Sustainability and Evolution of ICT-Supported Classroom Practice

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Introduction

Is practitioners' integration of ICT use into subject teaching motivated by a concern to "tick the right boxes" or a belief that it promotes "genuine useful learning"? This study took place in a climate of significant government investment in ICT resources and an intensified focus on approaches to whole school improvement through embedding technology in teaching, learning and management. Research indicates that integrating ICT is a gradual, reflective process for most teachers and one that is influenced by a complex mix of factors. In particular, effective practice involves developing new forms of pedagogy. However, little is known about the influence of teachers who have already established ways of working with ICT in stimulating wider implementation of such practices within the context of their subject departments or schools. This project thus examined the evolution over time of ICT-supported classroom practice. It comprised a follow-up interview survey of 16 teachers, and 11 of their colleagues, in five English secondary schools. Three years earlier the 16 teachers had participated in a collaborative programme of 10 small-scale research projects in which they developed a range of technology-integrated pedagogical strategies (TiPS) within six curriculum areas: English, Classics, Geography, History, Science and Technology. Additionally, one project involved an after-school support group for pupils with English as an additional language. The present study investigated the mechanisms underlying development and dissemination of these practices over time and identified factors that supported or constrained these processes for both the project teachers and their colleagues.

Research context

Over recent years, unprecedented Government investment in ICT in schools has been directed at implementing infrastructure and connectivity. An exponential increase in provision of technology resources (including projection technology) has ensued. The focus of national policy has now shifted towards whole school improvement through utilisation of ICT resources (DfES, 2003). Findings of the ImpaCT2 study (Harrison *et al.*, 2002) pointed towards the potential yields from embedding ICT in learning, teaching and management, yet reports suggest that as few as 15% of all schools have integrated the use of ICT in these ways across the whole school (Day, 2004). Over 75% of teachers nationally have undertaken training programmes supported by the New Opportunities Fund (Preston, 2004), but the continuing importance of providing guidance on incorporating effective, subject-related pedagogy has been widely acknowledged (e.g. Cox *et al.*, 2003; Ofsted, 2001), and is now emphasised in the current ICT in Schools initiative (DfES, 2003). Our research offers insights into how successful forms of ICT use are being integrated effectively into existing subject practice. It also addresses a gap in the existing literature in this area. There are some examples of innovative use of ICT in technology-rich environments, particularly in USA, but less research concerning integration with established practice in mainstream schools. This project explored teachers' own perspectives and experiences of using ICT, across a range of curriculum subjects. The study is highly unusual in focusing on evolution of practices over a 3-year time period, and on dissemination of practices between colleagues.

Key literature in the field

This project builds on previous work in the area of integration of ICT use into subject teaching. That research takes an evolutionary perspective on the processes of cultural change. For example, Kerr's (1991) interviews and observations with American teachers indicated that incorporating technology into their practice allowed 'obvious and dramatic' changes in classroom organisation and management, yet changes in teachers' pedagogical thinking were slow and measured. Our own interview and observational studies with teachers in TiPS schools indicate that a gradual but perceptible process of *'pedagogical evolution'* appears to be taking place, involving both pupils and teachers developing new strategies and ways of thinking in response to new experiences and the lifting of existing constraints (Hennessy *et al.*, in press).

This line of research also highlights the many factors which may have an impact on teachers' motivation to implement, continue to develop, or to share innovative practice. Perceptions about the usefulness of ICT in aiding classroom work are influential (Cox *et al.*, 1999), and the belief that an innovation should offer 'added value' above and beyond existing practice (Hennessy *et al.*, in press), is central here. New approaches must also be compatible with existing pedagogy and be perceived as meeting a need. We might additionally expect sustainable and transferable innovations to be user-friendly, adaptable and applicable to other classroom contexts.

Many studies have pointed to the practical *constraints* operating within the working contexts in which teachers currently find themselves. Innovation and adaptation are costly in terms of time; developing effective pedagogy around ICT involves significant input in terms of planning, preparation and follow-up of lessons (Cox *et al.*, 2003). Other contextual factors which can act as barriers include: lack of confidence, experience, training, access to reliable technology resources (Dawes, 2001). Some writers distinguish between 'school level' and 'teacher level' barriers, with 'teacher level' factors such as pedagogical beliefs, technical skill and confidence viewed as particularly influential (Mumtaz, 2000). Another recent literature review focusing on barriers to using ICT highlighted the complex relationships between 'external' or 'first order' influences such as access to reliable technology, and 'internal' or 'second order' influences such as school culture, teacher beliefs and skills (BECTA, 2003a). Tearle's recent work (in this volume) confirms that availability of resources and whole school characteristics, culture and ethos are all highly influential. In the light of contemporary prominence of ICT within UK educational policy and the increase of resources within schools, we aimed to ascertain key *factors of influence* on development and dissemination of practice over time for the TiPS teachers and their colleagues. We also examined teachers' accounts for any impact of new technology generally, and projection technology in particular. Perceived advantages of the latter are numerous (e.g. BECTA, 2003b; Coghill, 2003) and it is striking that most of the teachers identified in our current analysis of 'expert' practitioners' strategies involving use of ICT in mathematics and science (ESRC-R000239823) had access to some form of projection technology in their teaching room.

Potential obstacles affect different individuals and groups of colleagues to varying degrees. Dawes (2001) describes how teachers develop professional expertise and the motivation to evolve from being 'potential users' (through the stages of 'participant', 'involved' and 'adept') to 'integral users' ultimately. The diverse group of teachers we originally studied were found to span this entire spectrum. At the time of the TiPS project, they shared a commitment to developing their practice in using ICT to support subject teaching. They also worked within a supportive organisational culture, as evidenced by the agreed agenda of

schools within their research partnership to focus on developing use of ICT. We were interested to see whether these apparently favourable conditions had facilitated the dissemination of promising pedagogic approaches; independent evidence about this from the relevant research coordinators was central here.

Finally, secondary teachers in the UK do not generally work alone; the subject department acts as a *'community of practice'* (Lave and Wenger, 1991), sharing resources, approaches, cultural values and aims, and collaboratively-developed schemes of work. Our previous work leads us to expect departments which work effectively together as teams to constitute robust communities of practice within which innovations involving ICT may be readily shared (Ruthven *et al.*, in press). However, research indicates that practice develops over time and this process is not automatically triggered by simply sharing information with colleagues (Loveless *et al.*, 2001). It entails developing ideas and trying them out, considering the principles and purposes that underpin activities in particular contexts, and critically reflecting on them. In this study we solicited the accounts of subject colleagues concerning their ways of working together in order to understand the mechanisms underlying development of existing and new pedagogical approaches to classroom use of ICT.

Research methodology and focus

The sample comprised three groups: 16 of the original TiPS project teacher-researchers, six of their nominated colleagues (the head of department or another colleague who had used the approach or materials) and the five representative research co-ordinators. Five of the teacher-researchers were interviewed individually; five further pairs/teams of teachers who had undertaken joint projects were interviewed together. Colleagues were asked to comment on take-up within or beyond the department. In addition, we aimed to gain a wider view of the impact of TiPS within each school through interviewing the research co-ordinators. They were asked to comment on whether, and how, any recent whole-school or departmental organisational changes and/or initiatives had affected the use of ICT generally, and the further development and dissemination of TiPS practices in particular. Note that the opportunity to follow up the original teachers arose through availability of further research funding rather than as part of a planned longitudinal study.

We devised and piloted three separate semi-structured interview schedules for teacher, colleague and research-coordinator interviews, with some overlap. Prompts were designed to elicit responses relating to our key research questions:

> Which practices are still in evidence after 3 years have lapsed, have they been further developed by the originator, and have they spread more widely?
>
> What were the motivational and organisational factors of influence? In particular, are the sustained practices considered to be particularly successful in terms of pupils' learning?
>
> Were there any obstacles to sustaining or disseminating practice and have they been overcome? Are any emerging organisational constraints school-based or departmental?

All interviews were recorded, transcribed and imported into a dedicated software package for qualitative analysis. Our coding framework centred around three main, but interconnected, *themes* identifying how far the ICT-based practices had been *sustained, developed* and *disseminated*, the mechanisms associated with these processes, and the supporting or constraining factors. Coding was restricted to classroom uses of ICT rather than administrative purposes. The cross-case analysis incorporated two distinct strands: (1)

sustainability and development of practice; (2) dissemination. Within each strand teacher data was compared with colleague and research-coordinator data.

Summary of main findings

Evolution of practice

It was striking that all of the participating teachers were found to have *sustained and further developed* the particular practices they had initiated 3 years previously (despite being unaware that a follow-up study would ensue), and to be using technology in other ways too. While they were clearly a motivated group originally, their practice was not necessarily well developed. Over time they have shifted towards being confident, 'integral' users (Dawes, 2001) of ICT, typically describing it as 'part and parcel of what we do'. However, development was a slow and evolutionary process, with considerable potential for further use remaining. *Mechanisms* through which evolution of practice over time had taken place included:

(a) *trialling* pedagogic strategies over time and refining them; dropping unsuccessful features; extending them to new topic areas; reflecting upon their success;

(b) feedback from colleagues, collaborative development and sharing of resources.

Trial and improvement of strategies over time is highlighted here; critical reflection upon their success helped the teachers' practice and thinking to move forward (Loveless *et al.,* 2001). Examples of evolving practices included increased direction and prescription relating to Internet research in Science, and introduction of electronic writing frames in English which allowed the teacher to exemplify effective writing practice and to comment unobtrusively on pupil work.

Dissemination of practice

Almost all of the teachers had disseminated their practice informally or formally within their own subject departments. Many colleagues had then 'taken their own paths' through adapting them in some way. A strong degree of departmental collegiality emerged: the development of ICT use was treated as a joint learning enterprise. By contrast, dissemination outside of departments was limited although available opportunities had been exploited. Teachers perceived further potential for dissemination, especially within departments. *Mechanisms* of dissemination included:

(a) 'institutionalisation' of ICT-supported practice or its *integration into departmental schemes of work* – sometimes reflecting shared ownership and generation of schemes, but effectively making practices compulsory; heads of department played a pivotal role here;

(b) *proactive colleague support* through the originator physically *sharing resources* and approaches, or offering *guidance, practical support and reassurance* – important in overcoming colleagues' fear or resistance. Support mechanisms included *electronic collation* of materials, *presentation at meetings, observing lessons,* and *training colleagues:* '...show them what the potential is ... this is how easy it can be, come and watch me teach this lesson'.

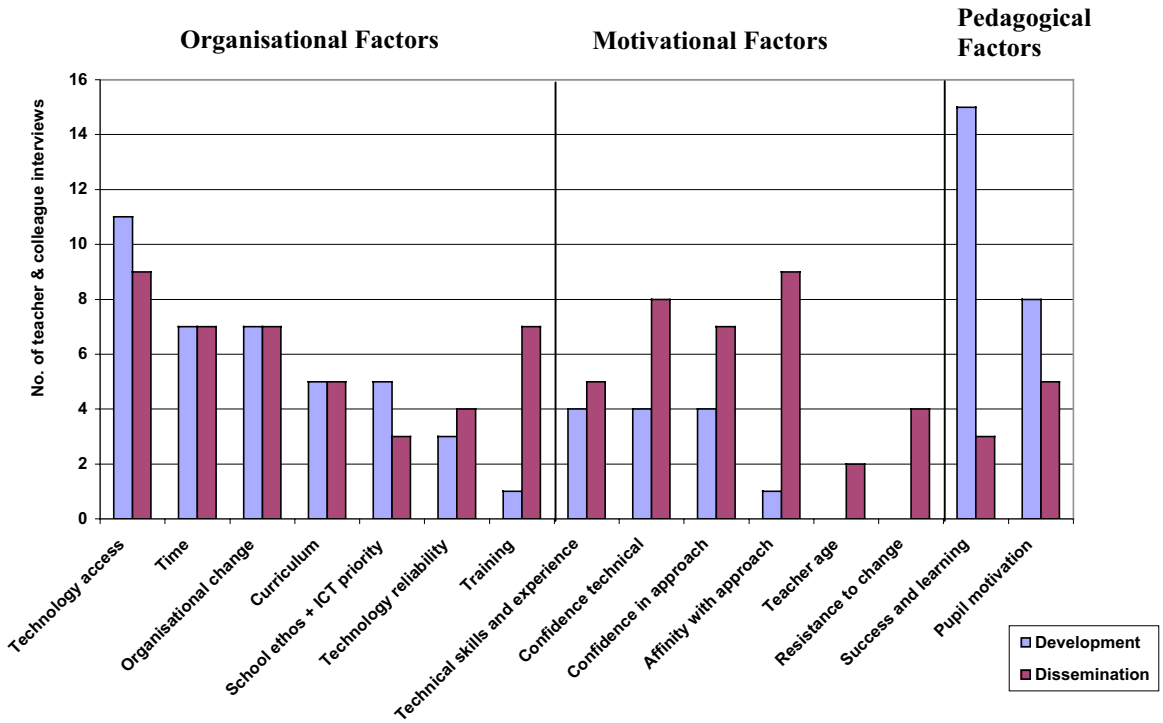
Factors of influence on development and dissemination of practice

Three broad groups of factors were identified (see Fig. 1) which variously influenced the processes of evolution over time and dissemination of practice for both the teachers and their colleagues:

(a) Organisational factors

Overall, extrinsic *organisational factors* or whole school characteristics were found to have the biggest motivating influence on both sustainability/development and dissemination of ICT-supported practice (mentioned in all 21 interviews conducted). *Access to technology* resources was the most frequently mentioned factor in this group. Here, teachers' comments highlighted the need for accessibility (ideally within their department) and flexibility of use over and above quantity of machines – which has recently risen dramatically. In particular, provision of interactive whiteboards and data projectors has impacted very positively on development of practice, enabling teachers to model processes using students' work, to work more collaboratively with the whole class and 'have a dialogue while you're working' rather than merely 'giving them instructions'. *Organisational change* since TiPS (particularly new school status, increasing resource levels and change in personnel) and *prioritisation of ICT* by the school were also perceived as having a significant impact on both development and dissemination. For example, in one school there was a 'mindset that ICT has a role to play'; in another very well-resourced school, it had become 'inherent and engrained' within the culture. The next most prevalent constraint was lack of *time* ('It's not that I don't know what to do, it's that I've not had time to do it'). *Subject curriculum requirements, ICT initiatives,* and *training* were further factors of influence. System *reliability* was a major issue in three schools; development of practice was impeded through 'lack of technical back-up, not through lack of willingness'; lessons using ICT had become 'very, very high risk'.

Figure 1: Distribution of Factors Relating to Development and Dissemination of ICT-Supported Practices



(b) Motivational factors

Two internal or *motivational factors,* namely teachers' *technical confidence* and *confidence in approach* played a key role too, although they were linked twice as often to dissemination, and thus more to colleagues' confidence levels. The teachers involved in TiPS – while not experts initially – had subsequently used ICT regularly for over 3 years and may therefore have developed their confidence to higher levels than colleagues coming to it more recently. The theme of *affinity* with a particular approach reflected the process necessary to become 'confident about what's worth doing and what isn't: it's quite hard to say to people "Here's a strategy. Off you go" '. *Technology skills* and experience, *resistance to change, and teacher age* (younger teachers were construed as natural and innovative users of ICT) were also influential.

(c) Pedagogical factors

All of the teachers and colleagues considered the practices they had developed to be largely successful in terms of enhancing pupils' *learning* (three times more often in relation to development than to dissemination). *Pupil motivation* was likewise an important factor in accounts concerning development and to a lesser extent, dissemination. These findings resonate with other recent work concerning the critical impact of teacher beliefs about the benefits of classroom ICT use for students (e.g. Cox *et al.*, 1999; Ruthven *et al.*, in press; Tearle, 2004). We propose that while National Curriculum requirements ('ticking the right boxes') are influential to some extent in take-up and integration of ICT-supported practices, once practices are established and trialled, teacher confidence and enthusiasm for using ICT and their pedagogic beliefs ('defending what you're doing in terms of genuine, useful learning') may become more significant motivational factors underlying their sustainability over time and generalisability to further contexts.

The three diverse groups of factors represented in our account are, in fact, closely inter-related. Teachers exhibited a strong desire to develop effective practice which benefits pupil learning. Their skill and confidence in using ICT and inclination towards the pedagogical approach were also contributory motivating factors, although barriers emerged where these were lacking. In both cases, however, proactive support from more experienced colleagues (and 'seeing what was possible') offered mechanisms for facilitating take-up of new strategies. Exploiting this support was, in turn, encouraged or constrained by organisational factors and a whole school culture which valued and promoted ongoing collegial activity.

Conclusions

This study shows that such pedagogical approaches to using new technologies in the secondary classroom are robust over time, are spreading from teachers to their colleagues, and are being consolidated through integration into departmental schemes of work. The extent of sustainability, further development and dissemination of practice found here indicates that the substantial levels of investment in school ICT provision may be paying off. However, teachers and subject departments depend on adequate access to reliable resources (and technical support) if practice is to evolve. A favourable management outlook and development of ICT as a school priority in turn leads to soliciting further resources and expanding practice, thus the process is complex and iterative rather than linear. Individual teachers' confidence, skills and motivation towards using ICT develop in response to other contextual factors, including a supportive organisational culture. These 'internal' factors also play a critical role in the processes of both developing and disseminating new practice.

Recommendations

Our recommendations for practitioners and middle/senior managers in schools include:

- taking a whole school approach in prioritising development of ICT use;
- providing time and access to resources to enable individual and collaborative development and refinement of pedagogic strategies involving use of ICT in subject teaching; integrating ICT into departmental schemes of work;
- encouraging long-term collegial interaction within and between subject departments: e.g. facilitating observation of colleagues' lessons, presentations at meetings, training initiatives;
- extending established practices to new (topic and subject) domains.

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