Working towards a theory for music technologies in the classroom: how pupils engage with and organise sounds with new technologies

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The use of information and communication technologies (ICT) in schools is now common-place and, for many, an unquestionable part of everyday teaching and learning. But detailed studies of the use of ICT in classroom-based music education are rare. This article explores how pupils aged between 11 and 16 used ICT to create and perform music in new ways. Working as a teacher-researcher, the author used the methodologies of action research and case study to investigate how pupils engage with and organise sounds with ICT.

Introduction

> Ears become wired
> And minds become strong because
> You're speaking the language
> The language of music
> The door is now open
> To learn how to speak.
> (Lachlan Young 2003)

The last ten years have seen huge changes in the United Kingdom's education system. Many of these can be attributed to the well-documented and continuing sweep of new technologies throughout primary and secondary schools (Somekh, 2000; Selwyn, 2002). Within music education there have been dramatic changes too and it is now commonplace to find a range of technologies, both hardware and software, regularly used in music teaching throughout England and Wales (Mills & Murray 2000). As Cain points out:

> These practical changes are very considerable, and, what is perhaps even more important, they have brought into question some of the most basic conceptual frameworks that have underpinned music teaching. (Cain, 2004: 217)

Of course, this technological revolution is broader than the often-cloistered world of music education. The price of music hardware and software has fallen so greatly that it is now possible for young people to produce music of extremely high technical quality in their home environment. Indeed, many powerful musical tools that were previously housed within the realm of the professional recording studio are now available freely over the Internet. Théberge (1997) has discussed the domestication of the recording studio,

indicating that the home studio is essentially a private space both physically (often within a bedroom or basement) and acoustically (headphones are often used as an 'instrument of isolation' (Théberge, 1997: 234)). He draws an interesting comparison with the location of the piano within the living rooms of previous generations (Théberge, 1997: 234–235), an instrument at the centre of family life and entertainment. His conclusion is that:

> The domestic space has become one of the primary sites of these new technological practices – a private and increasingly isolated site of musical production and consumption. (Théberge, 1997: 241)

These things continue to move on apace. Yet the consequences of young people developing their musical skills in this private and isolated activity of technologically mediated musical activity for the shared and public world of classroom music-making demands to be examined in more detail.

During 1997 this journal devoted an entire issue to the use of technology in music education. In his editorial, John Paynter wrote the following:

> We are reminded frequently that IT [information technology] is a *means* not an end, supporting the quest for genuinely musical activities. . . . Used imaginatively – and, it is to be hoped, free of the unhelpful jargon – this is not IT for IT's sake but rather technology *in the service of music*. [his italics] (Paynter, 1997: 107)

Paynter's concern that any development of the music curriculum, as well as an accompanying theoretical framework, should be done *through* the vehicle of technology tells half the story. It raises an interesting question that he does not go on to address, concerning the fundamental relationship between ICT and music. His final comment states that ICT serves music as if music existed in an isolated conceptual or philosophical sphere of operation, divorced from the practicalities of its production (instruments, notations, pedagogies, etc). But the relationship between music and ICT is not one of servant and master, but rather a subtle, reciprocal and perhaps empathetic one in which the very nature of what constitutes musical practice is challenged, mediated and redefined through performers' and composers' uses of ICT. Ultimately, given a conceptual grasp of this alternative perspective, it could lead pupils and teachers to engage with and organise sounds in new ways, challenging the very nature of music itself at a fundamental level.

The recently published ImpaCT2 project (DfES, 2002) reflected on these issues in a general context of educational innovation. A key finding from this report stated that:

> The arrival of networked ICT placed great demands on schools and teachers and it is taking time to embed it in teaching and learning practices. In the schools involved in the study, implementation of this innovation has progressed in three stages: during stage one the main focus is on the provision of equipment infrastructure and support; stage two focuses on teaching ICT skills, often in specialist ICT lessons; stage three moves to the integration of ICT with curriculum subjects, including numeracy and literacy. (DfES, 2002: 3)

At the time of writing the report only a few schools seemed to have moved effectively into stage three. Reasons are given as to why many schools have been unable to make this final transition:

For many schools the main focus of activity following installation of networked ICT infrastructure was on teaching ICT skills. Cross-curricular use of ICT is difficult for secondary schools to achieve because ICT has traditionally been a specialist subject for GCSE [General Certificate of Secondary Education]. *A major shift in culture and established practice is involved in the introduction of ICT within subject teaching.* [my italics] (DfES, 2002: 19)

This final sentence summed up precisely what the investigations of the following research project sought to uncover. At its commencement in 1997, it was rare to find musical uses of technologies within schools that challenged established practices. To embrace the true potential of ICT would require a major shift in the music education culture.

Research aims

Bonnett describes the period of time at the end of the 1990s as being a 'seminal phase' in the history of Government initiatives to consolidate and extend ICT in the curriculum (Bonnett *et al*. 1999: 345). The scope of the initiatives and the funding being made available (for hardware, software and training) were beyond any previous Government's attempts at innovation (Somekh, 2000; Selwyn, 2002). They suggested that the new requirements addressed issues relating to pedagogy as well as personal skills in ICT. The key question that they were asking was this: 'What are the curriculum and learning gains which might result from such initiatives?' (Bonnett *et al*., 1999: 345)

Therefore, the aim of this research was to analyse and evaluate the use of ICT as a way to develop new approaches to music in the classroom. This aim broke down into two specific research questions:

1. What impact does ICT have on the ways that pupils learn about music, particularly composition?
2. How does the incorporation of ICT into the classroom affect teachers' pedagogy?

This article will focus on the first of these questions, drawing on a comparative analysis of the three case studies that demonstrated how pupils engaged with and organised sounds during the process of musical composition. A chapter published recently by the National Association of Music Educators (Savage, 2004) has addressed the second of these questions in more detail. It has explored what constitutes effective music teaching with ICT drawing on Swanwick's notions of 'music as discourse' and 'musical fluency' (Swanwick, 1999: 45). Looking at how to maximise opportunities for learning, the chapter discussed what can be described as doorways to music encounters with ICT which affect the teachers' approach to curriculum design, pedagogical content, teaching style, assessment and the integration of performance, composition and listening/appraising within the classroom.

Research method

The research project combined case study and action research methods. The participants in each of the three main case studies (3a, b and c) were all pupils at a rural high school in

Case study	Date	Participants	Main aim	Activities	Data collection	Output
Early compositional experiments	June—July 1999.	Year 10 GCSE group (12 pupils) Year 7 (84 pupils).	To explore the creative uses of sound processing technologies in vocal and instrumental compositional tasks.	Composition tasks using classroom percussion instruments or contemporary vocal techniques with Zoom 1204 sound processors in specially adapted camera cases.	Observation notes kept in teaching journal; Interviews with selected groups of pupils (Year 7); Class discussion (Year 10); Musical products (2 audio tracks).	Case study report; Publication for the European Music Journal (Savage, 1999) (http://www.music-journal.com).
Dunwich Revisited	January—April 2000.	Years 7, 8 and 9 (230 pupils) Year 10 GCSE group (15 pupils).	To explore and develop the ways in which sound processing technologies (hardware and software based) impact and develop performance and composition in the classroom context.	Using the history of Dunwich as a starting point, and a composition by Mike Challis as a source of inspiration, pupils produced their own compositions and performances inspired by Dunwich s history.	Observation notes kept in teaching journal; Class discussion (recorded) and evaluation with all participants; Pupil diaries in response to set evaluation questions; Concluding questionnaire; Interviews with selected groups of pupils (all years)	Performance of *Dunwich Revisited* at the 2001 Suffolk Celebration of School s Music at Snape Maltings Concert Hall; Publication for the *British Journal of Music Education* (Savage & Challis 2001).
Reflecting Others	October 2000—March 2000.	Year 9 (84 pupils) Group of young offenders at HMP Hollesley Bay.	To investigate the use of digital technologies as compositional tools.	Pupils and young offenders compiled 'digital scrapbooks' of sounds and images in relation to the project themes of identity, community and environment. After exchanging these scrapbooks at the midway point of the project, each group made short films about the other group using digital media and software tools such as Digital Performer, ProTools and Metasynth.	Observation notes kept in teaching journal; Class discussion (recorded) and evaluation with all participants; Pupil diaries in response to set evaluation questions; Initial and concluding questionnaires; Interviews with selected groups of pupils (all years); Musical and video products (including photographic materials, pre- and post-manipulated audio and video sample materials, images of the final installation product).	*Reflecting Others* installation; Case study report; Publication for the *Music Education Research* (Savage & Challis, 2002).

Fig. 1   The Final Case Study Design

mid-Suffolk where the author was Head of Music between 1999 and 2001. The three case studies were conducted over a period of just less than two years (see Fig. 1).

As Fig. 1 shows, descriptions and reports of each of the three case studies have been written and published elsewhere (Savage, 1999; Savage & Challis, 2001, 2002). This article will not rehearse these narratives and analyses, but rather will move on to a comparative case analysis that seeks to consider the impact that ICT has on the ways that pupils compose.

Discussion

As Pitts (2000) discusses, the incorporation of musical composition in the curriculum has a relatively short history. The establishment of a National Curriculum for England and Wales in 1992 has required teachers to integrate the three curriculum themes of performance, composition and listening/appraising within their teaching. However, as Fautley points out (2004), there are a number of other perspectives beyond the legal curriculum framework that have underpinned interest in musical composition by teachers and researchers in recent years. Fautley identifies three of these:

- Processes of composing, whether as individuals or groups, in laboratories or classrooms.
- The assessment of composing.
- Psychological or developmental studies of composing (Fautley, 2004: 201).

The following discussion will focus on two particular areas of interest related to the process of composition in the classroom context: how pupils directly engage with sound materials, and how they organise these sounds into their final compositions. These two aspects, are generic to all compositional activity, and are examined here through the pupils' uses of a range of ICT, including software- and hardware-based sound processors, recording technologies and computer sequencers.

Becoming directly engaged with sound

In each case study, the sounds that pupils made with the various pieces of ICT quickly captivated their imaginations. They were then able to engage with what Théberge calls the 'micro-phenomena' of sound (Théberge, 1997: 186). For example, in *Dunwich Revisited* pupils were clearly captivated by the new sounds produced through the use of basic effects on a sound processor. The most obvious effects, such as reverberation or delay, appealed to them most readily. More subtle effects, such as gates and filters, were initially ignored as pupils looked for more immediate responses to their representation of Dunwich's environment and history. Similarly, in the Early Experiments case study the processing unit could transform the most simple of vocal gestures into something of complexity and beauty that captured pupils' imaginations.

Pupils enjoyed exploring the sounds within a pedagogical framework of exploration and discovery rather than in the context of right or wrong compositional choices. But more than this, the technologies themselves brought about a shift of emphasis in compositional enquiry, away from thinking about melody, rhythm or harmony towards an increasing focus on dealing with the sound itself, and its intrinsic value and place in a wider musical structure (Théberge, 1997: 186). All composers share this concern, whether or not they make use of new technologies in their musical practice. But here the traditional compositional tools of staff notation, MIDI sequencers or electronic keyboards within the classroom were replaced by pupils' active exploration of sound itself through the sound processing technologies.

The case study data suggested that new technologies facilitate and enable a closer analysis of, and engagement with, the micro-phenomena of sound. Just as an advanced instrumentalist is able to mould and transform an instrument's sound through a highly

technical and sophisticated physical interface, so pupils could get to the very core of sonic material and begin manipulating its structure through a very simple interface.

There were numerous examples of this in each case study. Uncritical engagement with sounds, whether they are sampled sounds in the *Reflecting Others* project or live instrumental or vocal sounds in the *Dunwich Revisited* project, was always a danger. In a world where any sound has the potential to become a musical object it was vital to consider how pupils selected and transformed sounds for their compositions. As will become apparent below, the compositional process adopted by pupils in these case studies was crucial in ensuring they engaged with sound materials in a serious way.

The organisation of sounds with ICT

One of the most important structuring devices across the three case studies was a simple compositional model drawn from observations of electroacoustic composers working within the studios at the University of East Anglia. The simplicity of the original model was one of its key strengths and discussed at length in the case study report (Savage & Challis, 2002). Here the model will be considered stage-by-stage with reference to the wider research literature. But it is important to remember that many of the stages share common elements, activities and outcomes.

Starting points

> Teachers need to choose a context of relevance to young people's lives, select an interesting challenge and ensure that pupils have the necessary artistic skills. (Qualifications and Curriculum Authority, 2000: 9)

Inspiring starting points are vital in any creative activity. The choice of starting points can be made by teachers in the first instance, but there is also scope for pupils to define their own starting points within the 'context of relevance' that the QCA describe as being a key component in the fostering of artistic creativity. The *Reflecting Others* project, for example, had three initial themes – identity, community and environment – that were to shape various compositional activities. In the first instance, pupils were required to think of how each theme could be used as a starting point in the selection of audio and video material.

The exact starting point for a composition may not be found straight away. In both the *Reflecting Others* and *Dunwich Revisited* case studies a framework for the compositional work was provided but pupils had significant freedom to define with greater precision where their compositional activity would be focused. This often came after they had moved into the second phase of the compositional process – the Experimenting phase. This is vital, because for many composers the physical act of putting pen to paper (or the loading of samples into the computer memory) is the key impulse in beginning the creative work. Collins' (1992) phrase of 'initiating composition' is helpful here. He describes this as the 'tactile exploration and playing around with ideas' which is a 'physical engagement with sound-making devices' (1992: 107). He quotes Stravinsky:

> The very act of putting together my work on paper . . . is for me inseparable from the pleasure of creation. So far as I am concerned, I cannot separate the spiritual effort from the psychological and physical effort. (Stravinsky, 1974: 100)

Action is a vital part of musical imagination. That is why it is crucial that pupils are quickly given the opportunity to move into the second phase of the compositional process.

Experimentation

> Creative children are often learning and thinking when they appear to be playing around, often in manipulative or exploratory activities. (Torrance, 1972: 115)

One pupil described the experimentation stage as 'musical doodling'. This wonderful phrase captured many of the elements observed in the work of postgraduate composers at the University of East Anglia. Other researchers use similar phrases to describe this kind of experimental activity:

> . . . the doodling initiates a form of relaxed, perceptual scanning that eventually detects the possibility of affective centering – it could be that some happy accident of movement catches the imagination, a cluster of notes, a rhythmic pulse, a phrase or movement of speed. (Ross, 1980: 40)

Playful exploration and the possibility of chance happenings or happy accidents are not things that teachers can easily prescribe in their lesson planning or state as learning objectives. But giving time and space for this type of activity was vital in these projects. There were a number of examples of this in the *Reflecting Others* project where 'artistic accidents' occurred as a result of pupils' carefree exploration of various pieces of software. When 'inspiration' does strike an individual pupil, or group of pupils, the results can be truly outstanding. 'Save Me', a song composed by a group of Year 8 girls in the *Dunwich Revisited* project was composed within 30 minutes and proved to be one of the most memorable moments of the final piece for many other pupils.

In his fascinating writings about his compositional process, Stravinsky is careful to draw a distinction between invention and imagination:

> Invention presupposes imagination but should not be confused with it. For the act of invention implies the necessity of a lucky find and of achieving full realisation of this find . . . creative imagination is the faculty that helps us pass from the level of conception to the level of realisation. In the course of my labours I suddenly stumble upon something unexpected. This unexpected element strikes me. I make a note of it. At the proper time I put it to profitable use. This gift of chance is bound up with the creative process. (Stravinsky, 1974: 50)

This distinction highlights an important dimension of the compositional process. Music technologies allowed pupils to generate many sound ideas fairly rapidly. As discussed above, the ease of access into sound 'worlds' and the manipulative and transformational power of ICT allows for these ideas to be quickly developed and realised. But the changing technological environment does not alter the nature of invention or the need to cultivate our pupils' creative imaginations. Invention, in this sense, is something over which teachers have little control; the creative imagination can be nurtured and developed through careful supervision and sensitive guidance through the composing process. Key elements of the action research and case study design helped to guide pupils through this creative process without having to force 'external' musical ideas into their work. Carefully questioning

pupils within an explicitly circular and evaluative compositional model was a very positive teaching method. It took the stress out of pupils having to find out or come up with the right answer immediately, encouraging them to develop sets of creative possibilities or alternatives.

Ellis (1997: 15) makes a similar point in his compositional model. His 'Exploring' section is described as containing two main elements, the experimentation with sounds and different combinations of sounds and, secondly, the establishment of a composition vocabulary. This vocabulary becomes a limiting or structuring device for the future development of the composition. Swanwick puts it like this:

> In music, the prescription of sets of sound materials has always been an obvious feature of compositional processes. It seems essential for composers to limit available resources, to make music manageable, to get themselves started. Thus we have the tonal system, twelve note techniques, pentatonic scales etc. (Swanwick, 1988: 22)

It is sometimes difficult to ascertain which comes first – the creative ideas or the structuring framework within which they are housed. Within established systems, such as the tonal framework or serialist procedures, it may be that composers, just by choosing to work within a given genre, make these choices instantly. But the new composing environments faced by pupils in these projects demanded an experimental process by which they assimilated a 'vocabulary' of music expression, hand-in-hand with their creative imagination. This resonates with Collins' (1992: 107) notion of playing around with ideas in order to develop increasing sensitivity towards the medium within which one is working. This process of conversant involvement can only take place as one engages in the physical activity of composition.

In relating these ideas to classroom learning a clear distinction emerges between the case studies. *Dunwich Revisited* built on existing vocabularies and frameworks with which pupils already had a degree of familiarity. This was encouraged by the technologies used at various 'levels' within the project. As an example, little use was made of computers by Key Stage 3 classes. This was primarily for two reasons. Firstly there was only one computer in the music department; secondly, and more importantly, it preserved one of the principal strengths of classroom composition at Key Stage 3 – group work with traditional instruments and voices. The sound processing technologies were chosen to work alongside pupils within the classroom environment. So it was not a surprise to see pupils often developing their creative ideas within familiar frameworks, e.g. tonal systems, lyric-based compositions, programmatic pieces, albeit mediated and developed through the sound processing technology.

In contrast, the *Reflecting Others* project saw a radical shift away from familiar environments and frameworks. Within the computer environment where any sound or image could be sampled and used as source material for a composition pupils had to be much more responsive and reflective to the changing artistic demands made on them. As one would expect, the range of pupil responses to the challenge were varied. For some it was a step too far whilst for others there was a sense of critical engagement and a passing from, as Stravinsky put it, 'the level of conception to the level of realisation' (Stravinsky, 1974: 50).

Selection

The selection of sounds is a crucial stage in the compositional process. Electroacoustic composers relate the process of 'Experimentation' to that of improvisatory creative play. Pupils needed an opportunity to play with and explore sounds with the new technologies being used. But balanced against this is the need for a structuring of that play with mechanisms and devices, such as this compositional process and other metaphorical tools.

Many electroacoustic composers talk about the selection of sounds within the compositional process as building their own instruments. Unlike a physical instrument that remains broadly similar each time a composer comes to create a new composition, the instruments that these composers are building within the computer can be different every time. In this sense the computer becomes a type of 'meta-instrument' that is infinitely flexible and perfectly tailored to each composition's requirements:

> As in all other fields, the computer can change our entire perspective on the way we do things because it is not a machine designed for a particular task but a tool which may be fashioned to fulfill any task that we can clearly specify. It is a metamachine. In particular, it offers the possibility of being a universal sonic instrument, a device with which we can model and produce any conceivable sound-object or organisation of sounds. (Wishart, 1996: 325)

In practice, pupils found the process of selecting sounds relatively straightforward and unproblematic. Their work at this stage was assisted by the opportunity to reflect back on their improvisations and experimentations in a number of ways. In the Early Compositional Experiments and *Dunwich Revisited* project pupils used sound processor description sheets to help describe and develop sound ideas and also a portable Minidisc recorder to collect them. The 'listening back' to previous work assisted them immensely in choosing which ideas they would use in their final compositions. This is an obvious but important use of recording technologies in an educational setting.

Within the *Reflecting Others* case study this process moved to a software environment. The creating of new sounds from existing ones has been described within the detailed case study (Savage & Challis, 2001). The selection phase is basically about choices. The creation within the computer of a 'meta-instrument' of sound objects that Wishart describes is not unproblematic because if one can do absolutely anything then what precisely is worth doing? How did pupils judge the quality of sounds for inclusion within their compositions?

Pupils chose sounds that caught their aural imaginations. There were several stages in this process. Firstly, the repositioning of sounds from familiar environments to within the classroom (and the computer) was engaging and amusing for the pupils. They began to notice odd sounds of phrases that perhaps in a different context would have passed them by. For example, a group of boys recorded the sounds of a school basketball match complete with the chanting of the supporters and mock-commentary by one of the group. Odd phrases and comments by one of the boys stood out from the dense soundscape and became a focus point for them at this stage of the compositional process. Through the selection and editing tool they were able to isolate these phrases and move them into the next phase of the process.

At a sophisticated level, pupils began to explore the similarities and differences between sounds with a greater degree of engagement and purpose. Sometimes the links

between sounds were made at an obviously semantic level. Various sounds that related to a common theme were grouped together to illustrate that theme in a quasi-programmatic way. But other pupils began to explore the nature of the sounds themselves and make more abstract links between them. In one or two notable examples samples of pre-recorded music of particular personal significance were placed alongside other recorded fragments to illustrate or heighten the expressive effect of the composition.

The selection of sounds and their subsequent rejection or refinement is a time of incubation and development and can occur subconsciously or within the group dynamic. Whilst there was a tendency for pupils to try and close down this process of working with sound materials and move too quickly to completion, with encouragement from project staff they were able to work through this new approach to composition. This intervention was important to ensure that the process remained open-ended at this point and led into the fourth section.

Structure

Structuring is the gathering together of all the chosen ideas into a comprehensive whole. Within this process there are a number of important considerations, notably the need to manipulate the various elements of the work until some kind of 'relatedness' is achieved (Collins, 1992: 107). This requires that the composer is able to obtain an overview of the work.

Electroacoustic composers, like composers in other genres, recognise that formal structures are constantly in a state of flux and that any given composition adopts a position between working with established forms and generating new ones. The matter of representing these forms, particularly in a developmental process, is interesting and worthy of comment in relation to the case study materials. In early discussions with electroacoustic composers a number of responses to the issues of formal construction of an electroacoustic piece were noted. These ranged from a very fixed approach to a formal design to a more experimental and improvised approach to outworking a piece either in the studio or concert hall environment. These composers were certainly able to use hardware and software as performance instruments and work and develop their selected recorded samples akin to the way that a jazz musician would improvise within a melodic, harmonic or rhythmical framework.

Pupils were generally encouraged not to think about the final structure of a piece too early. This was a consequence of their more detailed exploration of sound's inherent potential as outlined above. Structuring of these sounds came later, although on a number of occasions pupils were keen to move onto these considerations at too early a stage.

The final structure of the *Dunwich Revisited* piece took the overarching framework of a ternary shape drawn from Mike Challis' original composition *Dunwich*. This shape was chosen as an obvious representation of the history of the environment of Dunwich. So for pupils in this project the ultimate question of what structural form to adopt for their ideas was redundant. They were required to fit their sound ideas within this particular framework. However within the second section of the piece (that represented the human inhabitation of the landscape) they were keen to include a diverse number of ideas and thought carefully about the order and presentation of such features as the song and the DJ

mix. The transition between sections and sound ideas was an integral part of the scheme of work and it was pleasing to note how pupils sought to layer and structure their sound ideas in imaginative ways.

Evaluate/revise

The final part of the compositional process is the evaluation and revision of compositional ideas. This leads a pupil back to any of the previous stages in order to refine their work. This reflection enables another circle of the process to be made and new skills and insights to be absorbed. In this way more complex and ambitious compositional ideas can be attempted.

As Ellis (1997: 15) points out, with recording technology one can work entirely in the medium of sound not symbol. At a simple level a recording of the work enables one to stand back from it and listen with a degree of objectivity. Through contemplating the whole one can develop aspects of a composition interactively. This is almost certainly the case in relation to pupils' work in these case studies. But in addition, pupils were quick to build in evaluation and revision at each stage of the model. This reflected their preoccupation with a good final compositional product as much as the process of getting there. Pupils often found it difficult to improvise freely without then wanting to quickly move onto selecting and structuring these ideas within a final and permanent compositional framework. This led to two major issues.

Firstly, the adopted compositional model implied a two-staged notion of generation and development. Sounds were generated through experimentation and play and then developed through being selected and structured into a final form. Secondly, pupils' preoccupation with producing a final compositional product shortened, and in some senses stifled, the compositional process that they were engaged in. In particular pupils were often quick to produce sound ideas and seek approval for them, but then had to be encouraged to develop these further before moving onto the next stage.

In reflection on these events it seems that an element of uncertainty within the composition process was the cause of this phenomenon. This will be the case in any truly creative activity where there has to be a sense in which one is breaking new ground, at least in one's own experience. The educational climate within which pupils of this age are being taught could be seen as working against this process. It seemed that in many areas of the curriculum subject knowledge and content came pre-packaged and easily digestible. Lesson aims and objectives were signalled and signposted at every juncture of the lesson and had to be easily assessable by the teacher in order for progress to be noted and reported.

But in the arts things are often different. Diversity and variability of outcomes are intrinsic to artistic practice. Personal interpretation matters and imagination and inventiveness are key attributes to value in pupils, but these are difficult to measure and assess. Eisner puts it like this:

> One lesson that the arts teach is that there can be more than one answer to a question and more than one solution to a problem; variability of outcome is okay. So much of current schooling is predicated on the assumption that success in teaching means

getting a class to converge on the single correct answer that exists in the curriculum guide, or in the textbook, or in the teacher's head. (Eisner, 2002: 196)

And just as there should be variability in final products so should one savour the process by which these things are made. In the rush to achieve things, even within these case studies, sometimes the process of savouring things is sacrificed for deadlines and efficiency. But Eisner is clear that this process is one of the most valuable applications of artistic activity to the rest of the curriculum:

If there is any lesson that the arts teach, it is the importance of paying close attention to what is at hand, of slowing down perception so that efficiency is put on a back burner and the quest for experience is made dominant. There is so much in life that pushes us towards the short term, toward the cursory, toward what is efficient and what can be handled in the briefest amount of time. The arts are about savoring. (Eisner, 2002: 207)

In concluding this discussion on compositional processes with ICT it is important to remember the changing nature of evaluation and revision whilst working with technologies. An essential part of this process is the possibility for pupils to stand back from the activity of producing music (through playing instruments, singing or designing and engineering sound at the computer) and reflecting on what they are producing. The process of recording one's musical output is educative for any musician, whether performer or composer, but the opportunity to work interactively with technologies that accurately represent recorded sounds as compositional material demanded particular aesthetic qualities and judgements from pupils.

Conclusion

The aim of this research project was to analyse and evaluate the use of ICT as a way to develop new approaches to music education. This article has considered one of two key research questions, namely the impact that ICT had on the ways that a particular group of pupils composed through a specific compositional process.

The adoption of musical principles and practices from the world of electroacoustic music, namely a clear and structured compositional process, provided that 'major shift in culture and established practice' demanded by a stage three incorporation of ICT into subject teaching (DfES, 2002: 19). This resulted in pupils engaging with sounds with an intimacy seldom seen in their previous work. The adoption of this compositional process within the classroom facilitated original and powerful artistic products. Although the adopted compositional process could be applied to any compositional medium, its use alongside ICT had certain clearly prescribed and distinctive benefits, namely supporting pupils' work when using new pieces of technology for the first time.

These case studies show that a careful analysis of the work of professional composers can be inspirational in tailoring the use of ICT for educational ends. Compositional practice in the wider world has undergone a revolution that we, as educators, ignore at our peril. Just adopting new pieces of technology in the classroom will not effect any meaningful educational change. There needs to be a wider appreciation of the working practices that

accompany such technologies. These can be drawn from a wider consideration of musical practice. As Cain comments:

> Curriculum change is necessary if the world of the classroom is to keep pace with the world outside. And it is also necessary to have a clearly defined theory which allows teachers to commit themselves intellectually to the change. (Cain, 2004: 219)

Whilst these case studies have not sought to provide the clear theoretical statement that Cain seeks, it is hoped that this detailed 'snapshot' of a particular group of pupils' work with new technologies will encourage others to give detailed accounts of their work with pupils and ICT. Over time, this culminative approach to case study should give impetus to the development of a theory grounded in practice that highlights the educational potential of such technologies for all teachers and pupils.

It is timely to revisit Paynter's comments quoted at the opening of this article. Our primary focus should be on seeking creative approaches to the use of ICT in music education that develop musical dimensions within the curriculum in ways that would be impossible without the technology. By using carefully chosen technologies within the music curriculum in this way, pupils' musical experiences can be more challenging, varied and educationally richer than those possible within a music curriculum devoid of ICT.

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