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Futurelab - Teachers Learning with Digital Technologies: A review of research and projects

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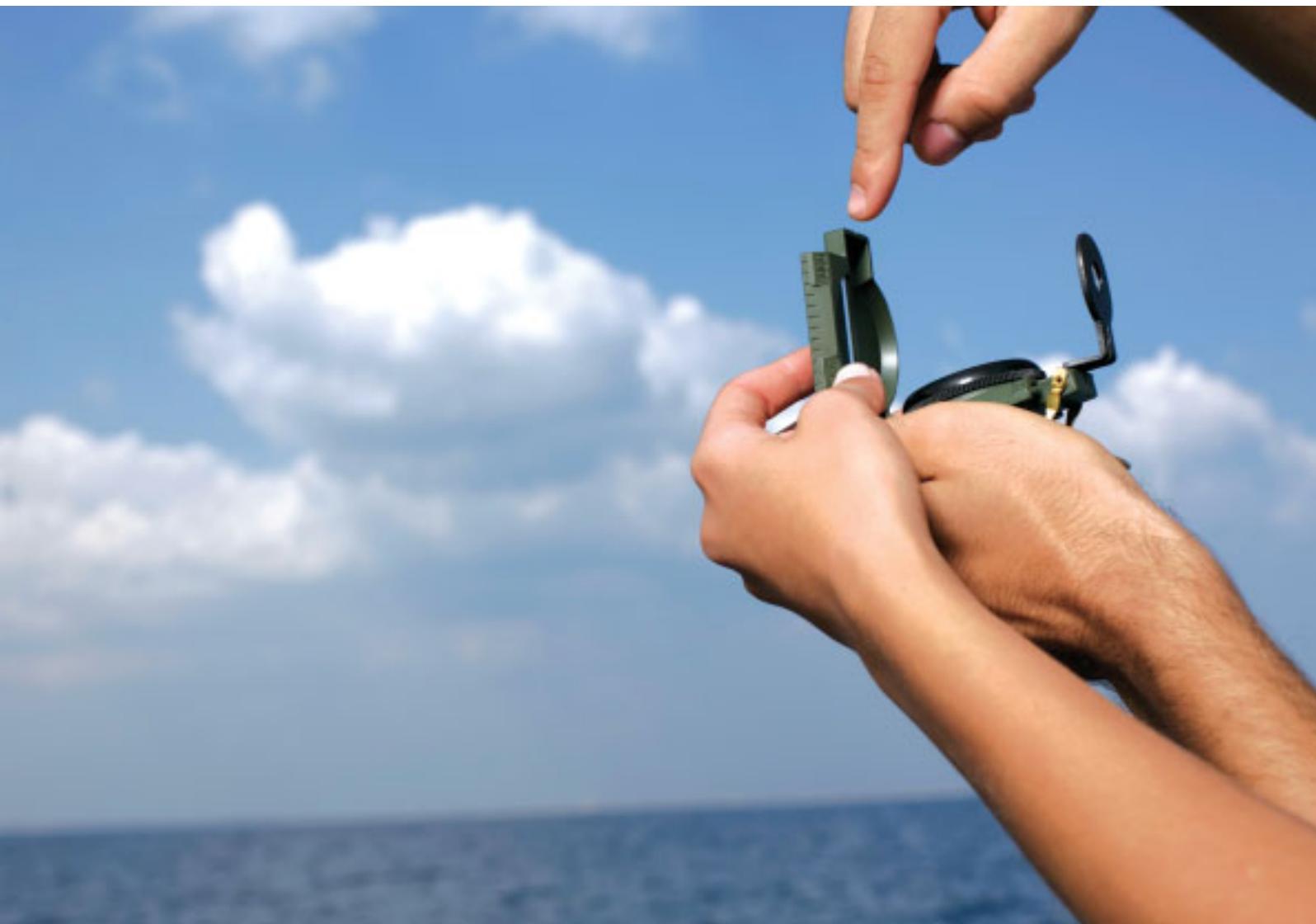
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REPORT 14:

Teachers Learning with Digital Technologies: A review of research and projects

Tony Fisher, University of Nottingham
Chris Higgins, Oxford Brookes University
Avril Loveless, University of Brighton



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FOREWORD

In recent years we have seen a significant, and long overdue, shift in education from an emphasis on 'teaching' to an emphasis on 'learning'. The focus of attention is now firmly on the learner, their needs, interests and aspirations, at the heart of the education system. This change in focus is to be welcomed as education is, of course, first and foremost about learners. And yet, in this shift are we in danger of losing sight of the people who are able to make this vision for education a reality – namely, the teachers who are asked to change their practices, shift their goals and develop new approaches to meet the needs of education in a changing world?

If we are interested in changing education, we need more than ever to be interested in teacher education, teacher knowledge and teacher learning. If we want to encourage different approaches to teaching and learning, and new relationships between pupils and teachers, we need to understand the ways in which teachers come to learn, adapt and make such new approaches a reality. If schools are to become 'learning organisations', with the confidence and capability to adapt to rather than be buffeted by change, we need to invest considerable time and attention to the question of how teachers as professionals can best manage their own learning and development throughout their professional lives.

It is in response to these concerns that we have commissioned this review, in order to provide an overview of the research on teacher education, and to provide a roadmap for how this might best be supported in an age of digital technologies. Tellingly, for all the reams of research literature on children's learning with digital technologies, there is comparatively little research on teachers' learning with these new tools. This review focuses specifically on what we understand to constitute powerful learning environments for teachers, and maps onto this the potential affordances of digital technologies to enhance and expand these environments. In so doing, the review raises a number of possibilities for teachers to act as knowledge builders, as collaborators and as reflexive practitioners. It offers models for the use of digital technologies in both initial teacher education and in ongoing professional development. As such, it is intended to act as a stimulus for debate and a call to action for the creation of learning experiences for teachers that are as powerful, relevant and meaningful as those they are asked to create every day for their own students.

As always, we are keen to hear your views on this review, and your proposals for future action at research@futurelab.org.uk

Keri Facer, Research Director, Futurelab

CONTENTS:

	EXECUTIVE SUMMARY	2
	SECTION 1 INTRODUCTION	5
	SECTION 2 THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING	7
	SECTION 3 TEACHER LEARNING AND THE AFFORDANCES OF DIGITAL TECHNOLOGIES	19
	SECTION 4 CASE STUDIES	26
	SECTION 5 DISCUSSION: RETOOLING OR RENAISSANCE?	39
	REFERENCES	42

EXECUTIVE SUMMARY



there is very little fundamental research that investigates how teachers might learn with digital technologies

EXECUTIVE SUMMARY

INTRODUCTION

Our purpose in this review is to examine how teachers learn, and what part digital technologies may have to play in that process. We have consulted the literature in order to examine the research base. We have found that, though there is research-based literature that deals with teacher learning, and a literature base for thinking about learning with digital technologies, there is little that deals directly with our specific focus of 'teachers as learners with digital technologies'. There is very little fundamental research that investigates **how** teachers might learn with digital technologies. Rather, there seems to be a pervasive assumption that teachers **will** learn with digital technologies. Hence, we take the approach of reviewing what is known about teacher learning, before introducing digital technologies into the equation.

THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING

Conventional conceptions of knowledge are that it resides 'in the head' of individuals and that it can be transferred (unproblematically) between the heads of individuals by processes of teaching and learning, and training and development.

More recently, the theory and research associated with the 'socio-cultural' school of psychology have suggested that the nature and locus of knowledge are considerably less clear-cut and significantly more 'social'. This view draws on ideas of distributed cognition, situated cognition, and communities of practice, in

which 'knowing' and 'thinking' may not be separated from the social context in which those mental functions occur. These socio-cultural aspects of knowledge have led to the view that knowledge is not simply to be reduced to specific items or facts. With the socio-cultural perspective our view shifts, from 'knowledge' as a state of individual mind to that of 'knowing' as a social process. These views of teacher knowledge have strong implications for our view of how teachers learn.

Teacher learning is an active, experiential process, through which knowledge is enacted, constructed and revised. There is also a role for 'conceptual inputs' which may provide stimulus for different actions, including different pedagogical thinking and different professional discussions. Teacher learning is subject to many influences. It is best seen as complex and resistant to standardisation. This complexity reflects the interplay between the professional and the personal, the individual and the social, the objective and the subjective, the formal and the informal, the situated and the generalised.

TEACHER LEARNING AND THE AFFORDANCES OF DIGITAL TECHNOLOGIES

Digital technologies can play a role as tools which afford learners the potential to engage with activities. The use of such tools may extend or enhance their users' abilities, or even allow users to create new ways of dealing with tasks which might also change the very nature of the activity. The technologies can also provide limitations and structure to activities, influencing the nature and boundaries of the activity. These 'affordances' and

'constraints' can be enabling and complementary as learners use them purposefully, but they do not exist as absolutes, or entities with power of their own. We propose to describe the affordances of digital technologies as 'clusters' of purposeful activity in teacher learning (see table below).

Shulman and Shulman describe features of accomplished teacher development and teacher learning - vision, motivation, capability (sub-divided into understanding and practice), reflection, and community - and summarise them more colloquially as being 'ready, willing and able'. They hoped that their model would be used to "design, diagnose or explain efforts at teacher learning in a more self-conscious and effective manner" (2004, p269). In considering the contribution of digital technologies to teacher learning, the affordances of the technologies can be

viewed as tools in expressing and developing the dimensions of being 'ready, willing and able'. These affordances can be articulated with the Shulman model's features of vision, motivation, understanding and practice, and can support reflection and community at a range of levels.

CASE STUDIES

Five case studies are presented which illustrate both facets of the discussion: each case exemplifies both the principles of teacher knowledge and learning, and the learning affordances of digital technologies. The cases are not intended to present a comprehensive overview of all that is happening in this fast changing field, rather they have been chosen because they take full advantage of and exploit one or more of the 'affordance clusters' that we have identified.

Knowledge building	<ul style="list-style-type: none"> • adapting and developing ideas • modelling • representing understanding in multimodal and dynamic ways
Distributed cognition	<ul style="list-style-type: none"> • accessing resources • finding things out • writing, composing and presenting with mediating artefacts and tools
Community and communication	<ul style="list-style-type: none"> • exchanging and sharing communication • extending the context of activity • extending the participating community at local and global levels
Engagement	<ul style="list-style-type: none"> • exploring and playing • acknowledging risk and uncertainty • working with different dimensions of interactivity • responding to immediacy

Table 1: Clusters of purposeful activity with digital technologies

EXECUTIVE SUMMARY



Each case study has a different combination of the affordance clusters and influences a selection of the elements of the model of teacher learning and development. There is usually some external 'conceptual input', often a structured dialogue and reflection with a human presence, eg an online tutor, mentor, facilitator or peer, and an action research orientation to the activities. In each case, teacher learning is seen as inherently complex – a situated process that is ongoing, social and dynamic. What links the case studies is the use of specific digital technologies in ways which enable the users, via the affordance clusters, to overcome some of the constraints of time and location which may characterise other contexts for teacher learning.

DISCUSSION: RETOOLING OR RENAISSANCE?

Teacher learning with digital technologies is a complex but exciting area. Much of what we say in this review has implications for school leaders, researchers, software developers, teacher educators and trainers, CPD providers, policy makers – and, of course, for teachers themselves. We ask whether we want a mere 'retooling' of teacher competences for specific purposes, or an approach which supports a renaissance in teacher development for an uncertain future. This is not about making an industrial process more efficient; rather, it is about enabling cultural change in the profession. Schools of the future will need a clear sense of the kinds of teacher professionalism, and teacher learning, they wish to support, in order to make wise and informed decisions about the role of digital technologies in processes of supporting such learning.

We face a challenge. Processes of teacher learning are complex, even messy, and teachers' current working circumstances contain inherent constraints. Yet the possibilities for real change in the system do exist. If we can bring the technologies into situations that resonate strongly with teachers' sense of professional and moral purposes, we may yet see what might truly prove to be a renaissance, in which teachers would employ digital technologies for understanding, reflection, ingenuity and creativity, and, through these, support their own learning in new ways.

INTRODUCTION



1 INTRODUCTION

Modern education is experiencing unprecedented levels of change, and has been for some time. This is reflected in a wide-ranging, change-related literature which suggests that change in education may now be thought of as a constant condition, rather than an event (eg Fullan 1991; Fullan 1993; Goodson 1993; Bell 1995; Fullan 1997; Day et al 2000; Hargreaves et al 2001; Loveless and Ellis 2001; Goodson 2003).

In such a context, not only are teachers vital as agents of change; teachers themselves also undergo change, and “teachers today are having to learn to teach in ways in which they have not been taught themselves” (Hargreaves et al 2001, p197).

Thus, the initial training of new teachers is in many ways different from that of their recent predecessors - in content, methods, structure and even location. Further, serving teachers are subject to ongoing requirements to absorb the implications of new policies and implement new methods and approaches. Research has indicated that:

“...lifelong learning is necessary for sustaining teacher morale, for career advancement and promotion, for a vibrant workforce, for managing change, for improving skills, content knowledge or pedagogy.” (Kington et al 2003, p43-4)

In short, there has probably never been a more important moment to be clear about the nature of teacher learning than the present, yet too often the reform process is subject to instrumental assumptions, and the crucial element of the learning process among teachers is either overlooked or taken for granted.

Increasingly, digital technologies (particularly networked computers) are being employed to disseminate information about education to teachers. In the UK this is seen, for instance, in aspects of the infrastructure of the National Grid for Learning, where the aim is not only to provide learning opportunities for pupils and students, but for teachers as well. These opportunities are not just ‘top-down’. Networked technologies also provide new opportunities for teachers to learn together, from one another.

Hence, in this review, we focus on the idea of teachers as learners. We also examine how the characteristics of digital technologies provide opportunities to enable and support the processes of teacher learning. We are convinced that new digital technologies offer great potential to support teachers as learners, but we are also concerned that, unless the processes are better understood, much of that potential will remain untapped.

1.1 SOME ASPECTS OF ‘THE BIG PICTURE’

The spread of new digital technologies is associated with major changes in the way we do many things. For example banking, printing, manufacturing, shopping and telecommunications have all experienced major change, made possible by networked digital technologies and the microprocessor. The development of increased computer memory and faster processing, together with the extension of the internet and its associated technologies, is closely associated with the compression of time and space and “the death of distance” (Cairncross 1997).

there has probably never been a more important moment to be clear about the nature of teacher learning than the present

INTRODUCTION



Widespread change associated with new information technologies is an aspect of globalisation. In the globalised economy of 'the information age', new technologies play a key part. "Geared as it is to electronic money – money that exists only as digits in computers – the current world economy has no parallels in earlier times" (Giddens 1999, p9). Some have gone even further, suggesting that new digital technologies are associated with the emergence of what the sociologist Manuel Castells refers to as the new 'informational society' (to distinguish it from earlier 'industrial' and 'agricultural' societies) in which control of, and access to, information and the means of its creation, storage and distribution, are the primary sources of power (Castells 1996).

Writers on education (eg Hargreaves 1994; Woods et al 1997; Morley and Rassool 1999; Helsby 2000; Robertson 2000; Smyth et al 2000; Goodson 2003; Hargreaves 2003) have set their analyses against this broader canvas of globalisation, showing how it provides a set of influences, both direct and indirect, on the work of teachers. Globalisation and the 'information economy' are aspects of the wider context in which governments frame education policy, and in which teachers do their work. Hence:

"The aim of many policy-makers in the UK and around the world is to encourage evolution into a learning society for the [21st] century: one in which all people are responsible for their own learning throughout their lives. Access to information and learning will often depend on new technologies as well as on an approach to teaching which supports collaborative professional development.

Governments in Europe and around the world have already recognised the need to review educational practices and incorporate new technologies. Their view is of a vocational imperative and one in which IT will increase the quality and efficiency of learning itself." (Somekh and Davis 1997, p3)

Government in the UK sees an opportunity to 'transform' education through the use of new technologies (DfES 2002; DfES 2003; DfES 2005). However some writers are more cautious, adopting a more critical stance towards some of what is claimed for the educational potential of new digital technologies. Some claims may be seen to reflect 'technological determinism' (MacKenzie and Wajcman 1999, pxv), which asserts or implies that the technology inevitably makes things happen and overlooks the role of human agency; others reflect 'techno-utopianism' (Goodson et al 2002, p2) in suggesting that all will be better in the technologically advanced future.

Thus we see that educational change, including the introduction of new digital technologies, does not exist in isolation. We say this as a caveat, since in what follows we will concentrate on teachers as learners, and the part that digital technologies can play in teacher learning. However, we should not lose sight of the bigger picture of which this is but a part.

1.2 STRUCTURE AND SCOPE OF THIS REVIEW

It is not our purpose in this review to examine overall change, actual and potential, in how education is carried out.

THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING



Nor is it to examine the role of new technologies in education. Our purpose is more specific, being to examine how teachers learn, and what part digital technologies have to play in that process.

We have consulted the literature in order to examine the research base in this field. We have found that, though there is research-based literature that deals with teacher learning, and a literature base for thinking about learning with digital technologies, there is little that deals directly with our specific focus of 'teachers as learners with digital technologies'. Hence, we have taken the approach of reviewing what is known about teacher learning, before introducing digital technologies into the equation.

The remainder of this review is divided into four sections. In Section 2 we seek to unpack the complex nature of 'teachers' knowledge' and 'teacher learning' on the basis of the research literature. In Section 3 we focus on the new digital technologies and the opportunities for teacher learning that these technologies might offer. Section 4 explores some case studies in which aspects of teacher learning with digital technologies are exemplified. Finally, in Section 5 we make some observations about the use of digital technologies to support teacher learning, in the light of the previous sections.

2 THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING

Teachers are knowledgeable people. They need to be, in order to do what they do. Teacher knowledge includes 'knowing one's subject' and techniques of how to teach it. It also includes other aspects of specialist professional knowledge, including legal responsibilities and requirements, together with knowledge about the systems and routines of the particular school in which a teacher teaches. Importantly, it also includes knowledge about individual pupils and students, such as their learning strengths and needs, and how these may be supported, together with relevant aspects of their personality and background.

We can see from the preceding paragraph that teacher knowledge is a complex mixture of 'know how' (procedural knowledge) and 'knowing that' (declarative knowledge). In this section we explore the idea of teacher knowledge further, together with the closely associated process of teacher learning. This is important since, if we are to understand the potential of digital technologies to support teacher development, we need to have a better understanding of the complexity of the superficially simple ideas of 'knowledge' and 'learning' before we introduce digital technologies into the equation in Section 3. In particular, in this section we will challenge simplistic notions of 'knowledge' and 'learning'.

Our view, supported by the literature, is that the nature of teacher knowledge is highly complex – even more so than outlined above. This may be at odds with the view of 'the person in the street' who may feel that all that teachers need to



teacher knowledge is a complex mixture of 'know how' and 'knowing that'

THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING



'know' is their subject and how to keep good order (as if either of those were in themselves unproblematic). However, anyone who has had the experience of being taught by someone who 'couldn't get the subject over' will have realised that there is considerably more to teacher knowledge than that.

2.1 WHAT DOES IT MEAN TO BE KNOWLEDGEABLE AS A TEACHER?

As indicated in the introduction to this section, teachers need to be knowledgeable people. However, in the influential DfEE-commissioned Hay McBer report on 'Research into Teacher Effectiveness', which has influenced Government thinking on educational reform, the focus was squarely on teacher skills and behaviours. Teacher knowledge, when it was referred to, was conceived largely as relating to their subject area and how to teach it (Hay McBer 2000, para 1.1.5). Though there are references to 'teamwork', the over-riding impression of teacher knowledge in the Hay McBer report is that it is 'in the head' of the individual teacher and is manifest in observable aspects of individual performance. What it might be that teachers know above and beyond issues of subject knowledge, and how they come to know it - ie the substance and nature of teachers' 'professional learning' - is very largely left unsaid in the report. In this review we seek to be rather more explicit about the complex and problematic nature of what it is that teachers know and how they come to know it.

2.1.1 Individual and social views of knowledge

Conventional conceptions of knowledge are that it resides 'in the head' of individuals. Further, it can be transferred (unproblematically) between the heads of individuals by processes of teaching and learning, and training and development. More recently, a different way of thinking about knowledge has emerged from the 'socio-cultural' school of psychology. In the theory and research associated with this way of thinking, the nature and locus of knowledge are considerably less clear-cut and significantly more 'social'. These conceptions, the individual and the social, are sometimes presented as alternative - even incompatible - views of knowledge. In this section we will say something about both of these views in order to conclude that both are necessary to a fuller understanding of the nature of teacher knowledge.

2.1.2 Cognitive views of knowledge

Psychologists tend to refer to 'cognition' rather than knowledge. Cognition is the process of receiving, processing, storing and using information. The cognitive view of knowledge is that it exists in the mind in the form of representations and symbols, and is organised into specific schemas. For instance, a schema for a 'lesson' will be made up a number of separate components including aspects of subject knowledge, planned activity, remembered experience and many more, organised into a coherent, complex structure - a schema.

Thinking may be seen as the mental manipulation or 'processing' of these elements. When experience introduces

new information, it may be incorporated into an existing schema with which it is consistent. This is the process of assimilation. However, if the new element does not conform to an existing schema, it may force the modification of the schema, or even the production of a new one. This is the process of accommodation.

These processes are familiar to many educationalists from the work of the psychologist Piaget. However, though Piaget's work focused on cognitive development among children, the cognitivist perspective would assert that this view of knowledge holds true for both children and adults.

Thus, a teacher might have one or more schemas for, say, 'lesson plan', which would be developed during training, and used each time a lesson is to be prepared. Other representations, for instance aspects of the subject to be taught, would be organised with the aid of the lesson plan schema. Programmes of 'training' may attempt to modify the lesson plan schema through the process of individual accommodation to new information, for instance the incorporation of new teaching techniques associated with ICT. Hence, knowledge is not fixed but is best seen as dynamic, and undergoing processes of construction and reconstruction in the light of experience and new inputs. However, from the cognitivist perspective, knowledge remains essentially personal and in the head of the individual.

At its extreme, cognitivism may lead to a behaviourist view of learning. The behavioural view of learning was demonstrated in the famous experiment involving the conditioning of 'Pavlov's dogs'. Behaviourism, based on the ideas

of Skinner, suggests that individual learners need to be given external stimuli to elicit responses, and that observable behaviours of the individual indicate the presence of knowledge and the success of the learning.

2.1.3 Social views of knowledge

More recently, research attention has turned to those aspects of knowledge in general, and teacher knowledge in particular, that may be described as "social, distributed and situated" (eg Putnam and Borko 2000). Thus, the focus of interest is on knowledge in the world of social interaction between people, rather than the more strictly cognitivist view of knowledge in the head of the individual. This view of knowledge draws on ideas of distributed cognition, situated cognition, and communities of practice in which the operation of higher mental functions, such as knowing and thinking, may not be separated from the social context in which those mental functions occur (eg Wertsch 1991). These approaches draw in turn on the largely Soviet tradition of social psychology, expressed through the writings of Vygotsky, Leont'ev and Luria.

Distributed cognition is a view of knowledge that suggests that cognitive functioning, rather than residing in individuals, is dispersed among people, objects and tools.

Situated cognition is a view of knowledge which suggests that what is known is intimately related to the specific context (situation) in which that knowledge was acquired (Brown et al 1989). This view grew out of a realisation that the somewhat mechanistic 'rule-bound' approaches of

THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING



knowledge is not simply to be reduced to specific items or facts

the traditional cognitivist approach were inadequate to explain the observed characteristics of knowledge and learning.

Communities of practice (Lave and Wenger 1991; Wenger 1998) is a development of both of the above ideas and stresses the socio-cultural nature of knowledge. "Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wenger, undated). Knowledge is made evident in 'the way we do things here' – hence, much of this knowledge is tacit, provisional and enacted.

These socio-cultural aspects of knowledge have led to the view that knowledge is not simply to be reduced to specific items or facts. Rather, if we adopt the socio-cultural perspective our view shifts from 'knowledge' as a state of mind to that of 'knowing' as a social process.

2.2 CLASSIFICATIONS OF TEACHER KNOWLEDGE

2.2.1 Formal and informal knowledge

One simple classification of teacher knowledge would have 'formal' knowledge on the one hand (being the stuff of university-based knowledge about education) and personal/practical knowledge (developed largely through experience) on the other. Formal knowledge is often expressed in the language of 'academic' discourse, whereas personal/practical knowledge is expressed by teachers in common-sense terms (Page 2001). Too often these two forms of knowledge about education are seen in

tension with one another, whereas both informal and formal aspects are necessary components of an inclusive view of 'professional knowledge' (Wideen et al 1996, p192)

2.2.2 Shulman's classification

Lee Shulman developed a seven-part classification of teacher knowledge. He describes teachers' practice as drawing upon a professional knowledge base built up from seven elements:

- knowledge of subject matter (content knowledge)
- pedagogical content knowledge (the ways of representing subject knowledge appropriately for learners)
- knowledge of curriculum (grasp of the materials, resources and 'tools of the trade')
- general pedagogical knowledge (broad understanding of management and organisation)
- knowledge of learners and their characteristics
- knowledge of educational contexts (ranging from groupings, classrooms, schools, education authorities, national policies to wider communities and cultures)
- knowledge of educational aims, purposes and values.

(Shulman 1987)

These aspects of professional knowledge are drawn from a range of sources and, Shulman argues, form the basis of teaching as a 'learned' profession.

Part of Shulman's purpose was to demonstrate that, far from teaching being a simple activity that anyone could do, teachers possess a specialised knowledge base. Perhaps the most original and significant aspect of Shulman's classification is the category of pedagogical content knowledge (PCK). With this category Shulman is clearly suggesting that it is insufficient for a teacher to simply 'know the subject'. Rather, PCK suggests that a key part of the knowledge base for teaching is knowledge about how to teach specific aspects of whatever is to be taught. For instance, a science teacher who intends to teach about electricity will draw not only on knowledge about electricity, but also about specific pedagogical approaches for helping young people to understand what electricity is and how it operates. Thus PCK represents a level of professional specialism.

2.3 HOW DO TEACHERS LEARN?

In the previous section we outlined some perspectives on the nature of knowledge in general, and that of teachers in particular. In this section, we address the processes of learning, of 'coming to know'.

In current discourse, teacher learning is often implicit rather than explicit. For instance in terms such as 'initial teacher training' (ITT) and 'continuing professional development' (CPD) (recently brought together strategically in the Training and Development Agency for Schools, or TDA), the processes of teacher learning are implied by the terms 'training' and 'development' but not explicitly articulated. At the same time, published standards specify the performative criteria by which

teachers are required to demonstrate the outcomes of their training and development. There is an underlying implication in this discourse that the process of learning is instrumental and unproblematic: in essence, all teachers need is to be given the right 'training', the right 'development', and the result will be observable and measurable in their performance.

However, in-depth research with teachers (eg Day 1999; Hargreaves et al 2001; Goodson 2003), has shown that the learning process is considerably more complex, particularly when the context and substance of teacher learning is itself changing. In addition, the literature indicates that "teacher learning requires time and commitment if substantial rather than cosmetic changes in practice are to occur" (Kington et al 2003, p43).

Teacher learning is closely bound up with the earlier discussion of the nature of teacher knowledge. We have already indicated that, whilst having individualised aspects, teacher knowledge is better thought of as also having important social, distributed and situated characteristics. Further, teacher knowledge is dynamic rather than fixed, and constructed rather than transmitted. These views of the nature of teacher knowledge have strong implications for our view of how teachers learn.

2.4 PROCESSES OF LEARNING

Learning is a process - or, more accurately, a number of processes - for the acquisition and development of knowledge, skills, attitudes or values. It takes place through the associated processes of being

far from teaching being a simple activity that anyone could do, teachers possess a specialised knowledge base

THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING



the notion of reflection has an important place in conceptions of teacher learning

taught, studying or experience. Through learning, mental constructs or schemas are formulated or modified. Learning is also complex: for example, the Theory into Practice website lists 50 separate learning theories.

Here we focus on three specific and, in our view major, linked component processes of teacher learning: experience, reflection and construction.

2.4.1 Experience

By its nature, much of the work of teachers is cyclical, at a number of scales. The underlying model of the teaching process is a cycle of lesson planning-implementation-evaluation, with evaluation having formative 'feed-forward' into the next lesson plan. Other cycles for the teacher are the school day, the timetabled week, the school term, the school year, the Key Stage and so on. Thus, an important component of teacher learning is the iterative, experiential component, though as has been pointed out, 20 years' experience can be developmental over that period, or one year's experience repeated 20 times (Ridgway 1997, p7).

2.4.2 Reflection

The notion of reflection has an important place in conceptions of teacher learning. Reflection is implicit in the experiential model outlined in the previous paragraph, in the process of evaluation. Many education writers using the notion of reflection cite the important original work of Donald Schön. Schön's distinction between short-term 'reflection in action',

and the more deliberative 'reflection on action' (Schön 1983) is significant. Reflection on action is a means of learning from experience, and contributes to the development of teachers' practical knowledge. This knowledge is then drawn upon in future situations of unavoidable uncertainty, to guide discretionary professional judgement. Such judgement is deployed 'in the heat of the moment' and it is this quick reflection in action that characterises 'expert practice'. The experience is then available for further reflection on action.

2.4.3 Construction

Learning is a constructive process, and teachers are constructive learners, progressively making meaning of their experiences. Such constructive learning takes place both 'in the head', through the development and modification of schemas (eg reflection on the use of a new teaching method), and 'in the world', through interaction and discourse (eg discussion of that teaching method with colleagues). Knowledge construction 'in the world' is situated in specific contexts, such as a particular school or department, and is distributed between individuals, eg members of a teaching team or community of practice. Social learning involves interaction with others. Teachers, no less than other people, experience Vygotsky's 'zone of proximal development' (ZPD) in their constructive social learning with others – colleagues, students, 'trainers'. In the ZPD, the teacher learns, with assistance, that which cannot be achieved unaided, for instance through the process of coaching.

2.5 FACTORS INFLUENCING LEARNING

Learning is subject to numerous factors. Teachers will be familiar with the importance of, for instance, motivation and time. Here we focus on two more general groups of factors, relating to the individual and to the context.

2.5.1 Personal/individual factors

Learners differ from one another, and teachers are no exception. Learning requires receptiveness to new ideas and information, and Rogers' influential work on the diffusion of innovation (Rogers 1995) resulted in a scale of typical receptiveness among the population at large:

- innovators (2.5% of the population)
- early adopters (13.5%)
- early majority (34%)
- late majority (34%)
- laggards (16%)

(pp262-6)

Whilst not suggesting that these percentages would necessarily directly translate to the teaching population, Rogers' classification suggests that teachers will have different dispositions towards change, learning and innovation. Research in teacher biography (eg Goodson et al 2002; Goodson 2003) has demonstrated that the distinction between the personal and the professional is often blurred, and hence other more personal aspects of teachers' lives have an impact on the professional sphere, including professional learning. For instance, Goodson et al (2002) report a case study

of a teacher whose receptiveness to a teaching innovation (the use of ICT) was greatly reduced owing to personal circumstances which, superficially, had nothing whatsoever to do with school.

2.5.2 Contextual factors

The 'environment' in which learning takes place is a key factor in that learning. This is expressed in the concept of 'situated learning', where aspects of the context can either support or constrain learning. Awareness of this helps us to understand how some knowledge may prove difficult to transfer, particularly if it has been developed in a specific situation. Hence an experienced teacher moving to a new job in a new school may experience unexpected difficulties simply as a result of being 'new' and hence lacking knowledge of the local context.

A further aspect of the influence of context is to be found in the notion of distributed learning, where the development of knowledge may be supported by and shared among other individuals, and also among objects and tools.

2.5.3 Learning in activity systems

In recognition of the role of both individual and contextual factors in the process of learning, we suggest here that it may be useful to conceptualise learning as being embedded in activity systems, in which learning may or may not be the specific, intended goal. The complex and socio-cultural views of teacher learning and knowledge described so far recognise that learning flourishes in environments which enable purposeful activity and distributed

THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING



cognition (Somekh 2001). Teachers learn and develop their professional knowledge best when the aims and purpose of activities are relevant and authentic to their own lives; when they can use a variety of tools to help them realise and express their goals; and when they are in relationship with others in the wider community which shares rules and ways of working.

When we attempt in Section 3 to understand the role that digital technologies might play in supporting teacher learning, therefore, we need to adopt a model for framing the discussion that takes into account these elements of 'purposeful activity', of 'learning in social contexts', and which also offers a way of understanding the role played by tools, including new digital technologies. One such approach is to consider these environments as 'activity' systems (Wertsch 1998; Engeström et al 1999). This is because, within the concept of an activity system, people are seen to carry out actions or behaviours, including talk,

thought or knowledge construction, using mediating tools (including language and other artefacts) to support them in purposeful tasks. The key to this approach is that neither the teachers nor the tools may be understood in isolation. Rather, both are to be understood as aspects of 'mediated action' (Wertsch 1998, p180; Engeström 1999, pp28-9), itself occurring within a more complex social setting:

"In this system, individuals and/or groups engage in activities with purposeful outcomes, assisted or constrained by the unique features (affordances) of the tools themselves and the rules, structures and divisions of labour that govern the micro and macro social groupings in which the activity occurs." (Somekh 2001, p165)

A generalised representation of the activity system is shown in Figure 1.

The use of specific activity systems as a frame for understanding teacher learning is helpful in acknowledging that individuals do not learn or act alone.

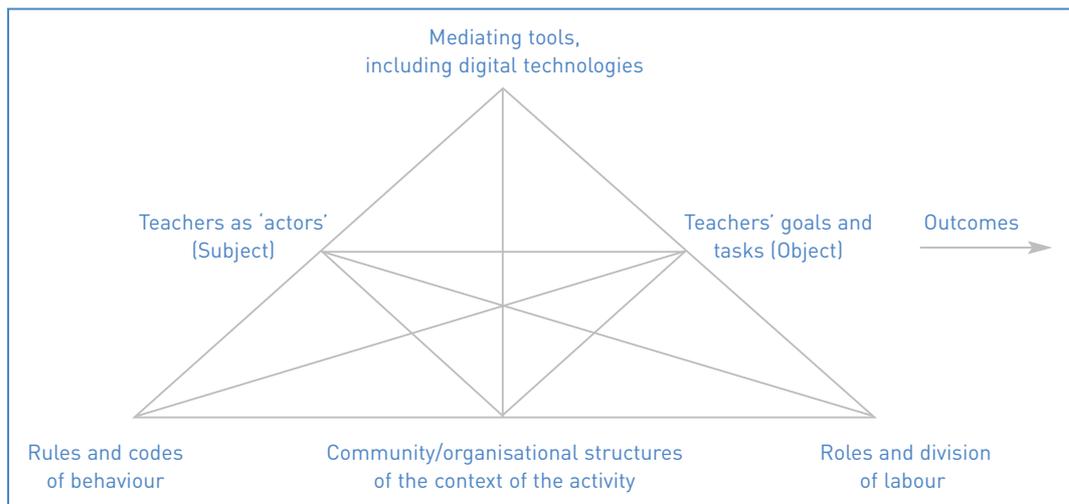


Fig 1: The activity system context of teacher learning

Rather, individual 'actors' play a part in the interactions with other people and their expectations, and with different tools, which help them to engage with and express their learning processes. Such a framework helps us to shift the focus from teachers as individuals, to the more complex interactions that relate to and influence their learning experiences, as expressed by the lower part of the triangle. Hence we see, for instance, that wider structures, such as the ways in which learning and teaching are organised at the level of the school timetable, or the presence of a particular assessment regime, may influence the learning opportunities of individual teachers.

2.6 COMPLEXITY AND CURRENT CONCEPTIONS OF TEACHER KNOWLEDGE AND LEARNING

In this section we focus on three models which bring together several aspects of the foregoing discussion of teacher knowledge and learning. These models, developed by Banks, Leach and Moon (1999), Hoban (2002) and Shulman and Shulman (2004), are not incompatible with one another. Rather, they provide three alternative ways of portraying the complex, dynamic, situated, individual and social nature of teacher knowledge and learning.

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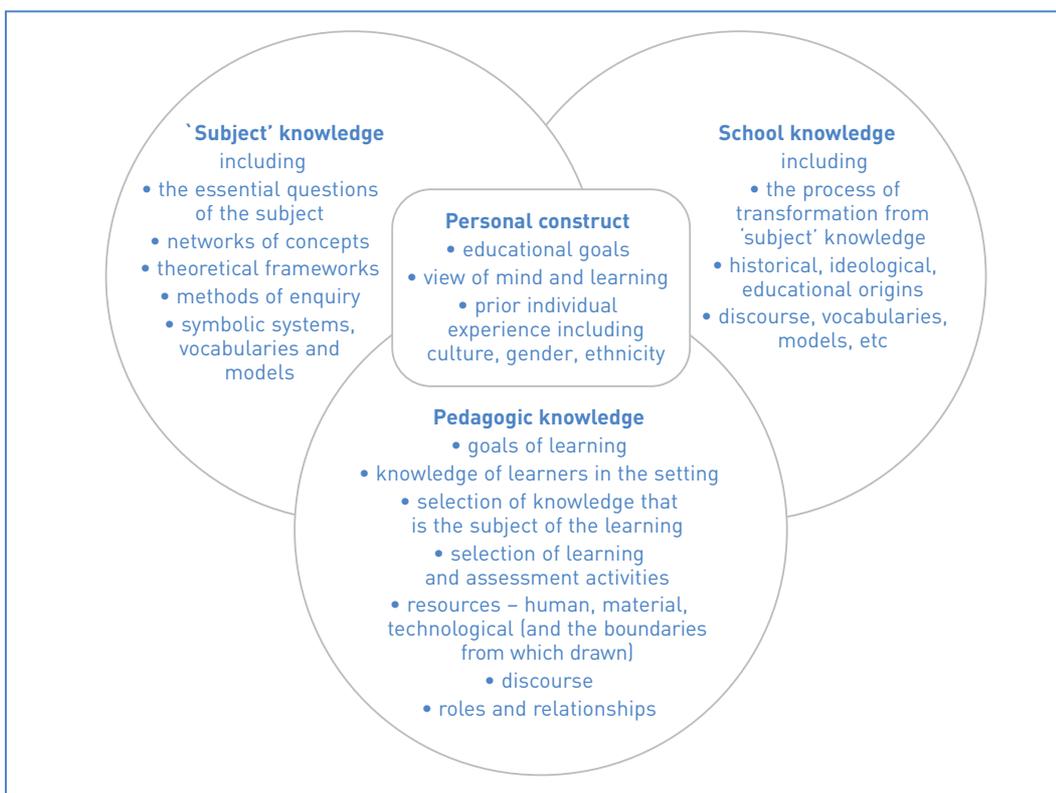


Fig 2: Teacher knowledge used in creating a pedagogic setting
(Taken from Leach, J and Moon, B (2000), p396)

THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING



teacher knowledge is multifaceted and subject to many influences

2.6.1 Banks, Leach and Moon

Work by Banks, Leach and Moon (Banks et al 1999; Leach and Moon 2000) has attempted to provide a more developed view of teacher knowledge than Shulman's original formulation of 1987. Their model, based on in-depth development work with teachers, draws on a number of perspectives (including Shulman's) in presenting a view of teacher knowledge that is dynamic and interactive and which allows for complexity and subtlety. Banks, Leach and Moon also recognise the political nature of the debate in times of an increasingly specified curriculum (eg the National Curriculum) and central guidelines on how to teach it (eg the National Strategy), by resisting the definition, by others, of teachers "primarily as technicians or pedagogical clerks" (Leach and Moon 1999, p109), and by reasserting the importance of the teacher as a knowledgeable professional. Hence, in addition to identifying three interrelated knowledge domains as shown in the diagram (Figure 2), they place at the centre of their model (and their thinking) the 'personal constructs' which "would encompass, but go well beyond, elements... identified by Hay McBer (2000) as characteristics of effective teachers" (Leach and Moon 2000, p397).

2.6.2 Hoban

Banks, Leach and Moon's model of professional knowledge embodies the realisation that teacher knowledge is multifaceted and subject to many influences, including the teacher her/himself. Thus, teacher knowledge is complex. It is not to be viewed from

a position where 'the known' may be unproblematically separated from 'the knower', and where personal experience is not relevant (Doll 1993). Rather, the individual is key, and different individuals in similar situations can learn and know very differently. This idea draws on complexity theory in which it is recognised that similar initial conditions for change do not necessarily yield similar outcomes, and in which small causes can produce large, if unpredictable, effects. Schools themselves may be regarded as "complex adaptive systems" (Morrison 2002).

Hoban (2002) builds on this by taking explicit account of complexity theory (pp22-40) in the rationale for his 'professional learning system' (PLS), which is a conceptual and practical model for supporting the professional learning of teachers. In this perspective teacher knowledge is seen as constantly being reconstructed in the course of experience and of interaction with others. Such a dynamic, situated, social view of teacher knowledge is incompatible with mechanistic 'one-shot' training models; nevertheless, there is an important place in the model for conceptual inputs of new ideas from outside the local setting. Hoban's PLS (pp67-70) describes the context for a planned approach to long-term teacher learning. His PLS draws on complexity theory to provide a context for learning which is both 'transformative' (resulting in change to practices) and 'generative' (in producing new knowledge). In the systems approach of Hoban's PLS, relations among the components shown in Figure 3 may be as important as the components themselves (Hoban 2002, p60-1).

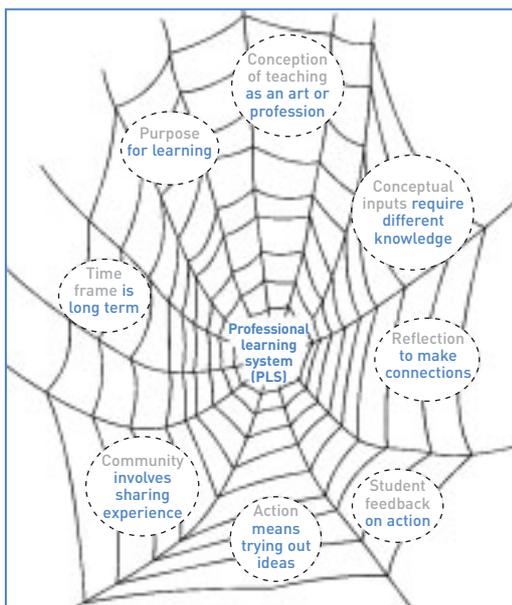


Fig 3: Conditions for teacher learning in a professional learning system (PLS)
 [Taken from Hoban, G (2002), p70]

2.6.3 Shulman and Shulman

A somewhat different way of presenting situated complexity as the context of teacher learning is offered by Shulman and Shulman (2004). On the basis of their work with ‘accomplished’ teachers, Shulman and Shulman identified the characteristics of these teachers which were associated with their becoming accomplished:

“We would now stipulate that an accomplished teacher has developed along the following dimensions: **An accomplished teacher is a member of a professional community who is ready, willing, and able to teach and to learn from his or her teaching experiences.** Thus, the elements of the theory are: Ready (**possessing vision**), Willing (**having motivation**), Able (**both**

knowing and being able ‘to do’), Reflective (**learning from experience**), and Communal (**acting as a member of a professional community**). Each of the dimensions entails an aspect of personal/professional development, and can connect with portions of a curriculum of teacher preparation or professional development. We can think of teachers becoming:

- ready to pursue a vision of classrooms or schools that constitute, for example, communities of learning;
- more willing to expend the energy and persistence to sustain such teaching;
- more understanding of the concepts and principles needed for such teaching;
- more able to engage in the complex forms of pedagogical and organisational practice needed to transform their visions, motives and understandings into a functioning, pragmatic reality;
- more capable of learning from their own and others’ experiences through active reflection in and on their actions and their consequences; and
- more capable and experienced in working as members of functioning learning communities and/or of forming such communities in the settings where they work.

In list form, the new model argues that the features of accomplished teacher development, and thus of teacher learning, are: Vision, Motivation, Understanding, Practice, Reflection, and Community.” (Shulman and Shulman 2004, p259, emphasis and capitalisation as original)

The Shulman model proposes a ‘nested’ formulation, shown in Figure 4. It places



THE NATURE OF TEACHERS' KNOWLEDGE AND LEARNING



teacher knowledge and teacher learning are two sides of the same coin

individual reflection at the centre, and arranges round the activity of reflection three 'levels of analysis' or 'layers': individual, community and policy. Each layer reflects the composition of the others. The 'individual' level is described in the above quotation. The communal level represents explicit recognition that teacher learning is to be seen as situated in communities of teachers: "...the individual and community levels are both independent and interactive" (p267). Policy, the outermost layer, represents the allocation of resources, for which Shulman and Shulman use the metaphor of 'capital'.

2.7 SUMMARY

Teacher knowledge and teacher learning are two sides of the same coin. Teacher knowledge is best seen as dynamic, and hence inseparable from the processes of learning. Teacher learning in turn is an active, experiential process, through which knowledge is enacted, constructed and revised. This does not however mean that teacher knowledge is only to be developed through experience and reflection. There is also a role for 'conceptual inputs' (Hoban 2002, p69) which may provide stimulus for different actions, including different

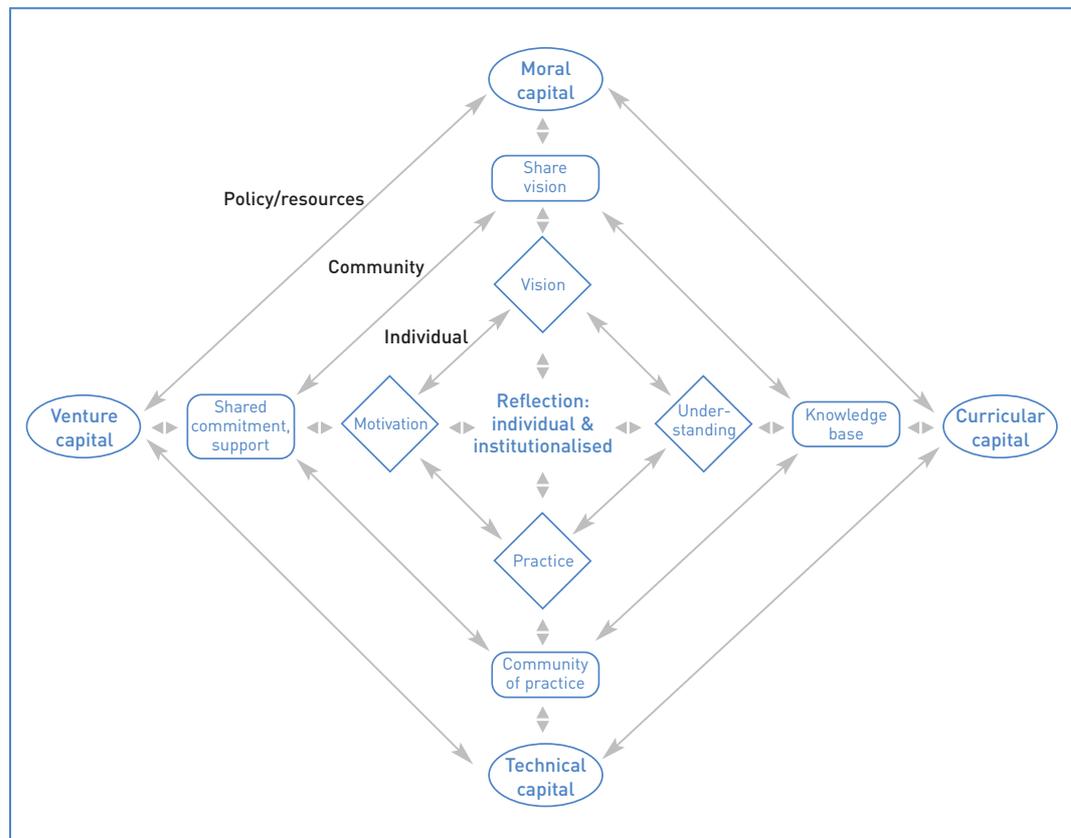


Fig 4: Levels of analysis: individual, community, and policy
(Taken from Shulman, LS and Shulman, JH (2004), p268)

TEACHER LEARNING AND THE AFFORDANCES OF DIGITAL TECHNOLOGIES



pedagogical thinking and different professional discussions.

Teacher learning is subject to many influences (Banks et al 1999), and hence is best seen as complex and resistant to standardisation. This complexity reflects the interplay between the professional and the personal, the individual and the social, the objective and the subjective, the formal and the informal, the situated and the generalised.

Teachers themselves may be individually more or less disposed towards professional learning, which requires vision, capability, motivation, reflection and willingness to participate in a professional community of practice (Shulman and Shulman 2004). Hence teacher learning is to be seen as a blend of the individual and the social, with due attention to be given to both aspects.

In the following section we will take the five core components of the Shulman model - vision, capability, motivation, reflection and community – and bring them together with the idea of digital technologies as tools in support of teacher learning, in a context of mediated action.

3 TEACHER LEARNING AND THE AFFORDANCES OF DIGITAL TECHNOLOGIES

In the previous section we examined a number of ideas relating to teacher knowledge and learning. In this section we will examine the idea of digital technologies as tools in support of teacher learning, in a context of 'mediated action' (Wertsch 1998) in activity systems. Such a perspective will enable us to examine the particular affordances of these technologies. We then bring these affordances together with the five core components of the Shulman model - vision, capability, motivation, reflection and community – in order to identify how digital technologies can support teacher learning.

3.1 WHAT CAN DIGITAL TECHNOLOGIES HELP US TO DO?

Digital technologies can play a role as tools which afford learners the potential to engage with activities. The use of such tools may extend or enhance their users' abilities, or even allow users to create new ways of dealing with tasks which might also change the very nature of the activity. The technologies can also provide limitations and structure to activities, influencing the nature and boundaries of the activity. These 'affordances' and 'constraints' can be enabling and complementary as learners use them purposefully, but they do not exist as absolutes, or entities with power of their own (Gibson 1986; Greeno 1994; Kennewell 2001; Howells 2005). The affordances of digital technologies must be considered in relationship to the characteristics of the wider activity system with its people, tasks,

digital technologies can play a role as tools which afford learners the potential to engage with activities

TEACHER LEARNING AND THE AFFORDANCES OF DIGITAL TECHNOLOGIES



rules, structures and divisions of labour interacting with each other. Such an approach helps to set technologies in a wider and interactive context, rather than focus particularly on them in isolation.

The 'features' of digital technologies which could make a distinctive contribution to activities have been described as provisionality, interactivity, capacity, range, speed, accuracy, quality, automation, multimodality, neutrality and social credibility (DfEE 1998; Sharp et al. 2002). Such a way of describing the features locates these characteristics in the technologies themselves, and does not open up the understanding of the interaction between digital technologies as tools and the people who use them purposefully within activity systems. It is therefore more helpful to consider the affordances of digital technologies in context in order to gain greater insight into

how these support and interact with the development of teachers' professional knowledge within a range of learning environments.

Conole and Dyke describe the affordances of ICT as epitomising the features of late modernity, and offer a taxonomy of: accessibility; speed of change; diversity; communication and collaboration; reflection; multimodal and non-linear; risk, fragility and uncertainty; immediacy; monopolisation and surveillance. They argue that making these affordances explicit will help practitioners to make informed choices about how they might use digital technologies (Conole and Dyke 2004).

Another framework which offers a way of looking at digital technologies in use is that of 'ICT capability', which relates understanding and competence to the

Knowledge building	<ul style="list-style-type: none"> • adapting and developing ideas • modelling • representing understanding in multimodal and dynamic ways
Distributed cognition	<ul style="list-style-type: none"> • accessing resources • finding things out • writing, composing and presenting with mediating artefacts and tools
Community and communication	<ul style="list-style-type: none"> • exchanging and sharing communication • extending the context of activity • extending the participating community at local and global levels
Engagement	<ul style="list-style-type: none"> • exploring and playing • acknowledging risk and uncertainty • working with different dimensions of interactivity • responding to immediacy

Table 1: Clusters of purposeful activity with digital technologies

general processes of dealing with information. The word 'capability' carries the meanings of having power or fitness for a task, being qualified and able, being open to or susceptible to development, and implies a knowledge or skill being turned to use, an ability which is used actively, involving understanding and choice (Loveless 2003). The National Curriculum for ICT identifies key processes of such capability as finding things out, developing ideas and making things happen, and exchanging and sharing information (DfEE 1999b).

We have considered how the description of the features of ICT, the taxonomy of affordances described by Conole and Dyke and Loveless' understandings of ICT capability as purposeful and appropriate human activity might be woven together. We propose to describe the affordances of digital technologies as 'clusters' of purposeful activity in teacher learning, as laid out in Table 1.

These clusters, whilst identified separately here for purposes of description and clarification, are not to be regarded as mutually exclusive – rather, they may be seen as overlapping and interleaving aspects of activity, and may more normally occur in association with one another, rather than separately. How might such clusters of affordances of the digital technologies be expressed in models of professional knowledge, and therefore be recognised in the design and experience of projects, environments and initiatives for teacher learning?

3.2 AFFORDANCES OF DIGITAL TECHNOLOGIES AND MODELS OF TEACHER LEARNING

In Section 2 the models described by Banks, Leach and Moon (1999), Hoban (2002) and Shulman and Shulman (2004) offer frameworks to express the features of professional knowledge and learning. These frameworks also reflect the characteristics of environments, settings and experiences in which learning might flourish for individuals and communities. The features that Shulman and Shulman describe of accomplished teacher development and teacher learning - vision, motivation, capability (subdivided into 'understanding' and 'practice'), reflection and community - were summarised more colloquially as being 'ready, willing and able'.

Shulman and Shulman hoped that their model would be used to "design, diagnose or explain efforts at teacher learning in a more self-conscious and effective manner" (2004, p269). In considering the contribution of digital technologies to teacher learning, the affordances of the technologies can be viewed as tools in expressing and developing the dimensions of being 'ready, willing and able'. The model is helpful in two ways:

- It can be used to describe a 'snapshot' of the dimensions of teachers' professional knowledge at the different levels of individual, community and policy. This locates teachers as individuals within the wider interactions in the systems, thus helping to explain why some initiatives and innovations might be successful in some contexts but not others.

TEACHER LEARNING AND THE AFFORDANCES OF DIGITAL TECHNOLOGIES



- It can indicate a goal in designing experiences and environments for teachers' learning. Professional development initiatives need to ensure that the interactions between the dimensions and layers are recognised in planning, reflection and evaluation.

What might these dispositions of 'ready, willing and able' look like in the context of teacher learning in an 'information age' in which digital technologies play such a significant role? How might these dimensions of teacher knowledge relate to teachers' own ICT capability and recognition of the affordances of digital technologies? Given what we understand about teacher learning, how might we exploit the affordances of digital technologies as tools in developing professional knowledge? How might we articulate our 'affordance clusters' of knowledge building, distributed cognition, community and communication and engagement with the features of teacher learning - vision, motivation, understanding, practice, reflection and community - taken from the Shulman model?

3.2.1 How can digital technologies support the development of teachers' vision for education?

Shulman and Shulman define one feature of an accomplished teacher - vision - as being ready to pursue a vision of classrooms or schools that constitute, for example, communities of learning. In their model there is interaction between the levels of moral capital, shared vision and vision in policy, community and individual. This creates the range of understandings of the goals of education in an 'information

society' which itself can be perceived as inevitable, pervasive and associated with economic and social change. In the context of teacher learning we take 'vision' to have three elements: views of purposes of education within society; views of learning and teaching; and expressions of wider visions of teachers' own professional identity and contribution.

The affordances of digital technologies have not only played a role in changing the social, cultural and economic landscape of society, but also in developing teachers' vision of education. The affordance cluster of distributed cognition supports this by providing mechanisms for receiving and gathering information about the nature of the world. However, teachers need a critical view of utopian and dystopian views of the 'information age', and an awareness of the possibilities of bias, selection and manipulation and the influence of vested interests. The community and communication cluster affords opportunities for sharing views of the world as well as providing communal support for cultures of resistance to unwelcome influence. Vision is also developed through the engagement affordances through personal experience, exploration and informal learning with digital technologies.

3.2.2 How can digital technologies support teachers' motivation to learn and develop their practice?

Motivation for an accomplished teacher is described in the Shulmans' model as being willing to expend the energy and persistence to sustain teaching that matches their vision. Teachers' willingness to engage with innovation and change is

how might we exploit the affordances of digital technologies as tools in developing professional knowledge?

closely related to their vision of their professional role and identity. Their motivation to learn is linked to the ways in which they are able to engage in professional development which is relevant, useful and rewarding in improving practice in teaching and learning. Developing ideas and materials; accessing information and resources; participating in sharing and exchanging information with colleagues; and exploring new resources which make a contribution to the curriculum and a range of teaching strategies, are essential activities in teacher preparation, presentation and learning.

Just as there are many factors which act as barriers and enablers to teachers' use of ICT (Jones 2004; Scrimshaw 2004), the affordances of digital technologies can act as both enablers and barriers to motivation to learn. The knowledge building cluster enables teachers to use and adapt multiple representations of subject content, and develop their ideas and own materials for use with their pupils. The distributed cognition cluster provides access to information and resources, potentially increasing the range and quality of material, yet raising issues of information overload and the need for critical appraisal of what is on offer. Community and communication affordances allow participation in sharing and exchanging information with colleagues, and being exposed to others' experience. The informal learning inherent in successful play with digital technologies is a powerful example of the engagement cluster supporting motivation. A barrier is the time required for such playful activities, and a perception, born of a pervasive culture of performativity, that because it may not yield an immediate,

identifiable result, it is not worthwhile. Teachers may well be highly motivated to use digital technologies in their personal development of professional knowledge, and very aware of the presence of and priority given to digital technologies in their own learning and practice, yet not be willing or able to change their pedagogy. This may not be because of personal resistance, but could be related to other factors in the system. For example, if the curriculum and assessment frameworks in which they work do not require or recognise professional and pedagogical change with digital technologies, teachers may not feel encouraged to change in this way.

3.2.3 How can digital technologies support teachers' professional knowledge, understanding and practice?

The category of 'understanding' in the Shulman model of an accomplished teacher is quite large and closely related to 'practice' in the overall category of 'capability'. It includes the aspects of professional knowledge first described nearly 20 years ago (see Section 2.2.2).

The knowledge building cluster of affordances can play an important role in teacher learning, not only in providing multiple representations of traditional and developing disciplinary knowledge, but also acting as mediating tools in challenging conceptual understanding in the disciplines, from musical composition (Gall and Breeze 2005) to the human genome. Digital technologies can be appropriated not only to 'amplify' knowing, but also to 're-organise' cognitive practice. Crook (2001) illustrates such appropriation

TEACHER LEARNING AND THE AFFORDANCES OF DIGITAL TECHNOLOGIES



digital technologies might challenge understandings of subject knowledge

by describing how the use of word processors, for example, not only allows more text to be written in the time (by a competent keyboard typist), but also “restructures the underlying system of writing – it gets it done differently” (p26). The distributed cognition cluster is closely associated with the affordances for knowledge building, in that digital technologies not only provide access to information, materials and representations of the different aspects of professional knowledge, but also play a part in the composition and presentation of teachers’ conceptual understanding. The community and communication affordances enable teachers to participate in a variety of ‘knowing communities’ – from subject associations to formal and informal professional groupings. Engagement can be reflected in the whole experience of teachers’ learning with digital technologies – from word processing to WebQuests, wikis, PDAs and locative media.

Digital technologies might challenge understandings of subject knowledge, but this in turn will challenge understandings of Pedagogic Content Knowledge, which might then demand changes in curriculum resources, teaching strategies and approaches to timetabling and classroom management. Loveless, DeVoogd and Bohlin (2001) draw attention to how digital technologies can provoke shifts in understanding of knowledge itself as it is presented in the school curriculum. Traditional curricula can present knowledge as static, impersonal and unchanging, yet this misrepresents the revisionary, creative, personal and pluralistic character of knowledge – characteristics which can be clearly expressed through the affordances of digital technologies.

The ability to engage in appropriate performance in practice is described by Shulman and Shulman as “the heart of teaching, the capacity for intelligent and adaptive action” (2004, p263). An accomplished teacher is not only ready, willing, but also able to express vision, motivation and understanding through action and practice. McCormick and Scrimshaw (2001) present a detailed description and discussion of three levels of change in practice with digital technologies, and how these affect professional knowledge. The levels of change are described as “... to improve efficiency of conventional teaching, to extend the reach of teaching and learning, and to transform teachers’ and learners’ conceptions of the subject itself” (ibid pp44-45). Drawing attention to the ways in which many official Government initiatives in the UK, whilst using the term ‘transformation’, actually focus more on ‘efficiency’ levels of change in practice, McCormick and Scrimshaw’s analysis provides a useful framework to support the design and evaluation of the development of teacher learning and practice with digital technologies. It is in action and practice that the affordances of knowledge building, distributed cognition, community and communication, and engagement, are expressed, and illustrations of such practices in professional development projects are presented in more detail in Section 4.

3.2.4 How can digital technologies support teachers’ reflection?

Critical and analytical reflection is considered to be central to teachers’ professional learning and practice (Schon 1983; Mason 2002; Pollard 2002; Shulman

and Shulman 2004). Professional development should “enhance teachers’ capacities to learn from their own and one another’s experience” and influence their potential for purposeful change (Shulman and Shulman 2004 p264).

Reflective knowledge building can be supported by technologies such as digital video, which enable teachers to capture, observe and review critical moments in their own practice. This can be extended by applications which enable teachers to select examples of such episodes, and then analyse and annotate these selections, linking them to reflective commentary through text, image and hyperlinks [see, for example, the use of 'VideoPapers' in Olivero et al 2004]. The community and communication affordances can be exploited as teachers reflect upon their practice within a wider community. They can use communication tools to engage in reflective analysis of materials and experiences with colleagues and mentors, and such opportunities for reflection, both on general practice and the use of ICT in their teaching, need to be built into and prioritised in the design of professional development schemes and innovations.

3.2.5 How can digital technologies support teachers’ learning in community?

In describing their model, Shulman and Shulman recognise the mutual shaping and interactions between individuals and the groups and communities within and between which they work and move. Vision, motivation, understanding, practice and reflection can be expressed at the level of

local communities through shared visions, community commitments, communities of practice and joint review. Individuals within communities can flourish, or be inhibited; they can also make positive or negative contributions to the development of the community. Digital technologies can play a role in supporting teachers in gaining and sustaining a communal orientation in their professional learning.

The knowledge building cluster of affordances supports learning in community when ideas, knowledge and understanding are co-constructed with tools such as wikis, shared databases, online conferencing, discussion forums and VLEs (virtual learning environments). The distributed cognition cluster can also be expressed in the connection between people using digital technologies to work together with information and representations. There are clear overlaps with the discussion of the community and communication affordances in each of the dimensions discussed above – accomplished teachers can draw upon digital technologies to help them learn to be ‘ready, willing and able’ in connection with others. Barnett notes how networked technologies can support teacher professional development by reducing individual isolation and supporting sharing of experience; by fostering reflection and influencing the development of practice; and playing a role in process of forming communities of practice (Barnett 2002).

3.3 SUMMARY

In Section 2 we described teacher knowledge and learning as situated, complex and generated in “the interplay between the professional and the personal,



reflective knowledge building can be supported by technologies such as digital video

CASE STUDIES



the individual and the social, the objective and the subjective, the formal and the informal, the situated and the generalised". In the current section we have discussed how knowledge building, distributed cognition, community and communication and engagement are all processes involved in the development of teachers' professional knowledge as an expression of dispositions to be 'ready, willing and able'. The affordances of digital technologies can be articulated with the Shulman model's features of vision, motivation, understanding and practice, and can support reflection and community at individual, community and policy levels. In this section we have also indicated the complexity of the interactions between factors which enable, constrain, challenge or contradict our understandings of the contribution of digital technologies to teacher knowledge.

4 CASE STUDIES

In this section we provide some detailed case studies to exemplify some of the principles of teacher knowledge and learning, as outlined in Section 2, and the learning affordances of activity in which digital technologies are part of the context, as outlined in Section 3. We do not seek to provide a comprehensive, synoptic overview of all that is happening in this fast-changing field. Rather, we have chosen cases (and we acknowledge that we could have chosen others, to equal effect) which are fully taking advantage of and exploiting one or more of the 'affordance clusters' identified in Section 3: knowledge building, distributed cognition, community and communication, and engagement.

4.1 THE MULTIMEDIA PORTABLES FOR TEACHERS PILOT

This case study is among a group of projects referred to as the 'Education Departments' Superhighways Initiative' (Scrimshaw 1997). The Multimedia Portables for Teachers Pilot (MPTP) placed multimedia portable computers in the hands of 1,150 teachers in 575 primary and secondary schools. The computers were supplied with internet subscriptions and a selection of pre-installed productivity software, together with a selection of reference and subject-focused CD-Rom titles. The two main project aims were to:

- increase teacher confidence and competence in the use of IT resources
- promote learning in the pupils taught by the teachers taking part in the pilot.

(University of Nottingham School of Education 1998)

It can be seen that in MPTP the digital technology was both the means of supporting teacher learning and the object of that learning.

A notable feature of MPTP was the almost complete lack of formal structure: the only requirements upon teachers were to attend a session to familiarise them with their computer, to connect to the internet, and to cooperate with the evaluation. Hence, teachers were free to learn about and use their computers wherever and however they saw fit.

The project report notes that 98% of teachers involved in the project made effective use of their computer, though many started from a low base of personal ICT capability. Teachers involved in the project completed a baseline questionnaire, including self-ratings of confidence and competence. Self-rated confidence and competence in the use of the computer were both seen to increase markedly during the life of the project, as demonstrated by questionnaire results from over a thousand participants, and borne out by school visits. At the end of the project, 93% of participants "felt that their knowledge of IT had increased 'substantially'" (ibid, p5).

A very small minority of teachers did not make particularly effective use of their computer in comparison with others involved in this highly successful project. This seemed to be associated with one or more of: a low level of confidence, poor support or poor motivation. However, the first two were not sufficient conditions, and were often overcome by other project teachers with a stronger 'internal locus of control'.

The evaluation report concludes: "This pilot has been an extremely successful one, and it has changed many teachers' lives. An important part of the success is related to the ongoing nature of the learning which the project has facilitated" (ibid, p32).

Recognition of the possibility of social learning among teachers was built into the project, in that computers were placed with two teachers in a given school, giving the potential for working with a local 'partner'. In some primary schools this led to a particular degree of collaboration, as it did where the two teachers were in the same secondary school department. However, in most of the 60 schools visited as MPTP case studies, "there was surprisingly little relationship between the two teachers on the project, and in some secondary schools in particular there was virtually no contact" (ibid, p28).

However, other social learning, often in informal contexts, was supported by the affordance of portability, which meant that:

"Teachers who did not have access to a strong support structure in their usual working environment at school could gain access to one, from colleagues, friends, neighbours or family... [so] portability gave access to informal support networks, which assisted many teachers in solving problems and increasing confidence." (ibid, p31)

The affordance cluster of distributed cognition was exemplified in this project, as the computer supported access to distributed knowledge. Teachers used the project CD-Roms and in some cases bought additional titles to supplement those provided by the project. Teachers

CASE STUDIES



the technology had an impact on the teachers' vision, motivation, understanding and practice

also made use of the internet for e-mail communication, and for web-based information. One project teacher in an MPTP case-study primary school, who was a computer non-user before the project, said, "Everything I've learnt is from the net" (ibid, p51), which she described as "a tremendous self-helping organisation" (ibid, p50). Portability also had a bearing on the notion of distributed knowledge, in the sense that teachers used the computer at home and at school, with portability rendering the computer, with its contents of (say) electronic marksheets and draft reports and worksheets, as something of an electronic briefcase.

Since there were so few specific requirements of teachers participating in the project, what teachers actually learnt, and how they learnt it, varied according to their different personal and professional contexts. This approach allowed elements of the engagement and knowledge building affordance clusters to come into play. One of the evaluators wrote in a summary report, "There was great diversity in what the teachers did: no two were the same" (ibid, p13). Thus there was considerable personalisation of learning within the project according to the situations in which teachers were using the portable computers. Some, prioritising the use of the computer in the teaching situation, were developing personal pedagogical content knowledge relating to the use of ICT. Others, using the computer at home, were developing their personal ICT capability by, for instance, searching the web in connection with a hobby before gaining sufficient confidence to use the computer in their teaching. There were numerous other examples where the lack of specified project requirements could be seen as helpful in supporting different

highly localised (and, hence, highly situated) use of, and learning about, the computer.

This adaptability of MPTP to take account of highly individual circumstances enabled teachers to learn to use aspects of the technological tool as a 'mediating artefact' to address their own authentic purposes, specified according to their individual needs and interests within their own situations. Thus learning in MPTP was both individual and social. The project displays, if not an architecture, then at least the presence, of opportunities for teachers to engage in the development of knowledge that is "participatory, distributed and socially guided" (Crook 2001, p19). Hence the project may be seen to be an example of those "innovations of computer use in education [that] implicitly endorse this cultural view of knowing" (ibid). In terms of the frameworks discussed in Section 2, the affordances offered by the technology had an impact on the teachers' vision, motivation, understanding and practice.

4.2 TALKING HEADS COMMUNITY

The Talking Heads online community began as a pilot project in 1999 for the 1,200 new head teachers appointed in England to their first headship during that year. It aimed to reduce isolation, enable the sharing of good practice and offer emotional and professional support. When the National College of School Leadership (NCSL) was proposed, with the stated aim of providing school leaders with "the chance to share their experience of what works" and "the opportunity to learn from the best in leadership", it was realised that:

“The major part of the college’s operations must be available on-line as a virtual college... It will establish new networks within the profession, including problem-solving groups of heads across the country, discussion groups on priority issues, on-line master classes, and access to the most up-to-date research evidence.” (DfEE 1999a)

Thus, after its successful pilot, Talking Heads was absorbed into the new NCSL in 2000-2001, and by 2002 there were approximately 6,000 members of the community. Talking Heads is now (2005) just one of a number of online communities grouped under the umbrella of NCSL talk2learn, which has 71,000 members. It has become a centrally organised, highly structured, social arena.

From the beginning, the software for Talking Heads provided a range of online tools to support communication. These have developed over time and now include (NCSL 2005):

Asynchronous dialogical tools to support discussion:

- conversations allow users to engage in a discussion
- discussions have contributions divided into topics and threads
- debates allow users to contribute around different themes or positions, contributions are colour coded according to the debating position taken
- brainstorms allow users to contribute ideas anonymously into an online space
- ‘hotseats’ allow contributors to ask questions of a guest or expert who is then able to respond; questions and

answers are threaded to allow further discussion.

Synchronous communication tools:

- chat provides a facility for a group of users to meet online at a specified time for real-time discussion
- whiteboard provides a graphical interface enabling discussion to take place around images, diagrams etc
- instant messaging provides one-to-one synchronous communication.

Other tools:

- page publishing allows text, audio and video to be uploaded and shared
- articles allow users to write and publish text-based information
- e-mail provides a web-based e-mail facility
- sticky notes can be written and left for other users to see.

This sophisticated collection of collaboration tools is designed to scaffold learner interactions and afford a range of learning behaviours, demonstrating how online learning can enable a variety of interactions.

NCSL published a summary evaluation report (NCSL 2002) based on: regular reports from the developers Ultralab, based at Anglia Polytechnic University; a commissioned evaluation from Bristol University, which undertook a sample of users and examined other research evidence in this field; questionnaire surveys of users; internal NCSL evaluations.

CASE STUDIES



informal online communities can help to reduce head teacher isolation

The Bristol evaluation reported:

"This innovative strategy is uniquely ambitious... [there are no] other programmes operating on a magnitude of scale comparable to [these] communities." (ibid, p2)

An Ultralab questionnaire survey of 165 users in 2001 reported:

- 44% of the members surveyed were able to list concrete ways in which Talking Heads was increasing their effectiveness
- 40% of heads were also able to identify that the use of Talking Heads had led to school improvement.

(ibid, p8)

The main findings of the evaluations were found to be:

- informal online communities can help to reduce head teacher isolation
- active and relevant online communities can enable head teachers to generate and exchange insights regarding practice that can develop capacity for school improvement
- the expertise within Talking Heads is a valuable resource for school improvement and for exchanging and archiving expertise
- large cohort communities provide an effective way for head teachers to gain quick access to a spectrum of perspectives on key topical issues
- small communities provide an effective support environment, especially when commitment to participation is embedded into the community's purpose and development

- Talking Heads has made an important contribution to the use of ICT by heads and their understanding of its contribution to learning and school management.

(ibid, p5)

A key feature in the success of the Talking Heads community has been the role of facilitators in administering and developing the community environment, and providing interactive help, support and encouragement for the heads. As the Ultralab team reported:

"The overriding factor behind building commitment and purposeful activity is the role and activities of the facilitator, who has professional educational knowledge and builds personable and purposeful relationships with head teachers. Facilitation is a complex, skilled, professional task." (Bradshaw et al 2002, p9)

The Talking Heads community sought to be the virtual space where all 24,000 head teachers in England could engage in dialogue. This shared communication extended the community of practice for each head beyond anything previously envisaged, and exploited the affordances we have called community and communication. The distributed nature of the knowledge available to a head exemplified the distributed cognition affordance cluster. This was evident in the access to guests and experts via the 'hotseat' activities, but also via natural discourse with all the other participants, and the access to the growing resource that they were developing together.

It is likely that head teachers entering into the Talking Heads community were already ready and willing to participate - they had

vision and motivation - but the affordances of the technology (the use of facilitators, the expertise available within the community, the range of tools to encourage communication and collaboration) encouraged them to engage with the learning community, be more reflective and helped them to develop their abilities.

4.3 TEACHERS' PROFESSIONAL DEVELOPMENT IN THE USE OF ICT IN SUBJECT TEACHING – KS3 SCIENCE PILOT

In 2002 a pilot project for online CPD in the use of ICT in subject teaching was conducted for Key Stage 3 science teachers. The intention was to develop higher order ICT skills of teachers who had completed their basic ICT training under the New Opportunities Fund (NOF) programme and, in particular, to strengthen the teachers' ability to teach KS3 science using ICT. The overall aim was to enhance the teachers' pedagogical content knowledge (their knowledge of how to teach what they teach) by introducing an ICT element, and to use ICT to support that process.

Science departments in 40 schools were given a laptop, a data projector, science software, related online materials and access to a dedicated website. Although two different developers were involved, dealing with 20 schools each, the models of CPD adopted were very similar. The websites were the focal points for the CPD materials. Online pedagogic tutorials offered the teachers suggestions on how to teach a particular topic using ICT. A variety of teaching resources was provided

including digital video clips, animations, documents and simulations. After the lesson had been taught, the teacher would engage in a dialogue with an online mentor by responding to reflective questioning to support the evaluation of the teaching experience that had taken place.

Both developers provided paper materials to introduce the CPD approach and support users. One developer held a face-to-face induction day with participants, which was felt to be particularly valuable, whereas the other provided up to three after-school training and review sessions. In both cases the face-to-face component of the CPD model was appreciated.

The project offered the affordances of knowledge building, both of subject knowledge and of pedagogical content knowledge:

"Many experienced teachers commented on the development of their understanding of the place of ICT in their teaching and of their ICT skills, although their subject knowledge had not been extended. However, for more recently qualified teachers or for those teaching outside their particular subject specialism there was also a contribution to subject knowledge." (Denning et al 2002, p2)

A contributory factor to the success of the knowledge building was the adaptability of much of the material, exemplifying the affordances of engagement:

"There is strong evidence that teachers were able to use the resources as a basis for interesting and effective science teaching. In some cases the materials were used without modification, although a significant number of teachers customized

a key feature in the success of the Talking Heads community has been the role of facilitators

CASE STUDIES



the model has the potential to support small primary schools, small secondary departments or isolated subject specialists

the materials, making adjustments and adaptations to provide a better match with the classes taught.” (ibid, p3)

The situated nature of the learning was felt to be important:

“Materials produced by both developers proved to be highly usable. This was, in part, a consequence of the familiarity of the teaching contexts used by the developers for the deployment of the ICT resources.” (ibid, p3)

Access to distributed knowledge was a feature of the CPD model adopted. A wealth of online material and software was provided, and a multitude of links to web-based resources, ranging from skills teaching to research evidence, was contained within the pedagogic tutorials.

For some participants there was a social element to the learning. In some schools one or two teachers engaged in the CPD process effectively independently, but:

“For many schools the impact reached far beyond individual teachers, prompting department-wide exploration of new teaching strategies and renewed enthusiasm for sharing and collaboration.” (ibid, p4)

The community and communication aspects of the project had varied success. A feature of the CPD model was the intended engagement of the teachers in dialogue with their online mentors. Generally the one-to-one communication was felt to be useful and high quality discussion of classroom use often took place. However, the development of a wider community of practice was less successful, with limited levels of teacher

participation in the online discussions. This may have been due, in part, to the relatively short timescale of the pilot.

The evaluation report concludes that the project was successful in achieving its main aims:

“Teachers reported a positive impact on their ability to teach KS3 science using ICT. A large majority (over 80%) reported that the materials promoted more effective science lessons, supported more effective science learning and raised teacher awareness of ICT use.” (ibid, p2)

and:

“93% of teachers reported an increase in confidence in the use of ICT.” (ibid, p4)

This model had two strikingly successful elements: the high level and quality of conceptual input, exploiting the affordances of knowledge building and engagement, which impacted on the teachers’ understanding and practice; and the requirement for reflection by the teacher on their practice and discussion with their online mentor about their experiences using the material and approaches suggested.

The model has the potential to support small primary schools, small secondary departments or isolated subject specialists by the mechanism of the online mentors, but the establishment of local networks through face-to-face interaction and the subsequent development and maintenance of online communities of practice would require the continued support of facilitators.

In 2004, the approach was extended to develop materials for all KS3 subjects,

together with KS1/2 numeracy and literacy, in the ESTU ICT (Enhancing Subject Teaching Using ICT) programme. Many of the materials developed for ESTU ICT are now being made available by the DfES, free of charge, as the 'Learning and Teaching Using ICT – Practical Support Pack'.

4.4 'E-LEARNING COMMUNITIES' IN INITIAL TEACHER EDUCATION

In January 2004 the then Teacher Training Agency (TTA) (now the Training and Development Agency for Schools - TDA) invited all approved providers of initial teacher training in England to bid for grants to support the development of "e-learning teacher training communities to enhance the delivery of ITT" (TTA 2004, letter to providers).

The 'communities' identified in the specification for bids could be funded up to a maximum of £25,000, and:

"...should be a vehicle for communication between trainees and school and provider based tutors and mentors; encourage the sharing of ideas and practice between trainees and be a link between the trainees and their support; and should be driven by the desire and a plan to improve teaching and learning." (ibid)

A significant aspect of this scheme was its recognition of distributed and situated aspects of knowledge in the preparation of new teachers. Thus, bids could be generated locally, taking account of detailed aspects of a given local situation. From a total of 131 bids submitted, 61 were funded, making use of a variety of technologies. Here we focus on two: the development of the use of a virtual

learning environment (VLE) in the Oxford Brookes University Partnership, and the extension of the teaching and learning observatory (TLO) network in the University of Nottingham Partnership. Short descriptions of a number of the other projects are also available (TTA 2005). Further funding rounds have followed and from those we discuss the use of personal digital assistants (PDAs) in the University of Bristol Partnership.

4.4.1 Virtual Learning Environment (VLE) – Oxford Brookes University Institute of Education

The Oxford Brookes VLE was developed to support the 307 trainees on the Primary PGCE course in 2004/05. During the academic year the trainees undertook school experience placements in 420 schools and 21 school mentors were directly involved with the project. The VLE was intended to provide:

- a structured means of communication between the trainees and university staff for administration purposes during the year
- a central resource supporting university-based teaching sessions
- a communications mechanism for enabling the documentation involved in monitoring trainees' progress while on school experience to be transmitted electronically between the schools and the university
- a forum for mutual support for the trainees while they were away from the university during school experience periods.



CASE STUDIES



The administration function of the VLE was effective, both while the students were in university and when they were out in the schools. There was little use of the VLE by school mentors as a means of communication with their students, and with hindsight this was not felt to be surprising as:

“Conventional communication was preferred – through telephone conversations, e-mail contact and face-to-face meetings. Mentors felt that there is often little to discuss that would be shared beyond the triad of mentor-university tutor-trainee.” (Oxford Brookes University 2005)

The material supporting the university-based teaching sessions usually consisted of session notes enhanced by links, references and commentaries. Only the ICT tutors actively incorporated the VLE into taught sessions. The resources acted as a valuable record of the sessions and provided a library of material allowing access to the widely distributed knowledge base that supports teacher trainee preparation.

The use of the VLE also enabled the use of an extended range of media. Videos were prepared showing trainees what to expect at the start of their placements, and to demonstrate aspects of modern foreign language teaching in the primary school. Audio clips were produced by the music education tutor, for which copyright was negotiated so that the trainees could download them and use them during placements.

“The move into resources of a genuinely multimedia nature is a critical shift which marks the difference between what can readily be offered electronically to enrich

the trainees’ learning in contrast to the limitations imposed by traditional media.” (ibid, p5)

The trainees engaged in video production as well and their films were uploaded into the VLE, as were many still images of both professional and social activities, all of which contributed to the development of the online community.

The structure of the VLE, its content and the approaches adopted make use of the affordances of the knowledge building and distributed cognition affordance clusters.

The discussion forums were successful in developing a feeling of community amongst the trainees, both during the university-based periods of the course and while the trainees were out in the schools during school experience periods, exemplifying the community and communication affordance cluster. The messages were a mixture of professional discussions, requests for ideas for lessons while on school experience, expressions of mutual support and details of social arrangements. It is worth noting that, while there were a large number of messages addressed to the whole cohort in subject area forums, the majority of messages were posted in the teaching group forums. These were forums set up for each of the groups of 30 or so students who attended sessions together, and these groups quickly developed group identities.

Overall in terms of the teaching and knowledge frameworks of Section 2, the project provided conceptual inputs, which were an aid to the trainees’ understanding and practice, and also successfully introduced them to the community of teachers as learners.

discussion forums were successful in developing a feeling of community amongst the trainees

4.4.2 The Teaching and Learning Observatory (TLO) – University of Nottingham School of Education

The Teaching and Learning Observatory (TLO) network consists of a number of sites used to enhance pre- and in-service teacher education in a UK context. The project uses new technologies “to explore the gradual realisation that classroom boundaries can be redefined through teacher education practices. The TLO links a network of remote national and international secondary or ‘beacon’ schools with a university education department through innovative video conferencing facilities and interactive technology: pan/zoom/tilt cameras... video conferencing with large screen facility, ‘hot tables’ and interactive whiteboards” (Do Coyle, originator of the TLO concept).

The original nucleus of the TLO was a video-conferencing link between the University of Nottingham School of Education and Hockerill Anglo-European College in Bishop’s Stortford. In addition to remotely controlled cameras, the installation in both locations included a networked interactive whiteboard and data projection. Before an observation, introductory protocols ensure that the class to be observed is introduced to the observers – ethical principles are adhered to, and observation is not covert. The remotely controlled camera allows the observing group to pan round the room and zoom in on the teacher, and on class activity. Microphones at the observing end of the link may be muted to allow local discussion among observers.

The original focus was on innovative foreign languages pedagogy, with an emphasis on content and language integration (eg geography through the

medium of French). Large groups of student teachers at the School of Education can observe innovative teaching live, as a large data-projected image with sound, with classroom interactive whiteboard use ‘mirrored’ locally. After the lesson they use video-conferencing to discuss the lesson with the teacher and where possible with class members. In addition, lessons may be simultaneously recorded to videotape for later use. This approach makes use of the affordances of the community and communication cluster.

Since its inception the TLO network has expanded, and now includes several schools with similar interactive classrooms and video-conferencing. The TDA-supported project is the most recent phase of the extension of the network, installing a TLO in Swanwick Hall School. This has supported extension of use into other subject areas, where:

“...large groups of trainees have been able to have a shared experience of observing the same lesson in ‘real time’, followed by an immediate debrief with the teacher concerned. This is an enhancement of the training experience, since it supports group discussion and reflection on the basis of a shared experience.” (University of Nottingham School of Education 2005, p5)

The TLO has also been used for a two-centres CPD event, led from Swanwick and with the University TLO as a ‘satellite’ venue. Evaluation indicated the need for more extensive adaptation of the approach to CPD: “I feel that it was a really useful session as it foregrounded several issues about using the technology to support such an event. There are issues about the technology itself, protocols for the users, and the specifics of activities” (session participant).

classroom boundaries can be redefined through teacher education practices

CASE STUDIES



A further use of the TLO link with Swanwick has been to bring a group of school students and student teachers together in a virtual meeting, for the purpose of giving advice to the student teachers about what to do, and not to do, when on teaching practice.

This project provides an example where the affordances of the technology support the reflective and communal elements of teacher learning, and can contribute to the development of vision and motivation for trainee teachers.

4.4.3 Personal Digital Assistants (PDAS) – University of Bristol Graduate School of Education

The Secondary PGCE at the University of Bristol is supported by a VLE with discussion groups, course documents and links to teaching resources. It had been found that regular use of the VLE by students while on teaching practice could be difficult, due to problems of access via traditional computers and availability of storage media. PDAs had been considered as a solution to this problem. Research has also shown the possible benefits for teachers of the use of PDAs in terms of classroom management and presentation of information (Becta 2003). Thus this small-scale project looked at the use of internet-enabled PDAs by 14 PGCE Secondary Science students to enable their access to the VLE and internet, and support their teaching and learning.

The project aimed to investigate the potential of the PDA in particular as:

- an electronic book
- a source of dedicated science software

- an interface to the world wide web especially via a course-linked VLE
- a store of previously recorded pupil data
- a communications device for e-mailing peers and tutors.

(Wishart et al 2005)

After the students had become familiar with the PDAs, they reported value in using them for supporting their teaching practice and their own learning. However later in the year, towards the end of the main block of time in school, use diminished with three students dropping out of the study citing, amongst other reasons, that the pressures of school experience meant that use of the relatively unfamiliar PDAs became not a help but a hindrance.

During the course of the year the most commonly used applications were the calendar or diary scheduler, the web browser and the e-mail client. One student reported:

“The calendar and task functionality has been extremely useful. My timetable is surprisingly fluid, with various planning and review meetings being scheduled and re-scheduled – any paper diary would be unreadable and unusable.” (ibid, p3)

The other applications that proved useful were software such as spreadsheets or markbooks for organising pupil data, and the word processor or note recorder to note information for future use. One student commented:

“During teaching practice I have found myself constantly bombarded with new and noteworthy information. The PDA has allowed me to keep meaningful notes of this information, and structure the information (i.e. file) in a way that allows me to access it easily.” (ibid, p5)

The use of the web browser to gain immediate access to the resources of the world wide web exploited the affordances of distributed cognition. Using the e-mail client to send e-mails and to chat with peers, tutors, family and friends exemplified the affordances of community and communication in providing valued support to the students while on teaching practice. The scheduling, pupil data and note-taking activities again exploit the affordances of distributed cognition.

While the experiment was only partially successful in the sense that, for these students, the use of the relatively unfamiliar PDAs tailed off as the pressures of the PGCE course increased, it can be seen that there is great potential for the use of hand-held internet-enabled devices to support student learning in future. The affordances of the technology can help to inform the students' understanding and practice and maintain their feeling of being part of a community of learners while away from the university on school experience.

4.5 TEACHERS' TV

This case study considers the television channel Teachers' TV, which is a recent innovation, having been launched in February 2005. It is funded by the DfES, but has full editorial independence in the production of its programmes, which are transmitted digitally over satellite and terrestrial networks. The broadcast services are supported and supplemented by a multifunctional website.

The channel objectives are defined as:

- [sharing best practice and innovation across the country](#)

- [providing practical ideas to save teachers' time](#)
- [providing and recommending classroom resources](#)
- [delivering educational news and documentaries](#)
- [supporting in-service training and personal development in school.](#)

(Teachers' TV presentation at TDA conference, Autumn 2005)

The schedule is divided into three zones - Primary, Secondary and General. The Primary and Secondary Zones provide two types of programme: subject programmes - identified by National Curriculum subject and Key Stage, and concentrating on teachers in action, advice and reviews of resources; and role programmes - addressing the needs of those with specific roles or responsibilities in school eg managers, NQTs, TAs, coordinators for ICT or Special Needs. There are also pupil programmes from the BBC and Channel 4 to record and use in the classroom. The General Zone contains programmes of general interest such as documentaries on educational issues, current affairs programmes, careers advice, masterclasses on teaching techniques and behaviour management etc.

The complementary website (www.teachers.tv) contains resource material and programme information, but also acts as a valuable programme archive for CPD purposes. The video library has comprehensive search facilities, allowing searching by subject, role and keyword, and contains 1,000 programmes as at April 2006. Virtually every CPD programme that has been transmitted is available, and these programmes can be viewed online, or downloaded. Clips can also be edited for use in CPD presentations.

there is great potential for the use of hand-held internet-enabled devices to support student learning in future

CASE STUDIES



teacher learning
is seen as
inherently
complex – a
situated process
that is ongoing,
social and
dynamic

There is little available yet in the way of research findings or formal evaluation of the material and its use. However, informal reports by users (Teachers' TV 2005) comment on:

- The possibilities for innovative modes of access to CPD materials - Teachers' TV can be watched on PDAs, or hotlinks to selected programmes on the website can be e-mailed to specific colleagues.
- Downloading footage and viewing it on demand means that a new model of CPD is developing - teachers can watch a 15-minute programme at school when convenient to them, and a tailor-made package of CPD can be developed by and for individual teachers.
- The material is valued as it shows practical activity in real classrooms.
- Teachers' TV has a friendly and professional feel, reminiscent of regional teacher centres.

The most obvious affordances of the technology engaged with in this case study are those of the community and communication cluster. However, elements of the other clusters are also present: the distributed nature of the material available; the conceptual inputs provided by the programmes encourage knowledge building at both the subject and professional level; there are possibilities for the affordance of the engagement cluster for those teachers who download material and then edit clips to use in their own material.

The affordances of the project can contribute to the development of the vision and motivation of the teachers by presenting realistic examples of colleagues in action, can help to develop their

understanding and practice with the materials made available, and can engage them in a wider community of teachers than would be possible in their normal environment.

4.6 SUMMARY

What characterises these case studies is their specific, situated instantiations of the affordance clusters described in Section 3. Our view of these affordance clusters is that they are not simply inherent in the technologies themselves. Rather, they relate to specific, given circumstances in which the technologies are – or might be – in use. Each case study has a different combination of the affordance clusters and influences a selection of the elements of the model of teacher learning and development. There is usually some external 'conceptual input', often a structured dialogue and reflection with a human presence, eg an online tutor, mentor, facilitator or peer, and an action research orientation to the activities. In each case, teacher learning is seen as inherently complex – a situated process that is ongoing, social and dynamic. This reflects our understanding of teacher learning as outlined in Section 2. Such teacher learning can, we believe, be significantly supported and enhanced by the use of digital technologies. What links the case studies is the use of specific digital technologies in ways which enable the users, via the affordance clusters, to overcome some of the constraints of time and location which may characterise other contexts for teacher learning.

DISCUSSION: RETOOLING OR RENAISSANCE?



5 DISCUSSION: RETOOLING OR RENAISSANCE?

We have seen that teacher learning with digital technologies is a complex but, we suggest, exciting area. Much of what we have said in the previous sections has implications for school leaders, researchers, software developers, teacher educators and trainers, CPD providers, policy makers – and, of course, for teachers themselves.

Change is now a constant condition in our education system, reflecting changes in the wider world. This has implications for teacher identity and role. What sort of teacher development is needed in order to keep pace with such change? We have to ask ourselves whether we want a mere 'retooling' of teacher competences for specific purposes, or an approach which supports a renaissance in teacher development for an uncertain future. This is not about making an industrial process more efficient; rather, it is about enabling cultural change in the profession.

An instrumental model of teacher development is limited. It attempts to capture, copy and disseminate elements of 'good practice', out of the context in which they were developed, in order to refresh the educational process as if retooling an industrial production line. This may appear to meet short-term needs, but does little to develop reflexive professionals capable of intelligent action in fast-changing contexts.

A more comprehensive account of teacher development is needed. Hargreaves and Goodson propose a view of 'postmodern professionalism', based on seven principles which they identify as follows:

- opportunities and responsibility to exercise **discretionary judgement**
- opportunities and expectations to engage with **moral and social purposes**
- commitment to working collegially within **collaborative cultures**
- occupational **heteronomy** rather than self-protective **autonomy**
- a commitment to active care and not just anodyne **service** for students
- a self-directed search and struggle for **continuous learning**
- the creation and recognition of high task **complexity**.

(Hargreaves and Goodson 1996, pp20-21. These are condensed versions of the seven principles, with emphasis is as in the original.)

These principles imply high levels of individual agency, that is, the power of the individual to do things and to effect change. To them, we would add opportunities and support for creativity, and a recognition of the situated affordances of digital technologies to support teachers as knowledgeable learners.

Thus, an environment for renaissance in teacher development will often include new content (Hoban's 'conceptual inputs'), which is sometimes necessary but is, alone, never sufficient for professional growth. At its heart, such an environment for CPD will necessarily offer: structured dialogue and reflection; human presence, experience and memory; and an action-researching orientation.

To such an environment, digital technologies can contribute enhanced opportunities for knowledge building,

we have to ask ourselves whether we want a mere 'retooling' of teacher competences or a renaissance in teacher development

DISCUSSION: RETOOLING OR RENAISSANCE?



communication, distributed cognition, and engagement, as expressed in the affordance clusters described in Section 3. Thus, schools of the future will need a clear sense of the kinds of teacher professionalism and teacher learning they wish to support, in order to make wise and informed decisions about the role of digital technologies in the CPD process. Such communities will be resistant to bandwagons and snake-oil sellers.

In this fast-moving field there is a clear gap in research. There is very little fundamental research that investigates how teachers might learn with digital technologies. Rather, there seems to be a pervasive assumption that teachers will learn with digital technologies. Some teachers will, of course, but the culturally, institutionally and historically situated processes whereby this happens, and hence how best to support it, are not fully understood.

Such research is needed to inform the development of planned approaches to teacher learning with digital technologies. One of the messages from our review of models of teacher learning is that, in the light of the evident complexity, a holistic approach is needed. The models should not be disaggregated or atomised, with elements being taken out of context for a 'quick fix'. There is no shortage of Hoban's 'conceptual inputs', but there is a need for better - and better understood - structures in which to use them.

Teachers need to be effective learners in order to do their jobs in circumstances which are changing rapidly. This is not just an issue for initial teacher training, but also for ongoing CPD for teachers as lifelong learners. The potential affordances

of new digital technologies have much to offer in this regard. However, under present circumstances we fear that these opportunities are likely to remain underexploited by many teachers. The nature of current reforms may well make it difficult for teachers to experience the 'buzz' that comes from professional development:

"One of the most telling criticisms of detailed, standards-oriented reforms (or those that possess similar characteristics and are labelled as outcomes based) is that they reduce the curriculum, and curriculum planning, to narrowly technical and rational processes, losing much of what should be powerful and engaging in learning teaching." (Hargreaves et al 2001, p20)

Digital technologies, however engagingly presented and useful the content may be, cannot alone overcome the structural constraints imposed by other aspects of teachers' work. Teachers have experienced considerable intensification of their work and continue to do so. In their study of primary school teachers' use of ICT, Moseley et al (1999) found that the biggest challenge reported by teachers was time to develop skills and confidence in using ICT (p103).

As we saw in Section 3, the affordance clusters presented by digital technologies offer opportunities for the kinds of teacher learning that we described in Section 2, and we have exemplified such digitally-supported teacher learning in Section 4. However, for this kind of learning to become embedded within the wider 'macrosystem' of a country's educational provision means that it must equally be embedded within the microsystem of each

schools of the future will need a clear sense of the kinds of teacher professionalism and teacher learning they wish to support

and every individual professional life,
and we are a long way from that goal.

We have the technology. However, paradoxically, it is those same technologies which offer the opportunities we have written about in this review that have also enabled “the acceleration of just about everything” (Gleick 1999), and hence are deeply implicated in the wider causes of the intensification of teachers’ work, itself one of the reasons why it is so difficult to make the most of those opportunities:

“When teachers have their time stolen from them, one of the most precious things they lose is the time to learn and to think. Knowledge-driven organisations depend on effective brainpower – on understanding, reflection, ingenuity and creativity. But standardised reforms have taken away teachers’ time to think; and their imposed, prescriptive requirements have replaced creativity with compliance. An overexamined professional life is producing an unexamined, unreflective one.” (Hargreaves 2003, pp82-3)

We face a considerable challenge. The processes of teacher learning are complex, even messy, and teachers’ current working circumstances contain inherent constraints. Yet the possibilities for real change in the system do exist. If we can bring the technologies into situations that resonate strongly with teachers’ sense of professional and moral purposes, we may yet see what might truly prove to be a renaissance, in which teachers would employ digital technologies for ‘understanding, reflection, ingenuity and creativity’, and, through these, support their own learning in new ways.



teachers need to be effective learners in order to do their jobs in circumstances which are changing rapidly

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