

The sacred and the profane: subject sub-culture, pedagogical practice and teachers' perceptions of the classroom uses of ICT

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Drawing on extensive interview data with 37 participants across six subject areas (maths, science, English, music, modern foreign languages and geography) this paper explores and explains the extent to which subject teachers and their various epistemic communities or subject sub-cultures negotiate the relationship between ICT and learning in their subject contexts. The study uses Bernstein's (1996) conception of 'the sacred and the profane' as a heuristic to guide the dynamics of the process. Using a content analysis based on grounded themes, the findings show that with extended and supported use 'transaction spaces' emerge where subject teachers begin to negotiate with new technologies thus creating new meanings and accommodations. These changes are evolutionary rather than transformatory with the evidence pointing to a 'new' blend of technology and subject taking place; a trend that highlights the centrality of pragmatic pedagogy and the importance of the 'pedagogic dependent ICT resource'.

Introduction

Despite the rhetoric, the deployment and use of Information Communications Technology (ICT) in school contexts remain problematic. The common explanation for the lack of curriculum and classroom infusion is the varying levels of resistance offered by teachers and the subject sub-cultures in which their practice is embedded. Olson (2000), for instance, labels ICT as a 'Trojan Horse' and asks why should teachers abandon the safety and comfort of recognised subject pedagogy for the uncertainties and complexities that surround the use of ICT. Others, notably Goodson and Mangan (1995), John and La Velle (2004) and Watson (2001) paint a more complex picture arguing that rather than outright resistance, most subject teachers often accommodate, incorporate and assimilate ICT according to the levels 1

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of competence, subject tradition, resource provision and support (both technical and pedagogical) that are available.

Drawing on extensive interview data, this paper will explore and explain the extent to which subject teachers and their various epistemic communities negotiate the relationship between ICT and learning in subject contexts. The investigation uses Bernstein's (1990; 2000) use of 'the sacred and the profane' as a heuristic guide to the dynamics of the process. In particular, the analysis will highlight the ways in which both consonance and dissonance can develop within school subject cultures when ICT is introduced into the learning context; and that this 'dual effect' is influenced by the differentiated subject cultural machinery in which pedagogy and learning are embedded. The paper ends with a discussion of the ways in which ICT can both mediate and transform learning within subject settings.

The sacred and the profane

Bernstein's (1990; 2001) conception of *identity*, in particular, the ways in which the reorganisation of education at state level creates 'official pedagogic identities' of a distinctively new and powerful kind (Bernstein & Solomon, 1999, p. 27), lies at the heart of much of his writing. Principally, *identity* has to do with the ways in which orderings internal to the individual are related to and result from external orderings—both the discursive and the socially structured relationships in which they are embedded. Bernstein's analysis of these internal orderings and the assaults upon them was shaped by his use of Durkheim's concepts of 'the sacred and the profane'. The former (the sacred) refers to its relation to specific forms of knowledge (its otherness) and to the social and discursive obligations this relation requires; the latter (the profane), refers to the contextual demands and constraints of economic context that impinge on the sacred. Of central importance in this distinction are not only the levels of 'insulation between the two categories' (Bernstein, 1990, p. 23) but also the socialisation into subject loyalty which becomes 'the lynch-pin of identity'. In 1971 he first outlined these ideas when explaining the classification and framing of knowledge. 2

A sense of the sacred, the 'otherness' of educational knowledge, I submit does not arise so much out of an ethic of knowledge for its own sake, but is more a function of socialisation into subject loyalty: for it is the subject which becomes the lynch-pin of identity. Any attempt to weaken or change classification strength (or even frame strength) may be felt as a threat to one's identity and may be experienced as a pollution endangering the sacred (Bernstein, 1971, p. 56).

Over a quarter of a century later the same position is re-stated although this time the language of collection and integrated codes has been replaced by the lexicon of singulars and regions.

The sacred face (of singulars) sets them apart, legitimises their otherness, and creates dedicated identities with no reference other than their calling. The profane face indicates their external linkage (of regions) and internal power struggles.

Organisationally and politically, singulars construct strong boundary maintenance (Bernstein, 1996, p. 68).

Bernstein (1988) further speculated that regions—the re-contextualisation of singulars that face inwards towards singulars and outwards towards fields of practice—were a response to new market conditions on behalf of education institutions and therefore a challenge to the sacredness of subjects. This regionalisation was characterised, in part, by broad ‘generic’ (or pedagogic) modes that appear to either come into conflict with or are at variance with the ‘singulars’ (or subjects) that give rise to a sense of purity and sacredness. In a lecture in 1988 he observed that: [3]

We are witnessing ... a movement which started much earlier in the USA towards the *regionalisation* of knowledge: a good indicator of its technological orientation. We can see this ... as a weakening of the strength of classification of discourses, and with this ... the formation of less specialised professional identities whose practices are technological (Bernstein, 1990, p. 156).

Much of the current debate around the educational value and purpose of ICT can be set within Bernstein’s (2000) framework where the ‘singulars’ (or subjects) appear to come into conflict with the ‘generic’ (or pedagogic) modes that, he claims, have a tendency to functionalise education. This interpretation has led to a ‘cultures in tension’ explanation for the resistance of accepted subject sub-cultures to the incorporation of ICT into their curricular and pedagogic processes. These conflicting rationales have led to a number of explanations including subject resistance (Finlayson & Perry, 1995), techno-phobia (Selwyn *et al.*, 2001) and ‘technological colonisation’ (Goodson & Mangen, 1995, p. 626). At the core of this [4] ‘cultures in tension’, the idea that the particular discourses that have dominated the educational landscape for more than a century and a half have been thrown into sharp relief by the rise of digital technologies.

These dominant discourses cohere around the relationship between liberalism and functionalism. Put simply, the former sees education as being part of the need to develop the individual while the latter views the purpose of education as being to serve the economy through the production of human capital. In this sense, ICT is embedded within a functional (or profane) discourse where the education of the ‘whole person’ is derogated and appears value-less rather than value-laden. In consequence, the teaching of ICT is therefore perceived as a subject or process that eschews responsibility for making value contexts explicit. Such a representation, as Barnett (1994, p. 62), puts it, is: [5]

... an arrangement by which responsibility for practical capability rested with technology and for critical awareness with subjects such as social studies, history or religious education, that is, where values had been driven into exile from out of technology, would be undesirable. This would tend to confirm technology as a ghetto for ingenious tinkerers, and the humanities as the natural home for anti-technologists.

As a result, ICT has been variously cast as a functionalist discourse where the gaining of ICT skills and competences has been seen as dominating the curriculum. Indeed, as Watson (2001) pointed out, not only are the vocational aspects dominant,

they are also narrowly technocentric. However, recent National Curriculum pronouncements have tried to create a rapprochement between subject areas and new technology (Department for Education and Employment [DfEE], 2000). Teachers and students are now being exhorted to use ICT tools and information sources to support their work in subjects—giving ICT tools new pedagogical purpose (Ofsted, 2001). Reconciling the two has proved problematic, however. The core of the problem resides in the basic units of organisation around which secondary school curricula are built. The dominance of the subject department combined with the rapid socialisation into a subject sub-culture (Lacey, 1977; Goodson & Marsh, 1998) have created a set of lens through which national and school policy are filtered.

The centrality of subject-culture and its relationship to the classroom uses of ICT also conforms to other themes in the literature on ICT use. Andrews (2000, p. 26), for instance, claims that the ‘humanities based, liberal and book-dominated culture of English ... is undoubtedly a factor in the resistance of English teachers to new technologies’. John and La Velle (2004) similarly point out that the more overtly empirical disciplines such as mathematics and science have a greater affinity with technology while the humanities and music are more sceptical. Loveless and Ellis (2001) also highlight the importance of subject epistemologies and related pedagogical beliefs and their effects on technological integration. Much of this is related to the different contexts that frame subject content within schools. In her description of context, Lave (1988) makes the useful distinction between arenas and settings. She defines arenas as the larger institutions which have features that can both constrain and enable certain activities; setting, on the other hand, is the individually constructed and represented version of that arena. These definitions correspond to Bernstein’s (2000) metaphor of the ‘coin with two faces’ with the inner or sacred face looking to the subject and individual identity; and the outer or profane face looking towards the ‘external linkage and internal power struggles’ (Bernstein, 2009, p. 54) in various organisational arenas. The construct of setting [6] can also help us understand why individuals can experience the same arena differently and why subject culture is still open to individualised interpretation.

The shared perspectives—both tacit and explicit—that emerge from socialisation and acculturation into these subject settings have been described as subject sub-culture (Ball, 1981; Ball & Lacey, 1984; Goodson & Marsh, 1998). The disciplinary socialisation of prospective teachers contributes much to the creation of these sub-cultures even where the parent discipline exerts an invisible presence. The variety of perspectives within these sub-cultures also comes in part from the degree of theoretical consensus that operates within a discipline as well as reflecting differing histories and epistemologies. School subject sub-cultures differ from each other in other ways: there is divergence in terms of sequentiality and status as well as in terms of scope and coherence (Grossman & Stodolsky, 1999). Furthermore, subjects also seem to influence the pedagogy that is framed within them; and as Shulman (1988; 1997) has shown, the two interact continuously, bringing various traditions and contexts to bear on the way subject matter is represented in [7]

classrooms. Similarly, different kinds of personalities may be attracted to different subject matters; a process that may link personal beliefs, values and orientations to shared proclivities.

In terms of ICT deployment and use, subject sub-cultures have been seen by researchers as a barrier both to effective integration and transformation of practice. In a study of subject sub-culture, teaching style and levels of integration of ICT, Goodson and Mangen (1995) found that teachers were reluctant users of technology when the technology was at odds with the norms of the antecedent sub-culture. The authors also highlighted the tension between technology favouring subjects and those whose teachers felt their core values were fundamentally at variance with ICT. The latter feared colonisation and the replacement of academic learning with the technological; in such cases the computer was tolerated and co-opted becoming another tool amongst many. Selwyn (1999), in his study of the influence of subject cultures on differentiated computer use, found that both students and teachers constructed their 'computer identities' in terms of their subject courses and that these identities were shaped by a variety of personal predilections. He explained how, when faced with a perceived threat to the norms and traditions of their subject, teachers retreat into their subject sub-culture. He also highlighted the finding that the practices, content and pedagogical paradigms of some subjects had higher levels of congruence with ICT than others, in particular, mathematics, science and technology. 8

Selwyn (1999) explains this process using Lave and Wenger's (1991) and Wenger's (1990) notion of cultural transparency. He argues that for ICT to be used successfully in a subject area its significance as a learning tool must be highly visible, while at the same time its role as a mediating technology supporting the visibility of the subject matter must render it invisible. The balance between the two therefore becomes crucial if ICT is to play a significant role in both developing and transforming subject pedagogy and learning. However, Selwyn (1999) found that in ICT-resistant subject communities the role of transparency is reversed. Then, computers become highly visible as mediating technologies (often getting in the way of learning) and highly invisible as learning tools (either hidden away or given limited prominence) within the subject arena. Other studies (Bishop, 1998; Ruthven *et al.*, 2004) claim that school subjects, their pedagogical discourses and related practices shape ICT use, making it visible and giving force to learning. They also highlight the importance of pupil agency in this learning process.

The investigation reported in this paper focuses on the extent to which subject teachers and their various epistemic communities negotiate the relationship between ICT and learning in their various subject settings. Using Bernstein's (1996; 2001) conception of the sacred and the profane, the investigation explores the ways in which both convergence and divergence of ICT use develops within school subject cultures and how this relates to the issue of teacher identity. The primary unit of analysis in the exploration of this process is each teacher's perceptions of the classroom uses of new technologies and their perceived impact on learning. 9

Research design

Sample and data collection

The participants were 37 secondary school subject teachers who had been involved with the InterActive project (note in editorial) at various levels for four years. All had been working in Subject Design Teams (SDTs) to create Subject Design Initiatives (SDIs) (see note in editorial). The teachers were interviewed as part of the final evaluation of the InterActive project and were drawn from across the disciplines. Although the sample was not categorised specifically by age and experience all participants had between 3 and 17 years' experience of classroom teaching. Those being interviewed included: mathematics (n=9), science (n=7), English (n=8), Modern Foreign Languages (n=6), music (n=4), and geography (n=3). All taught across key stages three and four. 10

The participants were interviewed after the conclusion of the SDIs and were questioned about their involvement in the project. The questions included descriptive, process and evaluative types, the purpose being to ascertain the teachers' perceptions of the relative successes, problems, and challenges of working within the project. The interviews were semi-structured and lasted between 1 hour and 1 hour 45 minutes. Each interview was audio-taped and then transcribed for analysis.

Analysis

In order to create category codes for the data sets, Strauss and Corbin's (1990) constant comparative method was used. The analysis was therefore defined by a set of connected stages. In *stage one* the transcripts were read a number of times in order to identify strong themes and the relationships between them. In *stage two* the emerging themes were turned into succinct category codes. The corpus of interview data was then subjected to a thematic analysis based on these categories. The categories were also given strong supporting descriptions in order to improve the reliability of the coding process. Each category was described in detail thus forming the basis to the coding scheme.

At *stage three* the transcripts were read and re-read in order to create 'sentence units' using the category descriptions; the 'sentence units' were shaped using both single word or term labels, for instance, practice, teaching, learning, teaching style, subject, content, subject matter, etc, and short category implying phrases, for example, 'focus more on the process of teaching and on the process of learning'. A total of 1850 parsed sentence units were identified.

At *stage four* the initial coding was then checked for reliability by two independent 'experts' to adjudicate using 10% of the transcripts. High inter-coder reliability coefficients of 0.72 and 0.89 were obtained using the Scott formula (Ober *et al.*, 1971). The first level analysis sought to reduce the regularity of the 'sentence units' to percentages of the total within the six category framework. The second level proceeded to use the category labels to highlight the percentage of regularity of

comment according to subject area. The ‘sentence units’ formed the basis to a more fine-grained qualitative exemplar based account of the data.

Results

Content and pedagogy

Two prominent categories in the data referred to the ways in which the subject-specific pedagogy related to the use of ICT. Many of the respondents raised the issue of the relationship between what they regarded as ‘subject pedagogy’ and the underlying assumptions of ICT. Although suspicious at first about the ‘techno’ agenda the majority of the interviewees admitted that over time the distinction between their teaching styles and the use of ICT tended to diminish; and that by the end of their involvement with the InterActive project they had begun to notice fewer differences between how they taught, the subject content and the use of the technology. Comments included:

The overlap with what might be termed ‘traditional’ language work is excellent and it just offers other ways of approaching the subject that are genuine means of teaching and more importantly they don’t interfere with how I teach, they seem to work with it. (Modern Foreign Languages: MFL 6)

The art of it is choosing the moment and then seeing the opportunities to develop the ideas in a new style of teaching that blends with my usual practice and the topics that I’m working on in Geography. (Geography: GEO 3)

So they (the students) seemed to see the connections more clearly because of hyperlinks. This makes the teaching more powerful because the properties of the technology reinforce a way of teaching we use. It also helps to consolidate the subject learning through the teaching—that’s why I tend not to notice any difference now between what the computer can do and what I do. (English: ENG 7)

These comments reflect a wide range of responses that indicate the ways in which extended use under supportive conditions helps to blend ICT with subject-specific pedagogy. According to the interview responses, this blending works in a number of different ways: in one sense it acts as a lever helping teachers make their recognisable practice more effective; in another it acts as a fulcrum by facilitating degrees of re-orientation—and possible transformation—within that practice (Kerr, 1991; Ruthven *et al.*, 2003). However, of importance was the fact that for the pedagogy to blend and for the ICT to have any learning effect then the subject content had to have resonance with the technology, while the pedagogy used must be seen to ‘fit’ with the learning outcomes (both tacit and explicit) designated by the teacher.

It also became clear that many of the physical barriers to ICT use needed to be overcome before the blend could be operationalised. These barriers included:

- the inflexibility of the curriculum;
- the ‘out-dated’ structure of many schemes of work;
- the ‘stiff’ and ‘pencil and paper’ driven assessment structures;

- the lack of ‘laptops’;
- the ‘unfriendliness’, ‘cold’ ‘techie’ ‘awkward’ ‘neutral’ computer labs;
- the lack of appropriate and regular ‘on tap’ technical support.

Prominent among these was the dislike of the ‘computer room’ where many felt that the subject became de-contextualised and where the teaching and learning styles became dictated by the location. For many, the computer room represented the vocational curriculum made manifest; it was seen as the place where highly prescribed activities are introduced and practised in routine situations. These more esoteric concerns were matched by more direct professional challenges. The ‘technologised’ room, many feared, might lead to an instant loss of face if competence and confidence were perceived to be low. In English, Geography and Modern Foreign Languages the use of laptops seemed to offer the potential for greater permeability between the perceived functional discourse underlying ICT and the more liberal humanistic discourse underpinning their subject. However, it was felt that this permeability would only continue if schools, policy-makers and professional development providers recognised the validity of both discourses and began to resource schools accordingly (Watson, 2001). As one teacher put it:

This ‘computer room’ is more than room for the machines, it is about technology and about preparing kids for work. I hate it—it’s so cold and unfriendly, it represents the geeky side of computers and it can be frightening. (Geography: GEO3)

Schools have got to get their heads around this idea of teaching and stop buying kit all the time. They always seem to have new computer rooms and I just don’t buy this ICT as a subject stuff ... reeks of the factory and factory fodder ... I’m about making children think through maths. (Maths: MA4)

I have really benefited from using the new simulations and so have the kids—they have really engaged with it and I think their learning has come on in leaps and bounds—but we must make sure that schools and heads don’t think this is a simple and cheap answer—we need lab resources desperately and books and equipment not more computer rooms which tend to limit teaching. These are not opposites they should really be part of the same process—education, I think it’s called. (Science: SCI 8)

Throughout the data the teachers alluded to the changes that were taking place in their practice. Much of this can be understood by reference to the constructivist-associationist continuum. On the one hand, the technology appeared to move them towards more learner-centred approaches, allowing them to focus more on the student rather than ‘getting bogged down with telling’ (Geography: GEO 4). Comments included:

When I let them use the menus they seemed more able to work independently and I could focus more on them—supporting, prompting and generally helping them to think about their sentence constructions and their grammar. (Modern Foreign Languages: MFL3)

Yes ... I think things did change and I did begin to change even though the content we have to get through meant I was worried but they ... I know this sounds stupid but they forced me to leave them alone. (Science: SCI 2)

On the other hand, the prevalence of interactive whiteboards (IWBs) seemed to make the teachers more didactic. Many commented on the power of the tool to improve their ‘whole class teaching’ and helped make their presentations ‘more interesting’, ‘sharper’, ‘more gripping’, and ‘better illustrated’. These comments are in line with the findings from a recent review of the literature concerning interactive white boards (Smith *et al.*, 2005) where the perceived benefits included more purposeful interaction and participation in classrooms, increased efficiency and improved presentation through the use of multi-modal and multi-media affordances. In many ways the use of IWBs encouraged the teachers in the sample to return to the ‘teacher space’ at the front of the class although this did not elicit any negative comments. In fact, most did not see any tension between the didactic-heuristic approaches that technology could engender and for some IWBs offered an adaptive solution to the problem of interacting effectively with groups of students where without timely interventions they might develop more ‘idiosyncratic knowings’ (Godwin & Sutherland, 2004, p. 150). This may be a reflection of the essential pragmatism that lies at the heart of teaching or it may be indicative of the ways in which the affordances and constraints of the technology are being blended into accepted patterns of teaching.

Congruence and learning

Selwyn (1999), Counsell (2003) and Ruthven *et al.* (2004) all point to the need for high levels of congruence between the technology and the subject if ICT use is to become more widespread and effective in schools. However, a more fine-grained distinction emerged within the analysis. A number of interviewees highlighted the importance of what might be termed the ‘pedagogic dependent ICT resource’. This implies that the learning focus is dependent on the nature of the ICT resource and its affordances—both real and perceived. This relates to Counsell’s (2004) idea of type A and type B resource. Here an ICT resource of the type A variety means that the learning focus is intrinsic to the ICT use; in other words, the technology enhances the learning in ways that would not be possible without it. A type B resource, on the other hand, has a lower convergence with the learning activity and is more of an added extra. In the data, the higher the convergence of the ICT resource with the subject focus and the planned learning outcomes, the more likely it was that extended use would occur. Furthermore, it was here that new technologies appear to have most transformative potential by helping learners acquire new knowledge and understanding, deploy critical thinking skills and develop new forms of creativity (Noss & Pachler, 1999). The following comments are offered in support of the distinction: 12

The focus on the data in the second SDI and the way it was integrated more fully when I was planning the lessons helped them to develop supported conclusions about their area and they had better in depth conclusions and better evaluations than previously. It was like a jigsaw fitting together. (English: ENG 6)

Their learning seemed to be more genuine the second time around and it made me realise that I was making proper use of ICT—but it was all in planning really. The

schemes of work were flexible enough and I was able to see how the digital cameras and Excel could fit with my aims and objectives for the lessons and the fieldwork. (Geography: GEO 1)

It's easy to just plonk them in front of a screen or just get them to do things with Word – drop downs, word searches—you know that sort of stuff—but to really get them thinking about using drop downs to improve their vocab and their thinking in French means you have to plan it carefully so it links with your aims and with how you work with the kids.

(Modern Foreign Languages: MFL2)

What using ICT did do was help me focus more on the process of teaching and on the process of learning than I would usually have done. I suppose it was because it forced me to think about how I teach and the mental awareness that came along with it was the most beneficial factor. I also began to realise that my teaching style was changing—bit by bit—and that the software—the Sketchpad—was just ... part of the furniture. (Maths: MA 8)

We used PowerPoint for a lot of our SDI and e-mail and the web—you know for resources and images—but when you put them together you realise that you couldn't do the multi-modal stuff without the technology. It's the technology that allows you to teach—that's been an eye-opener. (English: ENG 5)

Three years ago I couldn't compare regions—we I could but it was slow—but now we can get instant comparisons and analyses from outside the UK as well, that means the field work is changing the whole geography thing is changing—ICT is—I know this might sound daft—but it's kind of changing the subject and me along with it. (Geography: GEO2)

Throughout the interviews respondents highlighted the need to maintain the primacy of learning goals within their teaching. Some concern was expressed in an earlier study (e.g. John & La Velle, 2005) that new technologies were so powerful and pervasive in youth culture that they feared their subjects might end up being re-shaped and re-directed by the deterministic elements of ICT. This concern that the 'medium will become the message' or at the very least influence its content was also prevalent in the current interviews—although at a less concerning level. In science, however, there were anxieties that the use of simulations might challenge the intentionality of the teacher. Many commented on the nature of the interfaces which they believed were designed to 'spark interest', and 'engage the students' but really belonged to the genre of 'gaming'. As a result they felt that students might miss the deeper subject significances preferring to see the simulation as an 'end in itself'. Comments included:

We used simulations in science but to be honest I can't say whether doing it the traditional way or using the ICT was any better—in fact I think they actually distracted the kids from doing the science in some ways. They seemed to go straight into play mode—they looked like games and they saw them like them. (Science: SCI 6)

The movements you get with a simulation—with a graphical simulation—are much clearer and better at explaining any concepts as they come up. But you have to build it in ... if you're using a model you have to build in extra information to clarify students' understanding. Because they don't take things further—they see it from two points of

view. Sometimes as a game because they are set up like that and marketed. (Science: SCI 3)

Using Word or Excel or other packages just speeds up things for me—they are helpful but I'm not sure they add anything to the learning. While Crocodile Clips and Savannah can actually result in deeper subject learning—if we use them properly. It's what they can offer that's important for me so we mustn't let popular culture dictate the way they are designed or science will become another game. (Science: SCI 9)

However, the Modern Foreign Languages and English teachers felt that the recognisability of the interfaces combined with their functionality seemed to free teachers and students from making a distinction between the technology and the subject. It is important to qualify these comments with the fact that these teachers tended to use generic software rather than subject specific applications that were more prevalent in science and mathematics. Some declared that:

So it can be the same with vocab and you can target key grammatical concepts as well. So the overlap with what might be termed 'traditional' language work is excellent and it just offers another way of approaching the subject that is genuine. Some were even beginning to think about audience and how a different language and a style had to be adopted. The beauty of technology is that they can do this from within the draft—seeing the potential and seeing it change as they save it. (Modern Foreign Languages: MFL 6)

Using the re-drafting process allowed them to see that working with the technology was actually the key—it was a way of helping them see that what they were doing and learning was not separate from the technology—in fact they couldn't re-draft and save and see the gradual change without the menus. (Modern Foreign Languages: MFL 4)

We thought that using hypertext might be a good way for linking poems and concepts together ... I hope they can now see the links between texts more clearly because there was a physical link by clicking on a bit of text and taking you to an analysis of it. Or click on the text, and it takes you to something that was similar in another text. So they seemed to see the connections more clearly because of hyper-links. This makes the teaching more powerful because the properties of the technology reinforce a way of teaching we use. (English: ENG 7)

There was also evidence that some teachers were beginning to see new technologies as tools that could enable new forms of subject learning as well as loosening the constraints that often hindered deeper subject engagement and understanding. In a sense they were alluding to the ways in which key relationships and structures within subject domains could be made more visible and the ways in which ICT facilitated that process (Noss & Hoyles, 1996). They also commented that if learning goals were compromised then ICT use became inhibited. In these instances, viewing technology as a mediating tool (Wertsch, 1998) appeared to emphasise its invisibility thus allowing subject learning to develop with limited technological obstacles. In this sense, the technology appeared to be integrated less problematically with the activities. However, some still expressed concern that too often software and hardware 'got in the way' and that it 'obstructed' or 'limited what kids should learn' as defined by the teacher. This bundle of issues tended to relate in the main to the students' need to 'tinker' with the technology and to 'go off

task' too easily. This was most cogently expressed by one English teacher who felt that:

... they are always bloody fiddling and it irritates me because it gets in the way of learning. They are bloody obsessed with layout—it's underline in red and do the headings in 'neat' problem we had with exercise books but it's on a larger scale because of all the possibilities for fiddling. I really stress that layout and presentation are secondary to content but most are just obsessed. (English: ENG 1)

This reference to what Triggs and Matthewman (2003, p.125) call 'obsessive compulsive font disorder' reflects Wenger's (1990) concept of cultural transparency and the ways in which the artefact can get in the way of understanding and learning because of the power of some of its more visible affordances. However, the levels of concern were relatively low which implies that during the course of the InterActive project there appeared to be a greater synergy emerging between the transparency and opacity of the technology thus improving its ability to facilitate subject matter learning. This increase in synergy may be related to the extended and supportive frameworks that resulted from the structure of the InterActive project (see note in editorial). 13

Throughout the data, learning goals therefore remained a priority but these were derived predominantly from the teachers' professional knowledge; ICT only appeared to influence this process when there was explicit encouragement from the researchers working alongside the teachers (see note in editorial). This suggests 14 that the provenance of learning goals remained within conventional pedagogies and curriculum patterns. In some ways this was a reflection of the constraining influence of the curriculum and its associated assessment structures but it was also a part of a broader set of influences. These relate to the fear of technological capture (John & Hoyle, 2005) where the use of new technology raises the spectre (for some teachers) of standardised, mass-produced lesson structures which can be tailored to specific locations and apparent learning needs with little or no professional input. This is, in part, a reflection of Bernstein's (1996) concern about 'generic' pedagogic modes and the associated de-professionalisation that might accrue from it. In this sense subject knowledge, subject-culture and subject pedagogy—the sacred elements—still form a significant part of teachers' professional identity and can be highly resistant to change.

A number of non-technological issues also emerged within the data that hindered the more extended use of ICT in the various subject areas. These included:

- the impact of assessment regimes;
- the constraints of timetabled access to technology;
- the tension between teacher control and pupil ownership of activities and learning;
- the need for pen and paper to provide evidence of learning or records for subsequent;
- revision and reference—best characterised by the exercise book;
- the demand for a deeper understanding of exactly what involvement with technology appears to be contributing to learning;

- the problematic nature of the subject boundaries;
- the challenge of integrating ICT with the recommended procedures relating to the various National Strategies for literacy and numeracy.

These hindrances did not mean that all of the integration that emerged within the project was simply adaptive in character; in fact there were many instances of a genuine accommodation taking place where subject and pedagogical imperatives were negotiated and where ICT was actually challenging as well as enhancing existing practices. Much of this was serendipitous, however, and resulted from students and teachers ‘playing’ with the technology; it also meant that in some classrooms the traditional sense of order had to be allowed to dissipate so that ‘organised chaos’ could ensue. It was under these conditions that many teachers began to watch students finding new ways to learn as well as helping them experiment with the affordances offered by the technology. For instance:

The biggest plus was that I got to play with Dance-Ejay ... I was one of them and the more I looked the more I learned. In fact the barriers seem to come down and I was one of them. (Music: MUS 1)

At first I was concerned about the noise and the lack of structure ... I was afraid a colleague might knock on the door and ask for quiet but they were really getting into it and I let them go—some were really going for it and moving around. It looked like chaos but there was learning going on I’m sure. (English: ENG 7)

Competence and confidence

According to Zhao and Cziko (2001), the key to understanding the barriers to the use and integration of ICT into classroom teaching lies with the issue of perceptual control. They claim that when weighing up the relative merits of technological use within subject areas teachers tend to home in on the issues of confidence, competence and control. They argue that three conditions are necessary for teachers to use technology effectively: they must have confidence that the use of the technology will meet existing and higher level learning goals; they must have the competence and sufficient ability to use the technology effectively; and that using the technology will not disturb the perceived equilibrium of the classroom and will not compromise learning goals. Having control over the learning outcomes and the direction of the lesson appeared to be important as was the ability to give direction to the lesson.

The surrendering of the control principle or the ‘ceding of expertise’ was highlighted by John and La Velle (2005) as a significant factor in limiting the formal and informal uses of ICT in subject teaching. The analysis of the current data sets indicated that the issue had diminished significantly with many teachers allowing new forms of planning and engagement with the technology in the lessons. It can be conjectured that some of this engagement can be put down to extended and supported use but there was also evidence that teachers were beginning to accept that ceding control to the students could produce positive outcomes—even if sometimes it was difficult to come to terms with the process. Allowing some ‘chaos’ to develop appeared to offer the teachers opportunities they had not foreseen. This

encouraged them to go off plan and allow situations to develop serendipitously. The extension of this to learning with ICT was a welcome feature and highlighted the trade-off that teachers were willing to make even if potential disturbance to fixed learning objectives and behaviour ensued. For instance:

I just let them go—it was difficult at first but they were getting going and I didn't want to stop them they were even going ... some anyway ... way off task but I thought ... look let them at it. They know what they're doing even if it looked a little chaotic. (Modern Foreign Languages: MFL7)

The only way I can describe it without feeling I'm making excuses ... because we're all afraid of not being in control of our classes, it's our worst fear isn't it ... but they were genuinely enjoying it and they were searching and thinking and arguing about what they were finding on the net—that's good isn't it? (Maths: MA3)

However, a number of concerns were also apparent. The first relates to the level of technical support needed to ensure that the improved levels of competence and confidence—both in terms of hardware and software—can continue. Too often, technical support in schools was variable and its deployment was dependent on staffing levels which were universally regarded as inadequate. The second is linked to concerns about the need for continuous multi-faceted support beyond the duration of any professional development programme. Here the interviewees requested that information about new software, ideas about classroom uses, forums for discussion and research evidence be made available beyond the life of any project or course. They also wanted more time to explore new technologies in private and be given time to 'play' and 'experiment' with new applications. They all also hoped that this form of exploration could be built into a specific school community where expertise could be gathered, shared and communicated.

Discussion

To return to the Bernstein's (1996) framework, the findings show that the extended and supported use of ICT in subject settings can bring about a greater convergence of the sacred and profane elements of teachers' identity. Furthermore, the evidence highlights the fact that some of the conventional constraints that underpin traditional classroom practices were being challenged and re-framed. This process of co-existence involved not only greater incorporation but also higher levels of accommodation which resulted, in some instances, in a perceived new rapprochement between ICT and subject pedagogy. The analysis also emphasised high levels of creative appropriation that showed (as Bernstein did) that the authentic inner self as expressed in the subject could co-exist with a finely honed capacity to adapt as long as this did not compromise the legitimacy of subject teachers as guardians of intrinsic educational values. The iterative nature of this process also highlighted the importance of perception change where teachers chose ICT applications, activities and approaches that were aligned with their own pedagogical perspectives. This then afforded them what Wood (1999, p. 2) terms 'psychological access'. It is here that the internal referentiality of a range of personal theories and beliefs became bound

up with external conditions that led, through guided participation (Lave & Wenger, 1990), to changed practice.

Many of the changes in practice, however, remained at the level of adaptation where new ideas and technologies were taken on board as long as higher order intentions—learning and subject based goals—were not over compromised. In this sense, high levels of consonance with existing subject sub-cultures were sought and approaches that could lead to dissonance were limited. This conception was represented in the interviews at varying levels of intensity. Examples of perceived transformation of practice, on the other hand, were limited. Where they did occur there was a significant move away from the use of a single context of learning—a process which implied an adherence to a linear, ends-means, approach to planning, teaching and learning—towards a more ‘multi-context’ approach. This involved seeing knowledge creation as demanding higher order thinking skills and analysis that could only be achieved through the creative use of ICT. It also meant seeing the barriers between personal, home and school uses as essentially permeable. At this point the technology as a learning tool became more visible but its role as a mediating technology less so. It also meant allowing ‘organised chaos’ to become a more integral part of classroom process.

Despite not being the primary focus of the thematic analysis, the data revealed a number of technological issues that: (a) interfered with perceived subject learning and (b) emphasised inter-subject variation. The scientists, in particular, were concerned that the interfaces used in simulations were too analogous to those used in commercial gaming. Whilst recognising the importance of familiarity among mediums or families of technological tools, they felt that it was important to tease out the ways in which particular pieces of software appear to imagine the user and whether this confused learning within science. There was also concern, particularly among the English and Geography teachers, that the productive capacity of ICT and its ability to speed up conventional approaches to knowledge gathering may also limit the deep subject engagement that is necessary for productive learning. This was noticeable in English where some concern was expressed about the need for slower, more reflective patterns of subject engagement so that the literary imagination would not be sacrificed.

In mathematics—a subject with a traditional close affiliation to new technologies—most teachers were comfortable with the deployment and use of ICT; however, some doubts were expressed about the potential loss of basic mathematical skills and thinking processes. In music, on the other hand, the teachers were more positive about the potential of new technologies to challenge both the performance and compositional base of the subject. For some, ICT amounted to a ‘democratising tool’ in that it allowed children with little traditional cultural capital in music to express their musicality with devices that connected to their own particular experiences. Finally, in Modern Foreign Languages there was the feeling that the generic software mirrored many of the needs of the subject and enhanced its semantic and syntactic features, although its limitations in terms of oral work were recognised.

The need for ‘information discernment’ (La Velle *et al.*, 2004) was also highlighted in the interviews, as were ongoing concerns about ‘attention deficit’ where many felt that the sheer speed of the technology and its constant interactivity might conspire to derogate what many called the ‘traditional’ skills of listening, watching, thinking and considering. Where this deficit appeared to be dominating subject learning, many teachers intervened to limit what they regarded as the ‘distracting aspects of ICT’ (Science: SCI 2). It was during this process of mediation that many of the teachers were able to blend their pedagogy with the recognisable affordances offered by the technology in order to re-direct attention onto the subject and its complexities. These findings are similar to those of Ruthven *et al.* (2004) who discovered that encouraging pupil reflection and criticality allowed the technology to play a greater mediating role in learning. They also noted that markedly contrasting subject profiles within the curriculum reflected corresponding differences in wider subject sub-cultures, in particular, the pedagogical discourses and practices that shape teachers’ representations of ICT use (Ruthven *et al.*, 2004). There was also evidence in the current study that teachers were becoming more aware of their own implicit theories about their subjects and the underlying pedagogy. In part, ICT encouraged this process of critical reflection and seemed to give a nudge to more challenging approaches to practice beyond the technology.

Crucially, the prominence of learning goals and the desire to maintain these underlying structures in the face of technological intrusion was a key feature. Ruthven *et al.* (2004) suggest that this implies a support role for ICT and the inevitability of assimilation process rather than accommodation and even transformation. The inference drawn from this study is that the maintenance of underlying learning goals is not necessarily limiting but instead facilitates the blending of technology in a way that might eventually lead to greater transformation. Furthermore, it highlights the evolutionary and the exploratory aspects of the interaction between subjects and ICT where teachers maintain their professional control over the technology using their ‘pedagogic pragmatism’ (Moore, 2003; John & Hoyle, 2005) to decide when there is genuine resonance with subject philosophies. This idea of ‘continuous evolution’ is in contrast to the ‘discontinuous processes’ often put forward by many ICT advocates. Taking my cue from evolutionary theory (Dawkins, 1998; 2003), I would argue that the emphasis 15 on more radical or discontinuous transformations of learning through ICT, where teachers are encouraged to put technology and innovation before their pedagogy (Watson, 2001), might result in poor long term integration. Instead, a continuous approach is advocated where technology and pedagogy evolve in a more seamless way.

The findings therefore support what Watson (2001) terms a gradual shift in ICT thinking towards a ‘pedagogic cultural agenda’ where subject philosophies, pedagogical content knowledge and reflection are regarded as central characteristics. If this agenda is to materialise then schools and subjects need time to adjust to using ICT, to explore its possibilities and to engage with its affordances as well as understanding its constraints. The teachers in this study were in many ways

privileged in that they were given time and support, however, for that ‘community of practice’ (or the crucial parts of it) to be replicated there needs to be an investment in time and resources within schools (Triggs & John, 2004). Additionally, certain conditions need to be prevalent if the further blending of technology and pedagogy within subjects is to flourish. These conditions are dependent on a number of characteristics, all of which, according to Eraut (2000), are regarded as fundamental to the creation of a suitable organisational micro-climate. They include: 16

- a blame free culture;
- learning from experiences—positive and negative—at both group and individual levels;
- trying to make full use of the various knowledge resources held by members;
- encouraging talk about learning;
- locating and using relevant knowledge from outside the group;
- enhancing and extending understandings and capabilities of both the group as a whole and its individual members.

Conclusion

It was clear from the findings that the structuring of the relations between subject sub-cultures and ICT are as much about the relationship between the categories as they are about any intrinsic properties embedded within them. The key to understanding that relationship, as Bernstein (1990) points out, lies in the levels of insulation between the categories, how the boundaries between them might be crossed, and what sorts of transactions might take place. He was concerned (as were the teachers in this study) with the levels of encroachment which might lead to an emptying of the subject of its sacred elements. However, as the study shows, the evolutionary relationship engendered by participation in the InterActive project (see note in editorial) allowed a blending to emerge where teachers maintained their professional control over the technology using their pragmatic professionalism. 17

Of central importance, however, were the ways in which the crucial ‘borderlands’ between the subject and ICT became transaction spaces or what Galison (1997) terms ‘trading zones’ where exchanges and intense collaborations took place. In Galison’s (1997) book, *Image and logic: the micro-cultures of physics*, we are able to watch the fascinating trading that takes place between the various sub-cultures of physics (theoreticians, experimentalists and engineers) and how the various traditions underpinning the sub-cultures remained intact inside the collaborations that went on among them. These collaborations produced two competing instrument cultures—image and logic—which ultimately joined. Taking his lead from anthropology, Galison (1997) observed how exchanges between sub-cultures can be compared to the incomplete and partial relations which are established when different tribes come together for trading purposes. Each tribe can bring things to the ‘trading space’ and take things away; even sacred objects can be offered up and exchanged. This trading process also gives rise to new contact languages which are locally understood and co-ordinated.

The metaphor of ‘trading zone’ highlights the transient, evolving and incomplete nature of the relationship between subject sub-cultures and ICT. It also puts to rest the incommensurability argument which is often used to justify the separation of the subject from the technology. It is also important to extend the metaphor further and suggest that the notion of ‘transaction spaces’ implies that a wide variety of exchanges can and do take place when ICT meets antecedent sub-cultures of schooling and that they have the resources to take something from each other that enriches both. However, as the data suggests, the success of the exchange depends on the value of what is presented, acted upon and understood. This also highlights the fact that ‘transaction spaces’ are evolutionary where the affordances and constraints of the situation, the tools, and the setting can facilitate further interaction as well as limit it. To occupy a ‘trading zone’ does not mean abandoning one’s ‘sacred’ disciplinary ‘home’ nor allowing the ‘profane’ to dominate the exchange; rather it respects subtle negotiation and accommodation (Wertsch, 2003; Claxton *et al.*, 2003) processes that encourage multiple and modified identities to emerge over time.

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