Supporting professional development for ICT use in mathematics using the T-MEDIA multimedia resource

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The T-MEDIA[1] research project produced an interactive CD-ROM containing a video-based case study of teaching and learning with technology (graphing software, spreadsheet and online games using data projector and laptops) in one secondary mathematics classroom. Designed as a tool for teacher-led, collaborative professional development, the resource aims to stimulate debate rather than present a model of best practice. In the follow-up project outlined here, groups of teachers in 3 schools discussed the pedagogical approaches portrayed, planned a lesson in response, observed each other and reflected together on the outcomes and implications for practice. We present the outcomes of these trials and our development of a 'toolkit' that might guide other departments' use of the resource for professional development.

Keywords: professional development, ICT, video, secondary

Introduction

Schools in the UK have invested large amounts of their capital in data projection technology, which has generated an interest in how to support teachers to use these systems to enhance their teaching. Research into teacher learning suggests that stand-alone in-service workshops tend to be of limited value in developing sustained transformation in teacher practice (e,g. Muijs & Lindsay 2008). A more promising way forward appears to be a professional development initiative that *draws on practice and support within teachers' situated communities, encourages peer learning and reflective practice, and provides explicit opportunities for teachers to explore how they can introduce new ideas effectively into their classroom to promote student learning* (e.g. Clarke & Hollingsworth, 2002; Zwart, Wubbels, Bergen, & Bolhuis, 2007). Our work sought to incorporate these ideas into a programme of support for groups of teachers in their use of projection technology. The approach was informed by three phases of research activity: initial co-construction of theory between teachers and researchers (Hennessy & Deaney 2009, in press), development of a multimedia resource to stimulate teacher discussions, and the subsequent development of an accompanying 'toolkit' offering a framework for teachers' collaborative use of the resource. This paper reports on the development and trialling of the toolkit by three secondary mathematics departments and the reflections of teachers and an Advanced Skills Teacher-researcher (Dawes) on being involved with the project.

Teacher change

Our research draws on the literature on: teacher learning from a community of practice perspective, reflective practice and peer learning. While traditional off-site

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[1] 'Exploring Teacher Mediation of Subject Learning with ICT: A Multimedia Approach' (2005-2007). Funded by the UK Economic and Social Research Council (RES000230825).

one-off continuing professional development (CPD) sessions may be evaluated at the time as enjoyable, there is little evidence that such learning is translated into the classroom (Muijs & Lindsay 2008). This appears to be because such a form of CPD overlooks the complex contextual differences between a course and the reality of teachers' own classrooms, particularly with regard to the type of software and hardware available, the type of technical support needed and the specific pedagogical issues associated with their own pupils' needs and their own subject demands. It is also attributable to lack of time and space for teachers to trial and embed new practices during busy working lives.

Instead, ongoing on-site learning within existing communities of practice (Wenger 1998) appears to offer a more fruitful form of professional development, in terms of changing practice. Such a 'situated perspective' (Putnam & Borko 2000) appears to offer opportunities for teacher learning to be meaningful by engaging with teachers' beliefs that subsequently lead to changes in practice (Lerman 2001). Initiatives based in such a perspective can also be designed to offer teachers a 'generative' rather than 'responsive' role (Jaworski 2001) in their learning, which may again contribute to successful change in practice.

Being involved in regular critical reflection on concrete examples of practice and sharing among colleagues can promote potential long-term changes in teacher behaviour (e.g. Scherer & Steinbring 2006). One way of encouraging this is to use 'peer learning', which refers to the way that teachers come together in a formal manner to mutually support each other's learning (e.g. Zwart et al. 2007). Our teacher development initiative used peer learning in conjunction with the stimulus of a multimedia resource to encourage teachers to share their ideas about teaching, as well as to experiment with new practice and observe the effects on students.

Overview of the resource and toolkit for our professional development initiative

The toolkit represents an adaptable model for professional development using a research-based multimedia resource. The T-MEDIA CD-ROM contains video clips showing one mathematics teacher's use of a data projector, laptops and graphing software in her classroom, with analytic commentary and built-in prompts for discussion. The resource encourages teachers to experiment and reflect on their own use of such technology in promoting students' mathematical learning, by providing stimulus material for collective debate. Teachers are thereby able to draw on – and critically evaluate – classroom practice from outside their schools as well as on ideas from colleagues, and to synthesise these with their own situated knowledge. The adaptable model surrounding the use of this resource therefore differs from conventional professional development activities in providing opportunities for reassessment and development of pedagogy that are sustained over time by teachers themselves – with support from subject and school leaders being critical.

A toolkit document, which includes a flowchart of the adaptable model of collaborative working together with suggestions for professional development activities and a senior management team briefing sheet, was designed to act as a guide for teachers working together with departmental colleagues through this reflective process, independently of outside intervention (Hennessy et al. 2008). It is based on an iterative cycle of teacher-led discussion and review of the stimulus material, lesson planning, peer lesson observation, collective reflection and refinement. Commissioned by the National Centre for Excellence in Teaching Mathematics (NCETM), the toolkit document is the outcome of trials in guiding use of the T-

MEDIA CD-ROM by an Advanced Skills Teacher (AST) with other teachers. Both the toolkit and the multimedia resource are hosted on the NCETM portal (www.ncetm.org.uk) and are thus freely available.

Design principles of the initiative

This professional development initiative was intentionally developed to be flexible, teacher-led, collaborative, and based on supported professional dialogue and reflection on practice that are ongoing over time. While the resource and toolkit have a clear focus on developing subject pedagogy, teachers choose whether or not to focus on the use of ICT; the range of foci they selected to explore during our trials clearly demonstrated that the issues raised also went well beyond the specific teaching context illustrated on the CD-ROM. In addition, the initiative proved useable with departments and teachers at all levels of (teaching/ICT) experience – in groups or individually – and, while providing a department with common purpose, it also served a wide range of different needs simultaneously. It offered new opportunities to lead, to carefully observe colleagues' practice and understand their reasoning, to take stock and to experiment with new pedagogical techniques, and to explore the potential of new technological tools. The process likewise offered a rare opportunity for teachers who are not performance managers to observe – and collaboratively deconstruct – a colleague's lesson. Teachers could benefit from planning lessons together, supporting each other in developing and trialling new ideas.

In sum, our initiative valued teachers' own aims, insights and motivation to improve pupil learning outcomes. It was based on the critique of real examples of practice in an ordinary classroom with far from perfectly behaved children.

Research design

This work examines the impact of pilot work and the subsequent trials of the 'toolkit' document on participating teacher groups and their wider subject departments, and considers this in light of the radical variation in levels of participant experience of teaching and technology use. We were interested in how the teachers considered that engagement with the project affected their practice in the classroom, their thinking about teaching, their working with department colleagues and their perceptions of pupils' responses.

Our research questions were:
- To what extent and how has engagement in this process influenced participants' classroom practice, either in relation to technology use or not? Were any changes reported in the practice of individuals, participating groups, or wider departmental communities?
- To what extent and how did involvement in the process stimulate any impact on pedagogical thinking?
- Was any change embedded in ongoing professional development practices, either at the departmental or institutional level?

The AST worked with a small group of teachers within each of two school departments (one his own), initially to encourage teachers to engage with the resource and then also to support observation in classrooms. The toolkit was developed as an outcome of these studies and then trialled by a third, small secondary department, in the presence of an academic researcher (Bowker) who observed its use.

Primary data collected included a series of meeting recordings, lesson observation notes and short follow-up interviews with some of the teachers at the

time. Further data was collected a few months later and included teachers' reports of student feedback, responses to new approaches, and reflections on the contextual factors that affected how they were able to develop practice further.

The impact of the professional development activity

Teachers had a range of reactions to the resource, yet all of these were able to lead to change in practice. One teacher described the impact for him:

> I found it frustrating, the fact that she wasn't using the technology to its potential, I didn't feel. That's what's given me the impetus of thinking, 'well, OK, it's all right sitting criticising, but what would you do differently?' So I think I had a lot more interactivity in my lessons. [The pupils] were coming up and answering the questions on the IWB. And I'll be perfectly honest, I was actually quite surprised how well it went.

Our observations were that the typical initial reaction of teachers to watching the clips in the resource was to launch into a discussion of the teaching observed. Initially critical of what they were seeing – for example one teacher stated: "There is absolutely nothing that she did there that was particularly special" – these discussions developed as teachers reflected more deeply and shared their thoughts. Ultimately, teachers would comment on aspects they appreciated, for example "You've got to get the culture of working [among pupils] first, which is what Sarah had." And: "You can see it's obvious she knows what she's doing, so it's obvious it was a very good maths lesson." The focus of teachers while watching clips varied too. One stated:

> The technology wasn't the thing that struck me, really, it was the style of teaching and the interactivity with the kids which I don't do a lot of … and it was a real eye-opener.

Another remarked:

> I really liked her questioning and accepting a wrong answer… Is that the funnelling, when she was giving them alternative questions that kind of like clued them into the right answer?

Yet others were primarily interested in how technology might be used.

Comments about the different aspects of the initiative suggested that teachers valued the experience highly. Reflecting at the end of the project, one teacher remarked: "The [multimedia] resource is the trigger – it triggered the conversation and the conversation triggered the lesson." The peer reflective discussions were mentioned by almost all teachers, who considered them beneficial: "The sharing of the ideas in the group were what produced the lessons." One teacher pointed out that change in practice would not be instantaneous, but felt the initiative provided an impetus:

> I've tried doing a few things even in the last couple of weeks that without this stimulus I wouldn't have changed, but I'm very conscious that it's going to take a little while for me to hone my skills because it's changing a style of delivery.

Another, reflecting this need to continue to work collaboratively at changing practice, enthusiastically stated: "We must keep on doing this. It is essential we keep on doing this."

Returning after 6 months to the schools to conduct follow-up interviews, we were interested in any longer term benefits of being involved in this type of professional development initiative. All the teachers in these interviews alluded to using more technology in their lessons. One head of department stated:

> The biggest thing that's happened […] as a direct result of the project […] is that we've [got] 35 laptops which [...] all of us have used with most of our classes.

Another teacher, in a different school, announced that he had just been appointed to a new job on the strength of his new skills for using ICT in the classroom, directly derived from the meetings and the toolkit development. He was looking forward to implementing in his new institution more of the ideas with which he was still buzzing. He was 'incredibly grateful' to have been involved, not least because it was the only professional development he undertook during the 18 months posting at his current school.

Several teachers wanted to return to the resource and the toolkit: "I want to spend some more time with that initial resource"; "We sort of saw ourselves teaching. […] I'd like to do that more and that will also give me an incentive to design, hopefully, better lessons because I know that I'm recording myself." One teacher also envisaged how he would like to extend his experience to others who had not been involved: " 'Ok, this is what we did […] and then we start the conversation from there. It's like, 'well OK: wider implications of technology in maths: Let's go!'" While teachers had not formally returned to the resource and toolkit, owing to time constraints, one department had regularly continued the informal dialogue, swapping ideas about what might work with different year groups, and on occasion had been able to observe each other's use of technology. The findings will be further explored in a forthcoming longer version of this paper.

Conclusions

With support at the school level and from the toolkit, exploring a single but rich and flexible resource appeared to give the diverse group of teachers involved in the trials a means of opening windows on practice and moving both classroom and departmental practice forward in ways that they wanted to sustain over the long term.

While acknowledging the complexity of attributing motivating factors to 'the project', nonetheless teachers in each of these three schools reported tangible effects on their classroom teaching. For some, the project acted as an impetus for acquiring appropriate hardware or exploring software. For others it was an opportunity to experiment with different pedagogic techniques, to obtain feedback, or to discuss arising issues in a collegial manner.

These claims need to be contextualised since in all cases additional supportive factors could be identified. For example, impending curriculum changes encouraged the need to use technology, and pupil enthusiasm for using computers appeared to contribute to teacher motivation. These helped to maintain a forward momentum when faced with difficulties such as a lack of appropriate support in terms of allocated time to meet with colleagues.

In each school the process of reviewing and debating the video material together with colleagues, exploring some routes through the material suggested by the toolkit, trialling new approaches, and critically reflecting upon the outcomes, triggered demonstrable *changes in pedagogical thinking and practice – whether teachers were using technology or not.* Professional dialogue between colleagues working within an established and supportive community-of-practice proved central, and the desire to create further opportunities to perpetuate this dialogue was itself a key outcome for participating departments.

The findings indicated that the success of the collaborative professional development initiative needs to be interpreted, however, not only in terms of its

generic underlying principles but also in light of a complex interplay of additional situated factors. These include teachers' personal and professional concerns about their own practice, responses to the diverse practices depicted on the T-MEDIA resource and observed in colleagues' teaching, classroom dynamics and needs of particular pupil groups. Our work thus directly supports Mason's premise that teachers "have to work on themselves, informed by research, and shared practices" (Mason 1994, 179). In sum the cyclical process of inquiry was effectively scaffolded by the initial guiding framework we provided, but rapidly took on its own momentum, resulting in a unique course of action in each case; participants spontaneously and enthusiastically developed their own fruitful pathways of learning.

Acknowledgements

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