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Developing strategies for delivering music technology in secondary PGCE courses

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For some years, music technology has been incorporated into the secondary music Post-Graduate Certificate in Education (PGCE) course at Kingston University. Student evaluations of this work have been supportive in the main, but identified continuing challenges in relation to establishing a sense of ease with its application in education. A range of course developments were devised in response, and closely monitored in 1997. The first half of this article outlines the rationale behind them. It draws upon a range of texts that document the reception of IT in schools and colleges, and on an interpretative response (based on theories of cognition), which the writer feels holds much relevance for music educators. The second half outlines course developments, and includes feedback from students and partner schools. Eighteen months on, the fundamental strategy is still in place, and staff have found it consistent with the requirements for ICT outlined in circular 4/98 by the DfEE.

(1) Introduction

One of the principal challenges confronting subject specialist planners of Initial Teacher Training (ITT) is that courses do not provide a unitary experience. While emphasis on partnership with schools softens distinctions between educational theory and its application, classrooms provide the context where students develop most in terms of customising their practice, and this is complemented by input of a more over-arching nature from the Higher Education Institute (HEI). In order to maximise opportunities for stability and integration in a form of training which is, *a priori*, quite highly differentiated, the secondary PGCE music course at Kingston University, including delivery of music technology, has acquired an increasingly holistic emphasis. The emphasis on partnership in initial teacher training has increased in recent years to the point where both universities and schools are held equally accountable for quality. As a consequence, one of the main challenges for providers lies in ensuring that course developments have sufficient impact to make a difference to school experience, and that partner schools are aware of and involved in supporting them. The practicalities of this are addressed in section 4 of this article. These circumstances also influenced the character of the university-based work described below. It was clear that benefits would be much more likely to survive the transition to the classroom if they were directed at values and attitudes arising from practical contexts, and not simply reliant on providing more opportunities to develop skills.

(2) Improving practice: finding a direction

Historical student evaluation

In 1995 and 1996, successive cohorts of PGCE students were asked to comment freely upon the nature and usefulness of the music technology component of the course in relation to their skill development in music technology and classroom experience of it. It had, traditionally, focused on drum machine, sound processing, portastudio and sequencing work, with a strong emphasis on personal skill development acquired via school-type tasks. For example, students in groups would explore the transformational potential of a reverb unit by linking it to a drum machine, and then use both to produce a composition based on a picture or poem, which was then recorded on a portastudio. It should be noted that these evaluations and the course developments that followed were not preliminary stages of a discrete research project, but part of a continuing process of course review.

The students' responses are summarised on the left-hand column of Table 1. Nearly all the observations emerged in both cohorts and all were articulated by at least three trainees. Predominant challenges for the course were:

(1) Most observations embodied concern, anxiety or reservation about music technology.
(2) Students' circumspection was not strongly related to a desire for more time to be spent on music technology.
(3) On the subject of competence, it was difficult to see whether, on balance, teaching or technical expertise was the more significant factor in their thinking.

Given the spread of expertise across both groups, and the range of feedback and feeling, it seemed unlikely that anything but a fairly deep rationale for change would generate improvement beyond the superficial. The question, at this juncture, as to whether some of the issues raised were inherent in IT (rather than being subject specific) was appealing in that a substantial body of published material already existed which, it was felt, might help to elucidate the position. In the event, dialogue with students was enriched to a greater extent than anticipated by correspondence with documented trends in the reception of IT in schools, and especially teachers' views as to its accessibility, purpose and potential. Something of the nature of these correspondences is outlined below.

Broadening the sphere of reference

Since the mid-1980s a generation of texts which evaluate the reception of IT in schools has emerged. They often relate outcomes to expectations raised by the pioneering visions and promises of the late 1970s and early 80s. Scafe and Wellington (1993) provide a concentrated overview of the dynamics surrounding the introduction of IT in schools in Great Britain that includes reference to government funding and features of phase-specific assimilation. Drawing on the work of Sendov (1986), they note that the development of IT in the curriculum from the 1980s to the early 1990s has exhibited a number of trends or 'waves': 'In the first wave, the computer remained very much an appendage to education. As a result it became an object of study in its own right. In the second wave, the value of the computer and more generally IT as an educational resource begins to be appreciated and developed. ... The third wave which is as yet largely hypothetical, occurs when IT influences the content and aims

Table 1.

Summary of PGCE student evaluations of music technology in school and university	Trends in teacher response to IT from evaluative literature
Difficult to monitor how the compositional process has developed when pupils use sequencers.	Learning process may be concealed from teacher. Can be difficult to evaluate outcomes from a versatile and powerful resource.
Does not necessarily 'add' to a lesson.	May not amplify existing practice.
Anxious that equipment may let them down.	Computer may fail and teacher loses control – raises issues of competence.
A steep learning curve if there is little IT in your background.	Computer increases workload; teachers may not have had significant prior access to computer-orientated culture.
Sequencers afford compositional opportunities e.g. layering, track editing, which pupils might otherwise be unable to manage.	Can assist in pupil self-expression; pupils can reflect on own concerns. Amplifies pupil potential to succeed.
Sometimes difficult to integrate IT or other music technology skills with music skills.	Pupils need to learn how to use the computer as well as use the computer to learn.
Sometimes difficult to apply principles learned at university because school equipment did not match.	Tendency, in secondary schools, to use IT vertically, in subject-based way. May isolate or marginalise those whose equipment does not benefit from mainstream management.
Sequencers may foster attitudes that discourage acoustic work.	Manipulative and cognitive activity occurs within the microworld and not the real world. May influence attitudes towards the real world.
Pleased to have encountered music technology in the 'safe' university environment. More practice needed before sufficient confidence gained to try out in the classroom. Better to have done less advanced work, and had more time to consolidate the basics.	Training welcome, but sometimes insufficient to lead to immediate application. Accretion of skills a gradual process.
Equipment sometimes isolated.	Computers de-coupled from broader learning environment. Need special attention in terms of fair access.
Sequencers and portastudios may influence ways in which pupils think about form; may change their outlook.	Pupils make adjustments to thinking and responding in relation to IT. May widen or narrow horizons.
Equipment can be frustrating to use when things go wrong, or do not function according to expectation, often hard to see why. Manuals often inaccessible.	A degree of opacity associated with IT – user sees/is aware of some functions, but does not see all operations. Can alienate. Troubleshooting sometimes requires lengthy diagnosis
Music built up on portastudios or sequencers may encourage editing arising from nature of the equipment itself, e.g. quantising.	Equipment may foster editorial attitudes; these may enhance or detract from learning outcomes.

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of education itself, as well as the method and system of teaching' (p. 20). In addition, they cite three 'pressures', sociological, economic and pedagogical, which act in conjunction with the 'waves', and exert further influence upon teachers.

Many of the students' observations on Table 1 would seem to coincide with the 'second wave': they recognise that the computer 'affords opportunities', and relate to it as a *resource* to be accommodated, and not as an object which will affect planning and aims in a more fundamental way. Some of their anxieties also relate to 'pedagogical pressure' in the sense that there is a strong desire for classroom mastery driven by curricular requirements.

Parallel themes appear in a range of other texts. Underwood and Underwood (1990), explore in some detail the potential of IT as a *resource*, while on an international level, John Olson's work, (1988) which reviews a number of Canadian school-based action research IT projects, focuses strongly on teacher response to various IT-generated *pressures*. It was interesting, from the music PGCE perspective, that all of the student observations noted on Table 1 were echoed across the IT literature (albeit in varying contexts). In the right-hand column, an attempt is made to distil the essence of the correspondences from the many examples available. Given that students in initial teacher training are preoccupied by a range of course-specific concerns which do not always overlap with those of experienced teachers, levels of coincidence were not expected to be quite so high.

This consistency, both across the literature and in local experience, suggests that the outcomes stem from the nature of the IT itself, which provides a starting point for Charles Crook's interpretative work (1994) reflecting upon its use in schools from a psychological perspective. His work is reminiscent of Scafe and Wellington's 'third wave' in that it suggests that classroom culture (and successful practice) should be *shaped* by IT rather be considered *prior* to it. Crook 'would encourage a move away from design strategies based exclusively upon interacting with computers, towards solutions which consider computers as a context for social interaction' (p. 98). Although his analysis is IT centred, in the discrete subject sense, it influenced the way in which music technology within the PGCE course at Kingston was developed, and is therefore elaborated a little more below to provide a context for what follows.

Crook begins by describing features of the four principal modes of user interaction with IT (pp. 11–24):

(1) The computer as tutor (drill and skill).
(2) The discovery/constructivist paradigm. This is associated with the development of LOGO. Crook later provides an outline (pp. 57–62) of its development, including linkage of LOGO with Piagetian theories of child development.
(3) The computer as simulator (for testing hypotheses in specific environments).
(4) The computer as tool box (word processing, databases etc. to do with manipulation and organisation of self-generated data).

He then evaluates the properties of IT systems in relation to three psychological perspectives (pp. 52–62). The first of these is experimental cognitive psychology, which accounts for learning and action in terms of symbols (held in the mind as information) and symbol manipulation (information processing). He notes that this theory tends towards the 'private and computational' (p. 53) and is often portrayed as disembodied from broader social contexts. This pertains, he feels, especially to software which provides a workshop environment divorced from over-arching social processes, which applies to some degree to all four modes of operation, but especially to the computer as tutor and computer as simulator.

The second perspective relates to constructivist theory. Here the child acts upon the world, learns through discovery and passes through stages of development, which mature at different ages. Crook articulates a reservation, shared by other psychologists – including for example, David Wood (1988) – that testing for these stages often places children in unfamiliar environments, and may require them to respond to problems in language/situations they do not understand. Wood, for example, cites a case study (p. 49) relating to children at Piaget's pre-operational stage working on the concept of conservation. When confronted with liquids poured from one container to another of different shape, and asked questions relating to quantity, most children behaved predictably for their age, and did not perceive conservation to have taken place. When, however, the original container was presented as dangerous – having a sharp rim – which meant that transfer to another was made for a pragmatic reason – safety – more pupils recognised that conservation had taken place. Crook argues (pp. 69–71) that just as Piagetian theory tends to disregard social influence on cognitive development (the impact of *context* upon local child-centred activity), so IT which is related to Piaget's work – especially LOGO – may result in the user developing new cognitive tools specific to the means of operation: 'Acquired ways of acting with the computer tool get internalised' (p. 70).

The third perspective is one that Crook suggests has great potential for stimulating fresh appraisal of IT and its use in schools. It relates to the work of cultural theorists, which places emphasis on social contexts for thinking; psychological processes are conceived as being culturally mediated. For example, cognitive operations are mediated by notations, language, maps etc., which are culturally derived, and are used to regulate/organise behaviour. Cultural theorists are interested in the structure of these mediational systems, their active, adaptive and cumulative nature, and their relationship with environment: 'They place us in a position of constantly interpreting the world, rather than responding to it' (p. 35). A central point made in relation to IT and cultural theory, is that: 'There are few examples of a socio-cultural analysis applied to learning where *material artefacts* are central to the mediational process' (p. 72; my italics). One of the aims of his work is to look at ways in which cultural theory and related psychology provide a means of analysing the mediational characteristics of IT (this process is informed by reference to related sub-theories of intersubjectivity, a situated view of knowledge, and zones of proximal development). He focuses especially upon the belief that: 'A formal account of learning as a socially grounded achievement would inform any challenge to the technological visions of the isolated pupil' (p. 31).

Implications for music education

The concept of social isolation – teacher from pupil (with or without headphones!) pupil from pupil, teacher and/or pupil from machine, machine from broader learning context – when applied to the PGCE music evaluations, is revealing. It suggests, as does Crook's broader work, that a range of concerns with IT have developed because its social and mediational characteristics have not been a focus of work in schools. The notion of isolation may also relate to the fact that a 'storehouse' approach to knowledge (from cognitive psychology) has often been associated with IT. This is opposed to the idea of instruction as a discourse (from cultural theory) where knowledge is an activity 'guided by past interactions but shaped by the needs of the moment' (p. 97).

These are both powerful concepts for music. *Mediation* relates to the way in which

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relationships in sound become socially and culturally formalised. It coincides closely with the concept of expression in its broadest sense – embracing everything from utterance to aesthetics. Processes of formalisation relate, for example, to the evolution of styles and theories, attachment to rituals, use of oral and written notations, properties of instruments and softwares. Clearly, if such conventions and routines need to be re-thought and adapted for the medium of music technology, students need to develop the practical and critical skills for so doing. For example, what happens to the process of improvisation – and, for that matter, powers of internalisation – if a passage becomes fixed by a sequencer and can be re-played again and again? How will this phenomenon be dealt with in the classroom? How does it compare with improvisation on acoustic instruments? How will it influence students' dialogues with pupils? To take the other point, a 'needs of the moment kind of knowledge' appeals to the fact that interpretation, originality, expressiveness, direct engagement and creativity are valued in music, whereas the mechanistic is not. Research by George Odam (1995) into brain function and written symbol in music reinforces this perspective: 'Making certain that sound comes before its symbol means giving clear preference to aural perception and memory, and this is how we give the ear an advantage. . . . Most aural work with children will come in through the right brain, and we need to recognise and be wary of our left-brained adult obsession with words, symbols and writing when introducing our children to music (Odam, 1995: 23). Clearly words, symbols and writing which are encountered on sequencer screens, keyboard panels and tape machines may just as easily trigger left-brain activity, and students need to be able to evaluate the impact on 'needs of the moment' spontaneity of the right. How spontaneously, for example, can a quick expressive adjustment (for example, the addition of an attack to a single note) be made on a sequenced track? How easily can its intensity be judged? How many (left-brained) stages are involved in executing this refinement? What happens to a pupil's concept of attack if it is achieved by number/sight and not by feel?

The PGCE evaluations are shot through with concerns that relate to a sense of social and artistic distance from music-making processes. More specifically, staff recognised that questions such as those posed in the previous paragraph had surfaced historically, albeit in a haphazard fashion. They were not as part of a systematic overarching strategy to make students aware of the mediational, social and interactive properties of music technology, or to equip them to respond thereto. It was to these concerns that the course development described below was, in the main, addressed.

(3) Developing course structure

In the section above it is implied that forces prompting development of music technology within the secondary PGCE were twofold: those which stemmed from internal course design and feedback, and those which belonged to a wider research context. Of these, four were especially influential, and were selected for this research on the basis of their practical compatibility, which meant that all could be accommodated within the limited time-frame of the PGCE:

(1) A desire to provide a more holistic form of training by increasing integration across the course.
(2) A hypothesis that study of the mediational properties of music IT might benefit students by helping them to accommodate their experience of it within personal understandings of subject epistemology and application.

(3) A hypothesis that increased opportunities for students to share and critically evaluate perceptions and suppositions about music technology will improve confidence and quality of outcome when working in a community of users in schools, with teachers and pupils, and foster a sense of belonging to it.
(4) A need to find ways of involving partner schools in research.

Each issue is outlined below. The first two are qualified by a range of examples from the 1997 course (all three terms), and the last two, mainly by student and school evaluation. A short conclusion follows which brings the whole picture briefly up to date.

(4) Developments and their application

(1) A desire to provide a more holistic form of training by increasing integration across the course.

As noted at the beginning of this article, the impetus to make the PGCE more holistic was, chiefly, driven by a desire to improve consistency and continuity across a short and diverse course. However, this strategy also reinforced other aspects of course development related to cultural theory and critical evaluation of deployment of musical technology in teaching (points 2 and 3 above), in that students would encounter it in a *far greater number of reflective and practical contexts than hitherto.* Examples of intersection between general course content and music technology are listed on Table 2; they typify 1997 course development, and reflect a substantial increase in integration compared with previous years when music technology tended to be confined to a smaller number of discrete sessions. Further comparisons with previous practice are outlined below.

(i) Historically, music technology within the PGCE tended to be associated with students' subject skill. With course development, the emphasis broadened and, alongside skill development, *music technology was scrutinised much more systematically for the way it influences teaching and learning activity.*

(ii) While some equipment remained discretely housed, a degree of migration became a regular feature of the course, *allowing students to work with it in situations closer to the social reality of the classroom, or at least in a manner less isolated from it.*

(iii) Time devoted to music technology was about the same as before, *but varied in distribution.* On the one hand, at least three times as many taught sessions included work on music technology. However, sessions with a *high* music technology focus included more reflection on other issues, for example, assessment, equal opportunities. As a consequence, a better balance between students' own levels of expertise and broader course requirements was obtained.

(iv) *Greater diversity in delivery* provided opportunities for students to assume *a greater variety of roles than hitherto*: work in teams, work in groups, performers responding to technicians, and vice versa. One of the aims was to try to encourage the sort of adaptive behaviour which cultural theorists identify with 'situated' or 'context-related' knowledge, and which evaluations from previous years indicated might have been lacking, despite a strong hands-on approach.

While the aspects of development described above are quite specific to the Kingston course, the over-arching principles (in italics) outlined with them are flexible, and could be adapted to a range of contexts encountered by other providers.

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Table 2.

Aspects of general course content (not in sequence as delivered)	Points of intersection with music technology
(1) Introduction to the music National Curriculum (NC), GCSE and A level syllabi – expectations and requirements.	(1) Introduction to the IT orders: structure and standards; related publications and materials for music. Music technology at KS3, GCSE and A level. SCAA (1995 & 1996) and NCET (1996) materials.
(2) Review of students' own music education (values and assumptions); skills required by the music teacher; identifying areas in need of development.	(2) Music technology skill audit.
(3) Progression across the N.C. orders – linked to Indian music workshop.	(3) Workshop performance recorded on one track of a portastudio. Operation briefly outlined. Question: what happens to 'improvisation' when rehearsed for the microphone? How do players relate to the recording process? What is the impact on sense of ensemble? How can pupils take charge of this?
(4) Model lesson plans and evaluations. Model schemes of work. Integration of the attainment targets.	(4) Sequencing and score production: some mediational properties and skill requirements analysed. How to incorporate into long-term planning? Teaching music and teaching technology – finding a balance. Editing by sight and ear.
(5) Some philosophies relating to music education.	(5) Sequencing and factual, skill-related and aesthetic knowing. Debate and discussion.
(6) Resources for practical instrumental work.	(6) Study of the functions of electronic keyboards. Critical evaluation of opportunities and limitations. Implications for planning. Social considerations.
(7) Development of students' own skills.	(7) Introduction to sequencing and four-track recording for beginners. Comparative analysis (all students) of composing blues live (then taping) with experience of using a sequencer on a keyboard, or one on a computer.
(8) Equal opportunities and gender issues in music.	(8) A look at some research which relate to music technology, e.g. Hargreaves (1993), and the legacy of TVEI – Winter (1992), Green (1992).
(9) Issues in assessment.	(9) Using recordings of pupils' work in assessment: what can and cannot be judged from these? Is a quality of recording important?
(10) Listening and appraising – linked to gamelan workshops.	(10) Use of sequencers to support attainment target 2. Issue: compatibility of culture-specific organisation with operations of sequencing packages; nature of resultant compromises; usefulness as a teaching aid for de-constructing layers and identifying relationships.

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(2) A hypothesis that increased opportunities to reflect upon the mediational properties of music technology may benefit students by helping them to accommodate their experience of it within personal understandings of subject epistemology and application.

The opportunities that arose from this enquiry were both formative and summative in character. On a day-to-day level, reflection of a mediational character was drawn into teaching sessions across the entire course. These covered, for example, ways in which the organisational characteristics of music technology might influence musical processes and interactions; examination of relationships which might develop between visual presentation of music (as on a screen) and hearing it; analysis of adaptive behaviours developed when working with music technology. On another, more summative, level, students were asked at the end of the autumn term to participate in a discursive and written evaluation of their experiences of sequencing and score writing on computers. This had a twofold purpose: to allow staff to evaluate the impact of course development, and students to consolidate developing views about music technology.

The questions asked are outlined below, and student responses to two of them (as examples) are given in Table 3.

(1) What are the necessary pre-requisite skills for confident use of these packages, at appropriate levels of difficulty, at KS3?
(2) How might the packages influence perception of musical relationships and structures?
(3) Please comment upon ease of operation.
(4) Please comment upon quality of expressive interaction.
(5) Please comment upon the process of generating structures.

Questions 1 and 3 were *application* focused, encouraging trainees to draw upon lesson-planning skills to do with anticipating pupils' 'needs of the moment'. Questions 2, 4 and 5 were more closely related to subject *epistemology*, drawing upon previous discussions, mediational in character, as to ways in which classroom exchanges (verbal, written, technological) and associated artefacts can shape knowing, meaning and understanding.

Qualifying data and comments

(1) Most frequently expressed views are given first and those in italics were provided by 50 per cent or more of the cohort, which numbered twelve students.

(2) 17 per cent of the cohort were very experienced in music technology at the beginning of the course; 25 per cent fairly experienced; 58 per cent very inexperienced.

(3) All students worked with one of two possible sequencing packages – P1 or P2. Often both drew the same or very similar feedback. In these cases, responses have been conflated. Tasks were differentiated. Comments that pertain to single packages are qualified as being P1 or P2 related.

(4) P3 was a score-writing package, and used by 58 per cent of students at university. The other 42 per cent either knew it already, or evaluated from use at school.

In terms of range of response, the outcomes above were consistent with expectations for the early part of a PGCE course. Spontaneous reference, in two places, by 33 per cent and 25 per cent of students respectively, to different forms of knowing,

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Table 3.

Question	Responses for P1 and P2 (sequencers)*	Responses for P3 (score writing)*
(1) What are the necessary pre-requisite skills for confident use of these packages, at appropriate levels of difficulty at KS3?	*Performing accurately on a keyboard against a metronome pulse; IT skills – mouse handling, keyboard strokes, accessing menus; appraising skills for making judgements about outcomes – especially in relation to melody, rhythm and texture; confidence in improvising*; a balanced musical background at key stage 2 with experience of different forms of knowing (factual, skill-related, aesthetic); an inquisitive approach to music-making. P1 only – an ability to distinguish aurally between different parts.	*Familiarity with the conventions of staff notation; patience; ability to both hear and see errors; IT skills, especially entering data in step time using key strokes*; ability to retain a sense of the music (memory/inner ear) – as a whole – during a fragmentary inputting procedure.
(4) Please comment upon the quality of expressive interaction.	*Degree of feel depends of the quality of the keyboard – may not fully represent the player's intentions – frustrating?; when several tracks recorded, may require quantising to approximate desired expressive effect; quantising may undermine human feel; processing of sound indirect – undertaken after input – gives opportunities to consider interpretation in depth; depends on awareness of editing procedures, and how to access them*; combines different kinds of knowing (factual, expressive and skill-related) and so is complex – useful to have time to reflect and experiment; unlikely to reflect precise expressive intentions; processing of sound indirect – may encourage over-reliance on machine to produce.	*Not designed to focus on expression, but on production of a neat score; laborious operation may undermine original expressive intent.*

related directly to introductory autumn term work on subject epistemology. It was encouraging to note, across all five responses, the emergence of problem-solving phraseology, such as 'teachers should encourage', 'a process of adaptation is required', 'requires perseverance', 'encourages linear hearing'.

In terms of the PGCE in general, and possible implications for other providers, the exercise proved very useful as an indication of student development, and assisted greatly with planning for the rest of the course. One student commented later that she was 'Surprised by her ability to write confidently about music technology' and the lively discussion allowed students of all abilities in music technology to learn from one another. Simplistic as this might seem, given the tone of previous course evaluations,

it marked a change of emphasis which has reinforced the view that discursive opportunities which allow students to develop their perceptions in a supportive but *untutored* way are a worthwhile investment, and complement taught input well. However, the principal test of this, and the previously noted strategy, was whether or not they would successfully support school-based work, which lies at the heart of the following points.

(3) A hypothesis that increased opportunities for students to share and critically evaluate perceptions and suppositions about music technology will improve confidence and quality of outcome when working in a community of users in schools, with teachers and pupils, and foster a sense of belonging to it.

(4) A need to find ways of involving partner schools in research.

These two points were complementary. The first centred, to a great extent, on assessing the impact of university-based work on classroom practice. If it had, in the event, helped to ease the assimilation of music technology into students' vocational provinces and practices, the thrust of evaluation would show some change compared with previous years. In addition, if students' views and opinions continued to evolve on teaching practice, their end-of-course reflection might reasonably be expected to be more interpretative than responses listed on Table 3, completed at the end of the first term.

As far as approaching schools was concerned, a balance needed to be struck between a high emphasis on partnership, national requirements for IT in ITT, and departmental circumstances. In weighing up how this might be achieved in the research, a prime consideration was the degree of pressure experienced by (usually) small departments already committed to a mentoring schedule, and with different agendas for curriculum development.

The main initial strategy, adopted because it would make few if any additional demands on schools, involved extension of serial practice research. This provides a framework (via a set of tasks) for school-based information-gathering prior to teaching practice. In the autumn and spring terms, students were additionally required to investigate levels of music technology resourcing and modes of usage within their placement department. As staff expect to support students in completing the schedule, it was hoped that the exercise would create an opportunity for one or both parties to use it as a starting point for discussing music technology, and considering ways of accommodating access and involvement on teaching practice. 91 per cent of students completed the task, and 59 per cent said, additionally, that they found it helpful in determining levels of expectation in relation to music technology, while the others stated that it made little difference to their experience.

In addition, four schools were asked, for the purposes of this research, whether they would be prepared to complete a short evaluation at the end of the first practice, focusing on outcomes for the department, and expectations of university-based training. The schools were approached on the basis of their known use of music technology or, in two cases, known wish to develop it. The responses are described in detail in the next section, and are encouraging in the sense that they do not imply that university-based work is out of touch with schools' expectations.

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(5) Evaluation of school-based aspects of the research

This process was informed by four sets of feedback. The outcomes are given below with brief evaluative comments, and the main response, in the concluding section that follows.

(a) The number of students working with music technology during their first- and second-block teaching practices.
(b) Students' evaluations of work undertaken with pupils.
(c) Students' evaluations their own professional and personal development.
(d) Feedback from four schools.

(a) Numbers of students using music technology during teaching practice

Although no statistics exist for previous cohorts, making it difficult to evaluate data from a historical perspective, the outcomes were encouraging. The figures record percentages of students who engaged in different types of music technology on teaching practice. Students who used more than one type of music technology, appear, therefore, in two or more sets of figures. Statistics about students' competence in music technology can be found in Table 3.

(1) 34 per cent used portastudios.
(2) 59 per cent used sequencers (within keyboards or computer-linked, or both).
(3) 83 per cent used electronic keyboards.
(4) 100 per cent made video, DAT or cassette recordings of pupils' work.

In each of these groups except the first, more than half the students were very inexperienced or beginners in music technology at the beginning of the PGCE, and overall, every student used music technology during their teaching practice. No clear trends emerged from contexts for use, which ranged across both National Curriculum attainment targets, and composing and performing at key stage 4.

(b) Student evaluation of work with pupils

Students were asked invited to examine the following via a series of open questions:

(1) How music technology was integrated with schemes of work, i.e. was the focus mainly technological, mainly musical or both?

(2) The extent to which pupils were dependent upon teacher intervention or were able to work independently.

(3) Consequences (of 2) for learning – motivation, attitude, building on prior achievement, quality of outcomes. Responses from all students are summarised in Table 4, and conflated where very similar.

It was interesting that, despite the fact that most responses were recorded in the form of bullet points, students sometimes declared the *reasoning* behind their observations: they tried to convey a background rationale. This related closely to the aspect of the hypothesis stated above, to do with being part of a 'community of users'. It suggested that the feelings of marginalisation reflected, for example, in Table 1, were perhaps giving way to greater pragmatism, although it is recognised that this might also have something to do with the nature of the questions. Comparison of responses on Table 3 with those of Table 4 suggested that students' powers of self-expression in

Table 4.

Integration with schemes	%*	Pupil dependency?	Consequences for learning
Mainly technological	8%	– Dependency high, but desire to be independent. – Dialogue intensive, but forged strong relationships as result.	Pupils motivated, and curious about the technology. – Collaborations productive. Pupils keen to acquire autonomy.
Mainly musical	76%	Dependency a significant factor in only 8 per cent of cases. – Teacher not seen as technician but musician, so dependency much the same as when not using technology. – Sequencers occasionally enabled pupils to produce, via improvisation, combinations that would normally require teacher support. Score-writing work: dependency high over a limited range of very detailed tasks: software masked opportunity for applying 'like' skills.	– Headphones – reported by one student to afford improved concentration, by another, a temptation to slip off task. – Better keyboards facilitated creative work because sound sources were engaging, or data management was enhanced (esp. with sequencers) Pupils would explore independently and with good discrimination in the main; sometimes went hand in hand with quality of equipment. – Pupils keen to lead interactions with teacher, who took on advisory role. – Valued support with musical matters. – Score-writing work mechanical.
Both	34%	– Only a problem with persistent equipment failure, then detracted from lesson. – Best results where reasons behind functions were clarified, and demonstrated rather than explained.	– Equipment failure did detract from learning. – Pupils appreciated vocational nature of work. – Improvisation with functions as prevalent sometimes as with sound, e.g. quantising, looping, velocity change. Good focus on outcome; willingness to 'undo' where dissatisfied.

* Percentages of students working as suggested in column 1. Some students worked with music technology more than once under different circumstances.

relation to music technology had transferred to the classroom, and, moreover, that their discursive achievements were *supporting* their work in it.

(c) Student evaluation of their personal development

Students were all asked to respond openly to the question below. As their range of background and course-based experience was wide, it was felt that this would capture nuance of view better than a common agenda.

Comment freely upon ways in which your views about music technology have developed

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this year. You might, for example, mention how it relates to the purposes of lessons; whether/how it influenced your relationships with pupils; your own confidence or apprehensions; the impact of university- or school-based support.

Feedback correlated strongly with levels of prior training, and responses below have been arranged accordingly, and summarised as bullet points for the sake of brevity. The university response to this feedback is given in section 6.

(1) Most experienced users (17 per cent)

- No significant change in their attitudes to music technology, or its potential within an educational context.
- Technology was as considered as significant a skill as instrumental expertise, and as such would be invaluable to future personal operation in the classroom.
- Work covered during the college-based course provided a fair grounding, and would benefit, in the future, from more advice on classroom management, and how to use one or more pieces of equipment in diverse ways.
- Work on mediation was appreciated; it helped with anticipating how technological tasks might need to be broken down for pupils and presented.

(2) Fairly experienced users (25 per cent) and very inexperienced (17 per cent) who worked with familiar equipment.

- Very few apprehensions in relation to technical matters,
- All mentioned a need to improve aspects of teaching skills for more effective use of music technology, for example, to achieve better differentiation, or to develop more 'sophisticated' strategies for classroom management, so that planning for it might be more systematic.
- Most learning outcomes had been achieved, and departments were supportive.
- The university-based programme was evaluated as sound or better, and all were of the view that future development should focus more on school-related issues, for example, differentiation and strategies for grouping pupils, with some refresher work alongside.
- Discussions with peers had been valuable, and influenced their attitudes and practice.
- Preparation at university had helped well with developing ways of engaging with pupils.

(3) Evaluations from least experienced users/beginners (41 per cent)

- Apprehensive at first.
- High levels of support from departmental and university staff helped to improve confidence in personal skills, and provide clearer insight as to potential benefits.
- Use of music technology coincided with departmental aims and objectives.
- Relationships with pupils were said to be satisfactory or better; verbal exchanges easier than expected.
- All felt they would know where to begin in first posts with a range of, if not all, common equipment.
- 'Pupils respected me for using music technology' (stated one student).

(d) Responses from schools

Four schools were asked, briefly, to outline:

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(1) The context for students' use of music technology on teaching practice.
(2) The quality of outcomes.
(3) The degree of support given.
(4) Expectations of the university-based course.

The sample consisted of one independent boys' school, one mixed comprehensive, one girls' comprehensive and one girls' county selective. Three of the students were very inexperienced/beginners, and worked with portastudios or MIDI – i.e. were in situations of high challenge – and one was fairly experienced and worked with keyboards in the main.

Information about context and quality echoed student evaluations closely; that they overlapped to this degree is interesting, in that it suggests that there had been good consensus between students and staff, which might have owed something to developments in the university-based programme which had focused on communication. In all cases, music technology was integrated with schemes. All departments supported students, and the three which did so least received quite substantial assistance, in that some sessions were team taught, and some planning was undertaken jointly. In each case, however, students were required, at some stage, to assume independent control of technology-related work, and each was stretched. Two schools stated that they did not expect the PGCE to provide related training beyond the generic; in other words, they expected to have to prepare students for the specifics of their departments. One was of the view that comprehensive training should be provided, given statutory requirements. A different school echoed a theme highlighted by Kassner (1996: 194) that, 'The administrator of the future, given the choice of two otherwise similarly skilled music teachers, will certainly hire and retain the most technologically literate one'. Anecdotal feedback from students accepting first posts would indicate that schools' agendas are not, in reality, nearly so uniform, but the view is not without precedence, and it has been noted by the university.

(6) Conclusions

Overall, comparison of feedback with evaluation from previous years suggested some improvement in effectiveness. Neutral (no value-judgement) or positive comments, for example, for the first time, outweighed reservations. These suggested that most students were able to accommodate activities within personal frameworks of subject epistemology, and were not so much concerned about the nature of the tasks, as how to make the most of them (subject application), which also characterised responses on Table 4.

In addition, it was heartening that they responded to apprehension by engaging in constructive dialogue with placement departments, which perhaps owed something to the fact that they had been encouraged to discuss and analyse their experiences, which in turn provided better foundations for dealing with working situations. Schools reported satisfaction with these aspects of course development, and though the four involved in providing feedback were predisposed to supporting their students in music technology, there was no suggestion, via other students, that contradictory views were held elsewhere.

On the basis of this and subsequent feedback to date, course development has retained emphasis on integration and guards against isolation in music technology. Directions will continue to be shaped by evaluation, and therefore be institution-specific in detail. However, those which are proving most helpful in relation to

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adjusting to the demands of DfEE circular 4/98, which sets expectations in terms of delivery of ICT within ITT common to all providers, are given below:

(1) Retention of an emphasis on providing *variety of encounter* (relates to grouping of students and contexts for use). Evidence suggests that it encourages, especially in less-experienced music technology users, acquisition of adaptive behaviour (as outlined in cultural theory) which supports subsequent negotiation/discussion/definition of solutions to teaching (practice) situations.

(2) Continued inclusion of opportunities to consider *relationships between music technology and subject knowledge* (including further work on mediational properties of software) so that planning for its use is based, as other curriculum work, on thinking which seeks the most favourable conditions for achieving aims. This will be supported by retention of links between technology and research-based aspects of the course.

(3) Development of strategies for achieving *better integration of classroom management issues and music technology*.

(4) Integration, in the summer term, *of music technology with aspects of departmental management*, including long-term planning and budgetary strategy. This will draw particularly on spring term exploration of the mediational characteristics of different music technologies (in relation to associated learning theory) in order to help students make decisions as to how they can most effectively support developmental aspects of planning. These might include, for example, the relationship with development of keyboard skills (fingering, fluency); dependence upon gradual acquisition of listening skills which support creative work that evolves by accretion of layers, and will become more complex with age; hemispherical brain function and music technology – implications for aural perception of responding to symbols on screen; music technology and stylistic work – integrating textures successfully; suitability for exploring different styles, traditions and cultures; frequency of use; coping with limited availability; monitoring attitudes towards use – by gender and ability; a study of related research, e.g. Coomber, Hargreaves and Colley (1993 and 1997), and Hunt and Kirk, (1997).

(5) *Improved differentiated planning for students of varying expertise*. Given the importance attached by students (expressed through evaluation) to issues of classroom management, a possible way forward might be to involve more experienced users in related problem-solving earlier in the course, leading to outcomes which can be shared with their peers.

(6) *Discussing with students trends emerging from their own self- evaluations*, especially in the summer term, to encourage meta-analysis of issues and further self-reflection. The aim will be to strengthen a sense of personal belonging to a community of users, in order to improve the likelihood of confidence being sustained when students leave the course, when access to a range of opportunities may be limited.

(7) Continued exploration of ways of *keeping partner schools aware of university-based developments*, and of the mutual benefits to be gained from affording students opportunities to apply skills in music technology to teaching-practice work.

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