It's About Interactive Learning

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SUMMARY

This paper draws on results of a research project InterActive Education: Teaching and Learning in the Information Age. The overall aim of the project is to examine the ways in which new technologies can be used in educational settings to enhance learning. To this end the project centres around the design and evaluation of teaching and learning initiatives for pupils from the age of eight to eighteen. Within this paper we report on our work with teachers and pupils, who have developed learning initiatives for English, mathematics and music.

INTRODUCTION AND BACKGROUND

> Learning spills outside the official times and places of pedagogy. (Davis et al. 2000 260)

This paper derives from a research project InterActive Education: Teaching and Learning in the Information Age, whose overall aim is to examine the ways in which new technologies can be used in educational settings to enhance learning. The project draws on a range of theoretical perspectives with a particular focus on socio cultural theory with its emphasis on the crucial role which communication through language and other semiotic systems play in learning (Wertsch, 1991).

Within this paper we focus on case studies of learning within English, mathematics and music education, all of which centre on a set of 'intended' learning aims, developed by partnerships of teachers and researchers. Within the English case study 8-9 year old pupils have been using e-mail as a channel to communicate with a 'real', and at first unknown, person. In these authentic interactions they have explored and considered the idea of register in language – varying how they write in relation to the audience, purpose and context. Within the mathematics case study 10-11 year old pupils have been learning about shape and space mediated by the use of a dynamic geometry environment Cabri Géomètre. Pupils and teachers also worked with a host of other technologies, including written language, an interactive whiteboard, paper-and-pencil and concrete objects. Within the music case study 10-11 year old pupils have been learning about composition and musical structure through creating a piece of music in ABA form using a software package Dance eJay.

Students are active constructors of new knowledge and understanding based on what they already know and believe. These existing conceptions derive from experiences both outside and inside school. The out-of-school uses of computers strand of the InterActive project suggests that many young people use the computer outside school for writing (68% on a weekly or more basis) and for electronic communication (54%) (Facer, 2002). Increasingly young people are also using the computer in the home to produce music (19%). These results, together with results

from our previous projects (Facer et.al, 2003, Somekh et.al. 2002) highlight the ways in which 'aspects of life' outside school constitute incidental 'learning events' which are likely to impact on the intentional learning which is the focus of schools.

DESIGNS FOR LEARNING

> The path of learning can never be determined by the teacher. However the path of learning is dependent on the teacher — along with a host of other contingencies. (Davis et al, 2000).

Within the InterActive project as a whole fifty case studies on teaching and learning are being developed across the subjects of English, geography, history, mathematics, modern foreign languages, music and science and across the primary and secondary sectors. The learning focus relates to an area of the curriculum which pupils normally find difficult and which the team believes could be enhanced by the use of particular ICT environments. The work of each subject design team is characterised by: periods of whole team work, evaluation in the classroom and feedback to the whole group; periods of working in pairs (researcher & teacher) on a particular design initiative; researchers supporting teachers through classroom visits and feedback; use of diagnostic assessment as an analytical tool for reflecting on teaching and learning; use of video of classroom processes as an analytical tool for reflecting on teaching and learning; teachers supporting pupils to focus their attention on the object of learning.

The design process involves working within the constraints of the situation in a creative and systematic way and thinking as far as possible out-of-the-box. Design is informed in an iterative way by theory, research-based evidence on the use of computers for learning, teacher's craft knowledge and the research team's expertise. Data collected includes: pre and post initiative diagnostic assessments; pre and post initiative interviews with 6 pupils; video recordings of lessons; pupils written and computer-based work.

DESIGN FOR ENGLISH

This case study focuses on the work of a teacher of nine-year olds, Emma Scott-Cook, and an English design initiative concerned with developing an awareness of how audience and purpose shapes writing. The aim of the initiative was to see what impact the experience of authentic communication, using e-mail as a channel, would have on individuals' writing. The cultural conventions surrounding ICT text are more fluid and open-ended than those around letters. Study of a relatively large sample of e-mail texts (Petrie 1999) showed that there was considerable variation of register in e-mail and that this was mainly in response to context. We decided to construct the children's co-correspondent so that the context would suggest use of the more formal end of the style continuum, at least in the early stages. The whole activity was embedded in the children's history work on The Vikings and the purpose was defined as finding out about the Vikings.

The research team set up two e-mail addresses for two Viking settlers: Thor, a Danish jarl and for Freya, a fifteen year old daughter of a Viking warrior. Although both Vikings had well developed back stories, these were not shared with the children in advance. In class pupils were told that there were two Vikings who would answer their questions about Vikings; they could choose which one they wanted to e-mail. The children had no problems sustaining the fiction that this entailed; in fact their willingness to suspend disbelief was for some stronger as the correspondence developed. However in their interviews it was evident that they knew they were playing a game of 'let's pretend'. E-mails were received and responded to at the University and

copies of all messages were kept as data. Pupils mainly used the classroom computer to send and receive their e-mails; time was allocated for this at the beginning of the morning and afternoon. In advance of the initiative all pupils had had basic instruction in e-mailing. They had individual e-mail addresses and a class password. The focus of the initiative was deliberately on the *use* of e-mail; the assumption (a valid one in the event) was that pupils would gain skill and understanding in operating e-mail in the process of genuine communication. Some of this computer time was video recorded as were two plenary review and discussion lessons. In both sessions e-mails sent and received were shared (with pupils' permission). The focus was both on sharing information and on how writer-reader interactions were being negotiated, for example by looking at the different ways people had opened and closed their messages and by asking the class to speculate about how someone might have felt when they received a particular message.

This was conceived as a 'long, thin initiative' which would run over several months. Pupils were interviewed and reviewed their correspondence at intervals throughout the project. From the many insights the data have provided we have chosen to focus on two: factors affecting children's commitment to and involvement in e-mailing; evidence of children's strategies in negotiating a relationship with their reader. Involvement as measured by the number of e-mails sent was varied. Procedures to maintain a degree of equity in access to the computer were in place but it is clear that some children were more motivated to pursue the correspondence than others. As the initial excitement and novelty faded, and even in the face of technical difficulties which meant that feedback was not as fast as planned, a quarter of the class sustained a commitment beyond two exchanges. The drive to 'write back' was not associated with attainment. The children who wrote frequently, even when they had not received a response, spoke in interviews about their initial interest in the subject or the activity. In addition their e-mails showed a developing sense of the person at the other end. The correspondence was sustained most successfully where this was most evident. We can illustrate this with examples from two children in this group.

Ben told us he had a Viking game at home and he was interested in the subject. More important though was his commitment to his teacher: "I wanted to show Miss that I learned a lot from the computers and the Vikings." At this point he saw 'The Viking"' as a useful information source. When (for technical reasons) Thor's response to Ben's questions was delayed, Ben wrote to complain and ask Thor to 'hurry up'. Weeks later Ben re-read this e-mail and recalled a lesson about how people respond to the ways they are addressed. "I thought, 'hurry up?'...I thought I'd better not write it to a Viking but to a human being.". We video recorded Ben composing a response to Thor immediately after some whole class discussion on openings and closings. He was given considerable time on the computer for this and remained totally absorbed and on task throughout. Re-reading his e-mail later, he reconstructed in some detail the processes of shaping his writing. He spent a great deal of time thinking about how to address Thor. "I thought I might have writ 'hello'...I might have done 'dear Thor'" Eventually he chose 'Greetings', mirroring Thor's habitual opening to him. "That's the Viking way. I thought if I was writing to a Viking and I wrote 'hello' they might not have made up that word yet so I thought I'd write 'greetings'". The effect of Thor as a model was also evident in Ben's drive to write at some length, even though he was hampered (as were most of the children) by the slow speed of his typing. As the e-mail exchange developed Ben, like many of the children, began to include information about himself. His commentary on his writing shows that he is well aware of the importance of reciprocity in this relationship and that Thor was becoming real for him. "If I just ask him questions he'll get a bit bored...Otherwise I'll know everything about him and he wont even know how old I am."

Neither Ben nor Annette, whom we now consider, nor any of the children in the class were accustomed to sustaining written communication with another individual in any form. Even those (few) with access to e-mail at home did not use it. As we have seen with Ben, the e-mail activity combined with reflection and review, meant that some children very rapidly developed strategies for this kind of writing. Annette proved to be a determined and enthusiastic communicator. The delays she experienced in receiving a response (the same technical hitch as Ben) appear to have made Freya more real for her. On the Tuesday of one week she wrote to Freya using Thor's e-mail address - "I heard about your problems...I have a complaint here...please write back by Friday or I will be angry." In the subject space she wrote COMPLAINT. The opening was DEAR FREYA. She did not sign the message. All these were deliberate choices "I did it on purpose. I was angry and I was like shouting at her." On Friday of the same week, still without a reply, Annette wrote.

Subject: Are you o.k
dear Freya
I am looking forward to your replie.
I hope you have no more problem's.
LOVE ANNETTE!

Reviewing this Annette recalled: "I just calmed down a bit and I thought if I don't keep shouting at her she might be a little bit OK and start writing back." Coincidentally with this message Freya's delayed e-mail was released by the system. Annette, like Ben, was given extended time on the computer and wrote a long reply. Mirroring Freya's closing, she wrote GOOD WISHES, ANNETTE. "I was shouting that bit. I was so pleased she sent a reply." Annette, like Ben, appreciated the time to write. "I was pleased with it. Sometimes other people go on before me and I only get a little time to write. When its my turn sometimes I don't finish...." Freya is now very real for Annette. "When I gets an e-mail back it's like she's talking to me...I put that bit 'I don't know if you have had this question' cos loads of people could have been asking her about whether she was married and I don't want to keep asking the same questions." There is a clear sense of reciprocity. "She's telling me loads of things - I'll tell her things back. I did tell her yesterday - if she was wondering why no-one wrote to her for two weeks that we've been on holiday." She also has a strategy as a correspondent. "Yesterday I read all the e-mails I had and I wrote a reply back and when I went home after school I went up to my bedroom and I started writing everything that she told me on a piece of paper...everything I knew and everything I asked her so I don't have to keep asking her again."

We suggest that this learning is essentially grounded in the authentic context that e-mail has provided. We aim now to find ways to maximise this learning for more of the class, to address managerial issues and learn from our mistakes. We need to find ways to accommodate an increased pace and flow of interactions and to consider additional (if less controllable) correspondents. A question we are addressing is how to maintain the sense of individual ownership of the correspondence which was so important to the children while refining the social and collaborative dimension in which children share the information they have gained and reflect on ways of shaping their writing. We plan to repeat this initiative next year.

***Figure 1*:** Annette replying to her latest email from Freya

LEARNING MATHEMATICS

This case study focuses on the work of a primary school teacher, Pat Peel, and the development of a mathematics design initiative concerned with learning about 2-D shapes and their properties. The 'intended' aim of this mathematics design initiative was to teach 10-11 year old pupils to: 1) recognise particular polygons (quadrilaterals and triangles) and know the names of these figures; 2) characterise geometrical shapes by their properties; and 3) to classify figures hierarchically. Research has highlighted the difficulties which pupils have with characterising geometrical objects with respect to their mathematical properties. In particular primary pupils are likely to recognise figures as visual gestalts "In identifying figures they often use visual prototypes. Students say that a given figure is a rectangle for instance, because 'it looks like a door'. They do not however, attend to geometric properties or to characteristic traits of the class of figures represented. That is, although figures are characterised by their properties, students at this level are not conscious of the properties"(Clements & Battista, 1992, page 427). The results of the diagnostic assessment and interviews with three pairs of pupils (chosen to include a spread of mathematical attainment) suggest that before starting the work the majority of pupils could not articulate the properties of quadrilaterals and triangles, and also could not identify parallel and perpendicular lines.

The design initiative consisted of 6 one hour lessons (as part of the numeracy strategy) spread over eight weeks. The work took place in a computer room where the pupils sometimes worked as a whole group with an interactive whiteboard, a flip chart and other visual aids, and sometimes worked in pairs at the computer. The research team developed a series of geometry microworlds within the dynamic geometry environment Cabri Géomètre, which were aimed at supporting pupils to focus their attention on the invariant properties of particular polygons, which they became aware of as they manipulated objects on the screen.

For example in session 2 pupils worked at the computer, with all the 'special' quadrilaterals (square, rectangle, parallelogram, rhombus, trapezium, kite) available for manipulation. The teacher started the lesson by working with the whole class and the interactive whiteboard. When working in pairs at the computer pupils were asked to continue this process and write besides a particular quadrilateral the properties they had noticed.

One pair of pupils wrote beside a parallelogram "It has four sides, they are like train tracks, they are parallel, all sides are equal, it doesn't have any right angles, it's the colour turquoise, it can be a diamond" (see ***Fig. 2***). Beside a rectangle they wrote "4 sides, all sides equal, 2 sides are long and 2 sides are short, it's the colour red, it is not parallel, there are 4 right angles, it is not diagonal, it has opposite sides, it can be a 3D shape as well". Throughout the six sessions pupils were beginning to attend to properties of polygons, and this process involved noticing both mathematical and non-mathematical properties. Some of what they recorded was difficult to make sense of, for example with respect to a parallelogram and a rectangle 'all sides are equal'. This response could for example have meant "all sides have a side which is equal to it". Crucial to this whole process of teaching and learning mathematics is the making visible of developing conceptions and working with the whole class and the interactive whiteboard were an important aspect of this.

Overall our analysis of the post-initiative diagnostic assessment and interviews suggests that the majority of pupils in the class learned many mathematical properties of particular quadrilaterals and triangles. Analysing the processes of teaching and learning is still ongoing and we are trying to understand why, for example, pupils learned certain properties and not others. Does this relate to the whole class work, or the particular microworlds which were developed in Cabri or to particular conceptual difficulties? We are confident that the dynamic geometry environment has enabled pupils to enter the mathematical world of properties of polygons and that manipulating geometrical shapes at the screen has helped them to pay attention to similarities and differences between properties of different shapes. In the final session the teacher introduced the pupils to a mathematical game which involved them guessing (without seeing) which polygon the teacher was picking out of a black box. Within this game pupils asked questions such as "are the sides all the same length?", "has it got parallel sides?", "has it got any right angles?", providing evidence that they had learned what sort of a 'thing' a mathematical property is, something they were not aware of before they did this work. In the final interview pupils very confidently talk about properties of polygons when faced with the dynamic geometry environment , but were less confident when faced with a paper-and-pencil situation.

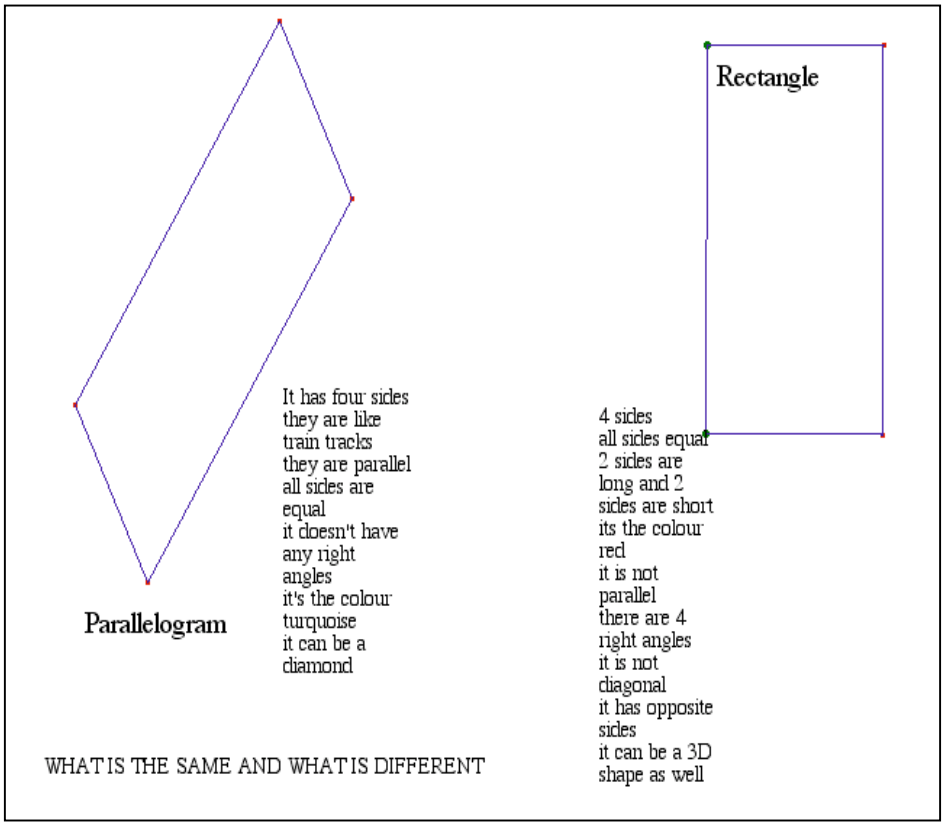

Figure 2: Similarities and differences between a parallelogram and a rectangle: work produced by one pair of pupils in Session 2

LEARNING MUSIC

This case study explores the work of two primary school teachers from the same school, Jo Heppinstall and Natalie Heysham, and the development of one design initiative focussing on composition work with 10-11 year olds. The aim of this design initiative was for pupils to be able to demonstrate: 1) an understanding of structure through creating a composition within the form - Introduction A B A; 2) the ability to refine and improve their work and 3) sensitivity in selecting and organising given sounds in relation to an intended effect. Two 'intended effects' were required: the 16 bar introduction had to build to a small climax in preparation for section A and section A had to have an 'ambient' or 'relaxed' feel. (Theme B was evidently a contrast to A). All work was carried out using a computer software package Dance eJay.

The teachers were interested in exploring the effect of pupils' working with technology not only on the product but also on the process of composition and on pupil motivation. Prior to this

project, within school, use of technology for music had been limited to only a few pupils working on keyboards, as part of whole class or group activities. Most often these pupils had some keyboard skills, learned in lessons outside school. Only a few students had had experience of working with similar software packages outside school.

The design initiative consisted of 6 lessons spread over eight weeks. Lessons were generally one hour long. The work took place in the computer room where the pupils worked in pairs at the computers**.** In session one the teachers used a data projector to demonstrate how to use the Dance eJay programme. Subsequent lessons began with teacher input and ended with whole class discussion and demonstration of work; most of the lesson time was devoted to pupils' paired work. Informal opportunities for listening to other's work were built in and the teachers also allowed movement around the classroom to enable pupils to interact with classmates other than those with which they were paired. All lessons were video recorded with a focus on the work of six pupils chosen to include a spread of attainment in music. The pupils were also interviewed before and after the design initiative.

Dance eJay provides pupils with a variety of short musical samples which they can organise to create their own piece of music (see Fig.. Each sound is represented as a coloured box with its name on it; these boxes vary in length, according to the length of the sound itself. Sounds of a similar quality have the same colour. Sounds are selected and dragged onto a screen consisting of a number of tracks that can be filled or left empty. Bar numbers appear above the tracks. This visual representation of the sounds and the frame in which the music is constructed clearly supported learning in this series of lessons. The process of composition was aided by pupils being able to point to sections of music to indicate to their partner, for example, their preference for the positioning of a particular sample. When questioned by the teacher or other classmates about the structure of their work pupils often used the visual representation as a starting point for a discussion about the structure of their piece. For some students the visual representation of music also stimulated new thoughts about the composition process. For example, Pete commented on another pair's work: "I didn't think it would sound good 'cos there weren't any gaps at all, cos they just had big blocks of grey …then blue, but no gaps…cos if you're having, like du de la music, then it gets a bit boring" . Pete was becoming aware of the importance of silence in music through noticing gaps in the music represented on the screen. Another boy Tim remarked to his partner on the work of pupils seated nearby: "All they're using is purple. All they're using is 'sequence' (the umbrella name for all purple samples). It'll sound really bad." When questioned about this, Tim indicated that 'bad' meant both boring and wrong. He had identified, correctly, even before hearing the music, that use of the same tone colour in both the A and B sections would result in little contrast.

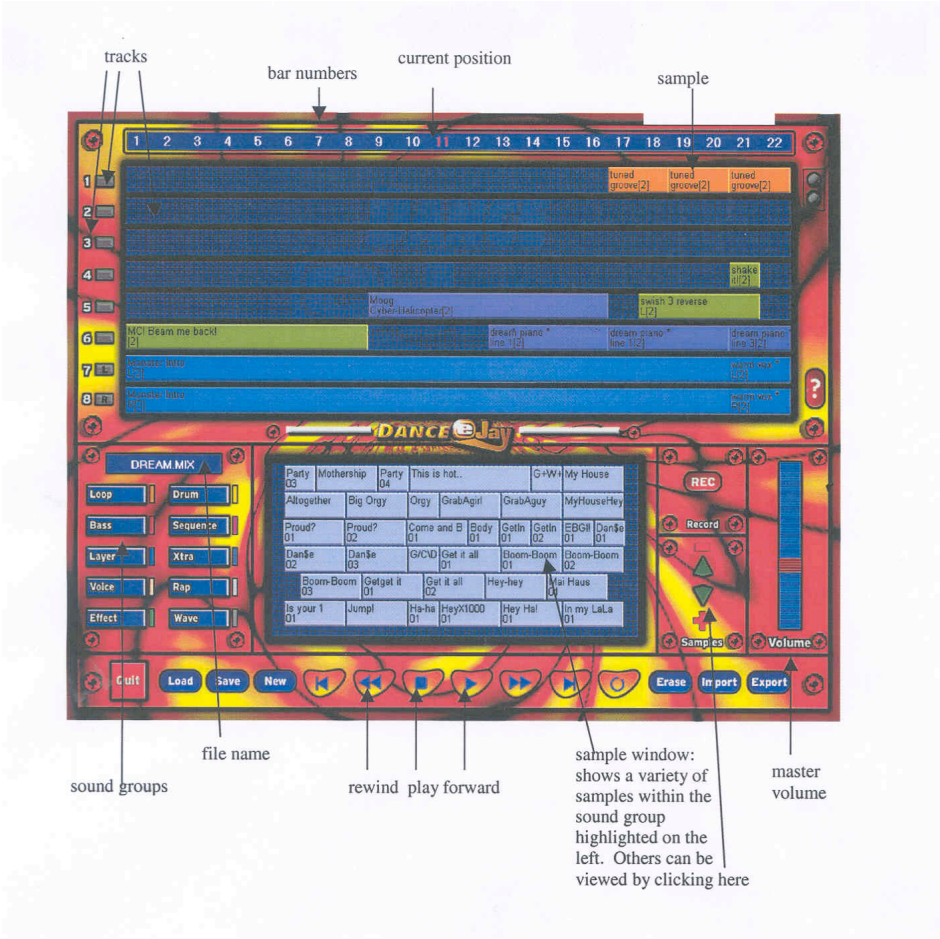

Figure 3: 'Opening of Dream Mix': Pre-recorded Demonstration Track (provided with the software)

Whilst the teachers encouraged pupils to use specific music vocabulary when discussing their work, the names and colours of the samples gave pupils with literacy difficulties a language with which to refer to the music, which helped them communicate what they wanted to their partner and teacher. When asked to explain what was happening in her piece, Sarah a pupil classified as needing special educational support, used the colours and names as a starting point for a dialogue about the music she had produced, especially its structure, and the processes of revision that she had undertaken. During lesson 3 of the project, the same pupil was watched by her classroom support teacher. Sarah, who generally has extreme difficulty concentrating on work, worked alone and unaided, completely focussed on the task which lasted over 40 minutes. She was the first pupil in the class to be observed considering the idea of placing the same sample on a number of tracks simultaneously to achieve an intended effect: "because that (pointing to the 'waterworld' sample) was so quiet I had to double up on it"

In fact, both researcher and teacher commented on the total absorption of *all* pupils virtually all of the time. It was clear, from pupils' body language that the modern 'Dance' music feel appealed to the pupils: they danced/moved to the music, nodded their head or clicked to the beat, sang the melodies of the samples on their own and with others 'Where the computer is used extensively…pupils can hear everything they write much more easily and frequently than when playing live…'(Patterson, 1999, p25). The ability to hear their music whenever they wanted enabled pupils to make constant refinements to their work. Since the computers were networked they were able to access the work of others with ease, without moving from their own station. Many pupils commented on how sharing ideas and listening to each other's work aided them with their own compositions. Perhaps the most important contributor to pupil engagement was the fact that they found the software easy to use.

SOME CONCLUDING REMARKS

In the three case studies presented in this paper the 'new technologies' being used are all relatively open-ended environments in which pupils can construct and express their own ideas. The interrelated qualities of these environments, which are valuable from the point of view of learning, are immediate feedback and facility to change and develop what has been produced. In all of the cases pupils were learning through engagement in authentic activity, writing for an audience, doing mathematics, and composing music. In the music and mathematics case the visual feedback from the respective computer environments seems to have been crucial in helping pupils to see structure and form and to notice the similarities and differences between different structures and their effects. Additionally the music and mathematics computer environments were structured by the teacher for pedagogic purposes, to enable pupils to focus and play with particular ideas and not others.

In the English case a sense of audience was realised through an actual audience who gave immediate written feedback at a distance. What would be the impact of constructing a similar audience for pupils to communicate their music and their mathematics? Would pupils begin to imagine the mathematical or musical responses of such an audience? It is such a dialogue around a particular purpose which we view as being a key pedagogic practice, made possible by ICT, but nevertheless grounded in the social and the cultural.

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BIOGRAPHY

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