Communicated with looks and gestures	More explicit communication
4. Read instructions poorly	Read instructions well
5. Slogged doggedly through worksheet	Skipped through as quickly as possible
6. Collaborated	Argued quite fiercely
7. Helped each other	Did not display this behaviour
8. Helped others	Did not display this behaviour
9. Driver navigator system	did not always take turns
10. Slower used computer more as a musical instrument and practised. engaged in "music discourse"	Faster. Engaged in "computer discourse"

One surprising result however was that when a 2-factor analysis of variance was used to test for gender against change score. There was a significant difference between boys and girls change scores ($F = 27.015$, $p = 0.001$). The classroom observations were categorised and the results indicate that even though boys and girls asked for the same amount of teacher help, boys however received more unsolicited help. In fact boys elicit more staff attention. More boys than girls gave up trying before the end of the sessions. These observations suggest that girls get on with the task more than the boys. Girls were found to help each other within the group more than boys and in fact helped other pupils outside their own group more than boys did. We also found less group cohesion among the boys than girls.Further observations indicate that there was more off task talk with boys than girls. Some boys played with the computer rather than attending to the music agenda. There was no evidence of girls doing this. Equal numbers of girls and boys remained working after the class had finished. These findings together with the results from the case study (see Table 1) suggest that girls entered into a 'music discourse' while boys were interested in a 'computer discourse' during these music lessons.

CONCLUSIONS

The study was a preliminary experiment. It revealed many qualitative technical factors affecting teaching and experiment in this area. We now feel that to answer our original question, more refined experiment is required. However, the study shed unexpected light on other questions. Our main such result was surprising in that girls did not succeed as well as boys for we found a significant difference between the boys and girls change scores. We suggest that girls entered into the 'music discourse' and not the 'computer discourse' during these sessions. These results are in keeping with Comber et als'(1993) findings that with the advent of computers in music education they have found that now more boys and less girls are taking this subject. The computer has many roles to play in music education and our subsidiary results suggest ways in which to improve the Harmony Space interface and the teaching syllabus which accompanies it however, must be aware that girls should not feel excluded from activities that revolve around computers. Comber et al suggest research into music education with computers is timely since the advent of its uses in this domain is still in its infancy. Therefore teachers and researchers should work collaboratively to identify those factors which contribute to current inequalities. We should work together to devise teaching practices that best address these problems.

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