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Middle Eight

Technology, accessibility and creativity in popular music education

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Current technologies, accessibility and education

How might some of the commonly used technologies fair when scrutinised within a British context of meeting the requirements of the Special Educational Needs and Disability Act of 2001? In effect, this act amended the Disability and Discrimination Act of 1995 to include more specific requirements for education providers. There are two key inclusions aimed at further and higher education providers with similar, but separate, inclusions aimed at schools. In brief, these state that there is:

> a duty not to treat disabled students less favourably, without justification, for a reason which relates to their disability; and a duty to make reasonable adjustments to ensure that people who are disabled are not put at a substantial disadvantage compared to people who are not disabled in accessing further, higher and LEA secured education. (HM Gov. 2001)

The key phrase in this statement is 'reasonable adjustment' which suggests that if there are alternative modes that can be used for communicating ideas or demonstrating techniques, modes that are perhaps more appropriate to an individual's specific needs, then these should be made available. This creates dilemmas for education providers. Perhaps most apparent is the desire for Further and Higher Education institutions to be seen as operating in-line with industry standards. For example, ProTools is widely accepted as being an industry standard studio recording technology and it is not unlikely that technology of this type will form the basis for studio recording practical sessions. From a creative perspective, ProTools is a powerful software-fronted recording environment which, as Savage and Challis (2001) have observed, is also intuitive enough for children as young as nine years old to work with creatively and independently. Unfortunately, and in stark contrast, it is also a particularly inaccessible environment for visually impaired (VI) users to work with (Zahradnicky *et al*. 2008).

A second dilemma faced by some educational institutes is how to provide a practical experience for a large volume of students. As Boehm (2007) observes, the general increase of HE music-related courses that incorporate both creative and

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technological elements can lead to courses being shared between different faculties; faculties that may operate on highly contrasting models of class-size. One resource that is likely to be in high demand is the recording studio. The very nature of the task, and size of environment, dictates the involvement of perhaps only a few people in a process that can sometimes be very long. There is obvious potential for this to impact upon the experience of students studying sound engineering, for example. However, as Eno (2004) reminds us, the recording studio is not the exclusive domain of the sound engineer, and should clearly be seen as a compositional tool. So, this same level of high demand is also likely to impact upon the experience of those studying popular music composition.

An alternative (or possibly additional) experience can be offered using computers running popular software as described earlier (Cubase, Sibelius, etc.) with perhaps a small collection of 'plug-in' virtual instruments. In practical terms this might be seen as a flexible, and therefore sensible, way of providing access to a wide variety of sound sources for compositional use. However, there are already a number of recognised design issues for users of software instruments and recording environments (Magnusson 2006), not least that the two-dimensional screen is simply not an efficient way of navigating and controlling the number (and type) of physical controls that often need to be available. This is before any consideration has been given as to whether the user might have additional needs. For visually impaired students in particular, highly complex graphic environments simply do not lend themselves to access via screen-reading software such as JAWS or HAL. Where standard text is not available for the screen-reader to access, graphic objects need to be interpreted within an off-screen model such as that described by Kochanek (1994) where recognised items can then be referenced using a scripting system. This kind of adaptive software and hardware intervention can only really be achieved if the manufacturer of the original product is willing to collaborate at some level.

At this point, it is also worth considering the role of music notation within popular music education. Moore (1993) reminds us that the 'primary medium of transmission of rock, since at least mid-1950s rock 'n' roll, has been the recording', suggesting that where a notated rock score exists it will probably be transcribed. He does acknowledge, however, that notation has a valid place within popular music and cites the continued use of sheet music as evidence of this. Indeed, in the UK, the Rockschool graded exam series includes notated pieces and technical exercises. These qualifications are included within the British UCAS tariff for evidencing musical ability (see UCAS). Graphical notation of this type is difficult for visually impaired students or pupils to access and presents challenges for individuals with dyslexia. Although there are non-visual alternatives, such as Braille music and 'Talking Scores', these have inherent complexities of their own. Ockelford (1996) presents a detailed overview of both Braille music and 'Talking Scores' but, in brief, both are 'displayed' in a serial fashion with the reader being required to 'read' everything before effectively filtering out that which is not needed. Within this, there are also fundamental conflicts between Braille and Braille music. For example, the Braille codes for the musical letters A to G do not correspond to standard Braille for the same letters. In fact, they map onto the Braille letters for I J D E F G H; a potential source of confusion for those learning both systems simultaneously. Furthermore, not as many registered blind people read Braille as might be imagined; this figure may be as low as only two per cent (Bruce, McKennell and Walker 1991).

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What technological aids to accessing music notation are available to visually impaired music learners? Within academic research a number of projects have addressed this area. Challis and Edwards (1997) proposed and prototyped a system that would allow blind musicians to browse a tactile structural overview of one or more pages of music. Using the 'Weasel' system (Challis 2000), music learners could press onto touch-responsive tactile overlays containing aspects of musical structure (bars, repeats, dynamics, etc.) and directly select extracts or phrases for immediate display. Filters could also be applied to enable the reader to focus on key music learning tasks (pitch, rhythm, fingering, etc.) with the notation displayed as audio playback, speech or potentially via a refreshable Braille display. Other non-visual approaches have since been considered by McKenzie and Marwick-Johnstone (2008) and also by Nicotra and Quatraro (2008). However, accessibility to commercially computer-based notation platforms (e.g. Sibelius, Finale) is currently very limited (McCann 2000). Although screen reading scripts for older versions of Sibelius (v.3) have recently been made available, the more current versions (v.4 and v.5) are, as yet, unsupported.

Issues over interaction in complex graphical software are not limited to visually impaired users; the on-screen interface can be difficult to manipulate for sighted users who have limited dexterity. Access by keyboard shortcuts may be available for many actions but the tendency to rely on floating toolboxes will usually require the use of a mouse, the control of which can be an issue by itself. Switch-based access is almost impossible. From a commercial perspective, the issue of how accessible technology should be will carry on for many years to come, but that is not the central issue here. The real question is whether reasonable adjustment can and should be made.

Novel instruments and interfaces employing gesture-based interaction

Much of the discussion so far has focused on the use of standard technology within a context of composition, recording and production, but there is still the area of music performance to consider. There are obvious issues in terms of accessibility with many conventional musical instruments, perhaps most noticeably a general reliance on well-developed fine motor skills. However, there are numerous novel technologies available that can assist significantly in terms of enabling access to practical music making. Some of these have been developed in part through academic research, e.g. MIDI Creator (Abbotson *et al*. 1994), E-Scape (Anderson and Smith 1996) and MIDI Grid (Hunt 1988). Others are commercial products that happen to incorporate naturally accessible features, e.g. Roland's Handsonic, Korg's Kaoss Pad, and most recently the Tenori-On from Yamaha. We should also remember that the Theremin (an early 'hands-free' electronic musical instrument) was itself naturally accessible; a feature that has led to this historic instrument finding continued use within music therapy (Magee 2006). With this particular concept in mind, the remainder of this article is devoted to the discussion of two contemporary music performance technologies that also make use of gesture-based interaction: Soundbeam and the Benemin.

During this discussion, it will at times be useful to consider such novel technologies in terms of the different modes of performance behaviour they can facilitate. A framework for this is described by Malloch *et al*. (2006), who suggest

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three such modes of performance behaviours: skill-based, rule-based and model-based. Of these, the mode of musical interaction-behaviour most similar to that of playing a conventional musical instrument lies within the skill-based domain. The implication is that the user will be interacting in real time in response to a continuous audio-stream. The other two models of musical interaction-behaviour operate at increasingly abstract levels of interaction with the user's interaction being less and less involved in terms of overall control and 'connection' with the sounds being made.

Soundbeam and Quinta Punkada

Soundbeam was originally designed to be used by dancers but has since become popular as a method of making music performance accessible to individuals with specific needs. Swingler (1998) describes the system as being 'an invisible, elastic keyboard in space that allows sound to be created without the need for physical contact with any equipment'. Soundbeam is popular in schools with special needs provision and is also generally acknowledged as being useful within both community music (Healey 2005) and music therapy (Magee 2006). The system can accommodate different types of switches and sensors, but the primary source of input comes from an ultrasonic 'beam', as the name suggests. When this beam is interrupted, sounds are triggered in much the same way a theremin operates. Though, in contrast to the gliding-pitch sound of the theremin, Soundbeam maps musical scales in steps along the beam using MIDI notes. These are transmitted to any sound module that is attached, so the diversity of sounds available for the performer is potentially very rich. The length of the beam can be varied according to an individual's needs or to accommodate environmental constraints. Interaction with the beam is essentially one-dimensional as movement within the beam cannot be sensed at multiple locations. However, the system adopts rule-based behaviours to allow the triggering of predefined harmonies and musical patterns so that polyphonic output can be achieved, i.e. chords.

Soundbeam is frequently featured in workshops and events hosted by Drake Music Project (UK), but there has been some truly inspirational performance work achieved by the Portuguese pop-rock band 'Quinta Punkada'. Based at the Cerebral Palsy Association College in Coimbra (Portugal), and coordinated by Paulo Jacob, Quinta Punkada are a group of musicians who play and perform publicly despite mobility issues that would normally make access to many conventional instruments difficult, if not impossible. Embracing many styles (including hints of jazz, blues and even punk), the band consists of keyboards, drums, vocals, and one or more Soundbeams. Perhaps the most noticeable component within the sound of Quinta Punkada is afforded by the latter instrument. Using one as a lead instrument, the band's 'soundbeamist' will occasionally break into a 'guitar' or 'keyboard' solo, gesturing with his hand or arm within the beam. Mapped to a blues scale, a sweeping gesture allows him to glissando up or down the pitches with smaller movement producing trills and arpeggiated effects. Three out of the four regular members of Quinta Punkada are wheelchair users, each with quite profound mobility problems. Indeed, the very notion of attempting to play a conventional guitar or keyboard would simply be unrealistic. Using this enabling technology, the same individuals are presented with the means to improvise and express themselves freely in a way that is both natural and fitting within a popular music context.

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Consider the notion of improvising with a conventional instrument over a groove-based chord backing. Although a rich and expressive solo might be achieved through the exploration of only a limited pitch-set (perhaps a single pentatonic scale), the player must still demonstrate skill in avoiding the pitches that do not belong within the set. With this in mind, devices like Soundbeam can introduce a level of 'compensation' into the interaction process (though, as Healey 2005 reminds us, the concept of ownership is important and, in this respect, there can be the potential for the relationship between performer and sound to be compromised). However, with careful composition and arrangement, a player can perhaps be liberated from the worries of skill-based errors that could result in mis-hit notes, encouraging the exploration of runs and phrases that would ordinarily be very difficult to achieve. In this instance the technology is presenting new opportunities and the performer is not relinquishing control within the decision-making process. The solos of the lead-instrumentalist in Quinta Punkada pay testament to this. These are not simplified, limited solo passages, they are exciting, expressive and complete.

The Benemin

The 'Benemin' is an accessible musical instrument that has been designed and built as part of ongoing personal research into the area of accessibility and music. The rationale for the project was realised through feedback from educators which suggested that there could be a place for a dedicated 'instrument' to be available within special needs education, this being in addition to very flexible systems such as Soundbeam. It was recognised that not all educators involved with music activities in special needs education are trained musicians and as such did not always feel comfortable or confident with setting up and operating systems that may, at first, appear complex. With this in mind, the central aim of this project has been to design an accessible controller that is a simple diatonic instrument when operated in its default (or start-up) mode, even though additional advanced features may be available. The idea of mapping gestures onto sound was seen as both powerful and potentially intuitive, so interaction of this type has been preferred but with an added desire to respond to more than one dimension of movement. Additional feedback suggested that if overall cost could be kept low, this could increase the potential for a number of instruments to be available. This was understood to be advantageous as the instrument would not then be regarded as a 'special' resource that only had limited access.

As a first solution to these suggestions, the prototype Benemin is an array of eight distance-measuring infra-red sensors that allow a performer to trigger sounds via MIDI. There is an obvious similarity between this instrument and Soundbeam as both employ distance measuring technology to map movement onto sound and music. However, the Benemin is effectively polyphonic. Gestures can be made with two hands or arms above the instrument (up to a range of about 80 cm) to produce simple harmonies. Potentially, all eight sensors can be triggered simultaneously. More detailed accounts of the design and construction of the Benemin can be found elsewhere (Challis and Challis 2008; Challis and Smith 2008) but it is perhaps important to appreciate that it operates at two levels of complexity: as an *instrument* (to meet the requirements just outlined) and as a *controller* (to allow more complex control of external software).

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The Benemin is not aimed exclusively at users with special needs, instead it should be thought of as an instrument for use by anyone, which has been designed with accessibility as a key consideration. So, the instrument is being tested within a variety of settings, including free improvisation, community music, special needs education, and general music education. It can currently be seen in use as part of free-improvisation on the Internet (Challis, Smith and Wiblin 2008), but for the purposes of this article it will be of most interest to reflect on the initial findings from its use within special needs education. Currently, the Benemin is being assessed by three contrasting user groups in special needs schools in the North of England. Within these groups, it is being considered firstly as an 'inspirational' device where individuals with severe learning difficulties can benefit from musical reinforcement within cause-and-effect style learning patterns. The second user group includes individuals with moderate learning difficulties and some mobility issues, and the final group includes individuals whose main barriers are related to mobility.

So far, the majority of testing has been with individuals from the second user group and the initial results are promising. Pupils have been allowed to explore the instrument in their own time, in effect, allowing them to freely improvise, exploring textures and patterns of their own creation along the way. There have been two particularly rewarding observations made during this early testing. Firstly, players will tend to instinctively use more than one hand to produce harmonies in an intuitive way. Secondly, having the instrument constantly available and ready for anyone to try, appears to encourage individuals who may be quite reserved to engage with this process of exploration in their own time and on their own terms. Although none of the children were working within a group setting as such, there have been examples where they have spontaneously responded to other musical activities occurring elsewhere in the classroom. It was also clear that the diatonic nature of the instrument would enable their improvisations to be incorporated into structured backing of some description; this still needs to be explored in practice though.

Summary

In terms of accessibility, it would appear that the range of typical music production provision available in most educational institutes might be compromised by an underlying need to be visibly in-line with perceived technological standards as dictated by current industry practice. With this in mind, it is possible that many popular music, music production and music technology courses may simply not appear to be particularly inviting from the perspective of applicants with additional needs. Yet there are clearly accessible alternatives and enhancements available, many of which are just as valid for ordinary users as they are for those with additional needs. It is clear that there is significant under-representation by musicians with disabilities in the popular-music industry, and it could well be that a general failure to inspire and include within many aspects of music making at an educational level is a key factor within this.

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