

**Continuing Professional Development in ICT for teachers:
A literature review**

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1. Executive summary

This report presents the findings from a review of literature related to the current range of continuing professional development (CPD) in ICT for school teachers. It sets out to examine and understand the features of effective CPD in ICT, meaning those activities, both formal and informal, within a range of contexts and involving a variety of participants, which contribute to enhanced teacher understanding and practice involving technologies to support students' learning. In order to explore this, it has been important to see professional development in ICT within a broader CPD context. The review has acknowledged the importance of understanding the factors which contribute to effective experiences of CPD for teachers generally. This has been fundamental to identifying the features which affect professional development in ICT specifically.

The literature provides evidence that many effective approaches to ICT CPD are in place, but they remain localised and there are insufficient means for ensuring that all teachers can access high-quality professional development in this area. The report has attempted to find out why it is that, despite considerable resources being dedicated to developing the use of ICT in schools in recent years, there is a lack of impact on teachers' everyday practice, or what Becta has described as a 'significant deficit' (*The Harnessing Technology Review*, 2008). This is despite the vast majority of teachers receiving some form of ICT CPD according to national surveys.

This was a qualitative review of literature in a fast-moving but surprisingly under-researched field. Wider studies of ICT integration or successful ICT implementation in schools frequently carry messages about the need for effective CPD, or imply that certain approaches are helpful, but dedicated studies in this area are limited in number. Although there is an extremely wide literature on CPD in general, and despite the length of time that technology has been used in education, recent literature about ICT CPD contains few large-scale studies or studies of long-term development of pedagogy using technologies. The review focuses mainly on studies published since 2006, and most of these are small-scale. Forty-two studies of ICT CPD are included here, which are mostly small-scale (involving samples of between 10 and 40 teachers) in specific primary or secondary school contexts. Additionally, recent Becta overview reports and inspection reports are included. The review also focuses on broader generic literature on effective CPD developed over a longer period, which contains insights which are relevant to ICT CPD. This is a broad field, and 40 relevant reports and reviews are drawn upon. The range of small-scale studies means that findings can at times be contradictory. The review represents an emerging evidential picture in a situation where ICT CPD provision has become devolved, with a very varied provision which has grown ahead of a comparable rate of research into its effects.

To reflect the scope of relevant material, the report is divided into three sections:

- Section A reports on the contemporary contexts which have a bearing on ICT CPD
- Section B presents key understandings about teachers' professional learning, which have relevance to the provision of effective ICT CPD
- Section C reports on the factors found in the literature which contribute to effective ICT CPD.

The literature suggests that there are issues which are specific to ICT CPD, which are linked to wider approaches to the effective professional development of teachers. These affect the degree to which pedagogy is prioritised in the provision of CPD. Issues which can be identified relating specifically to ICT are:

- An over-emphasis on skills training in itself at the expense of deep understanding and application of skills to developing learning and teaching. This is linked to a perceived need to address a skills 'deficit' in teachers, rather than to develop a focus on pedagogy.
- The challenge of developing an appropriate 'vision' for ICT among school leaders, which is focused on pedagogy and teacher development as a priority.
- 'Policy tensions' which deflect from coherent and consistent development of pedagogy using technologies, and create conflicts over how time and resources are used to embed technologies within schools.

1.2 A fragmented picture of ICT CPD

The devolution of control over ICT CPD provision to school leaders in an expanding free market economy for CPD has meant that an extremely varied pattern of provision exists. There is much inconsistency in reporting on the effectiveness of certain types of provision, especially regarding Local Authorities and Higher Education Institutions. CPD arrangements with these stakeholders are so varied that it is difficult to generalise about them in terms of their approach and success. The majority of CPD takes place within schools, where there is also an extremely varied picture of provision. It is possible for teachers within the same school to have widely differing CPD experiences, depending on the individual department, the relationship between the school and the Local Authority and the degree of teacher motivation. There is a prevalent dissatisfaction with one-off courses and external programmes which do not take account of the specific contexts of the school. There is also, however, dissatisfaction with school-based CPD where it is poorly planned and does not take account of subject differences and 'mixed ability' issues in teachers' technical competence.

1.3 Skills training is not enough

Although skills training is clearly vital to being able to integrate technology into teachers' practice, it is very evident that a focus on skills is not sufficient to help teachers to develop their pedagogy. The amount of skills training provided can have misleading consequences by sending the message that a lot of CPD has taken place, when in fact it makes little impact in itself on the quality of learning activities in classrooms unless it is accompanied by dedicated activities which focus on planning to teach a specific area of the curriculum to a specific class. A great deal of skills training has taken place in recent years, and yet there is a persistent lack of integration of technology into teachers' practice. The focus of CPD and the types of CPD activities have not led to the degree of change that was anticipated. There is a need for a review of CPD design, to focus on pedagogy. By this, CPD activities need to focus on planning for student learning, within a clear set of understandings about how learning happens. The incorporation of group work, collaborative problem-solving, independent thinking, articulation of thought and creative presentation of ideas are examples of the ways in which teachers' CPD might focus on pedagogy, with a view to how technologies can support these processes. The CPD design itself should incorporate these kinds of activities using ICT, so that teachers can experience active learning for themselves as part of their professional development.

1.4 Challenges for ICT CPD

The core issue to emerge from the review is that teachers need to be at the centre of their own learning if they are to change their deep-seated beliefs and habits regarding the use of technology. Otherwise, surface-level adoption occurs, by which teachers just have time to learn how to use a technology without deep consideration of how it might be used to address context-specific learning needs of students. Rather than deepening and consolidating understanding of how to use the technology for enhancing learning, teachers frequently find they have to move on to learn how to use another technology or address another priority.

The pressure to 'move on' or remain satisfied with surface-level adoption comes from conflicting priorities for CPD which arise when schools must implement multiple policy initiatives, concerning both ICT and other areas of development. It is difficult for headteachers to devote dedicated CPD time to consolidation and further development of ICT. There is a lack of time to both consolidate and respond to the next new initiative. Consistent, low-profile changes in the quality of teaching have been less visible than other high-profile initiatives such as installing interactive whiteboards in recent years. It is possible for observers to assume that teachers are sufficiently trained because they are 'using' a technology in a visible way, but this is no indication that genuine change has happened in the quality of the learning.

Problem-free access to equipment and specialist technical support are pre-requisites for CPD to take effect. Without these, teachers become demotivated and lack confidence in trying out new ideas. Although this has long been recognised, it is still a prevalent problem in schools, and a shortage of access to equipment which is concentrated in computer suites remains a serious obstacle to professional development.

1. 5 Features of successful ICT CPD

The main feature of successful CPD is that it addresses teachers' individual needs as a priority. Their needs are highly varied, and are determined by their histories of using technologies at work and in their home life, as well as their subject specialisms and context-specific issues related to the students in their schools. Meeting these individual needs takes very different forms, ranging from entirely school-based provision to external programmes which can make a significant impact in situations where schools are unable to provide sufficiently for teachers' needs. Treating teachers as individual learners is important if deep-seated beliefs about learning are to be reviewed and attitudes changed regarding the role of technologies in the classroom.

The source of CPD provision itself is less important than the learning approach which is adopted. CPD which is designed to be collaborative is reported as effective in a majority of studies. In collaborative ICT CPD, teachers take responsibility for their learning by discussing their priorities for development with peers, taking part in shared planning of experimental approaches and reviewing teaching. Different parties may be involved in collaborative approaches. Some parties may be ICT experts such as ICT co-ordinators or external advisers. It may equally be the case, however, that collaborative planning and experimentation takes place with peers who are at varying levels of confidence and competence in using ICT. It is more important that the focus is on improving learning, as long as there is access to ICT expertise when it becomes necessary.

Successful ICT CPD builds in opportunities for critical reflection on teaching. Teachers are encouraged to enquire into their practice, and to be proactive in deciding how it can be improved with technologies, rather than being passively reactive to a new initiative. By adopting a 'bottom up' approach to CPD, provision is highly differentiated and context-specific.

1.6 Communities of practice

Many of the features of successful ICT CPD indicate that a community of practice has been established within the school or as part of a wider programme. Social relationships are crucial to the ways in which teachers exchange information and ideas about teaching with technologies. Opportunities for informal talk are vital, as is the ways in which schools operate as learning organisations. In successful CPD, there is frequent talk about practice in the staffroom and staff are encouraged to be

proactive in taking risks and experimenting within a supportive school atmosphere.

Headteachers have a crucial role in fostering such a community, by open approaches to leadership, approachability, and democratic approaches to developing ICT policies and CPD arrangements. Headteachers who encourage staff to 'volunteer' to support others in developing their ICT use, and who adopt shared approaches to school development planning, help to create a school ethos in which staff feel able to take risks. This is a very important feature of learning to use technologies, where the consequences can be very exposing and can lead to class management difficulties when things go wrong.

1. 7 Recommendations

The report makes a series of recommendations in relation to three sets of factors affecting the success of ICT CPD:

- Factors stimulating teachers as individuals
- Factors developing the school as a learning community
- Factors affecting wider CPD provision.

We include here a summary of key recommendations.

1. CPD needs to be designed on the basis of meeting teachers' individual needs as a priority. These may be affected by a school-wide adoption of a technology which is important for them to master (for example interactive whiteboards or learning platforms). Lessons should be learned from the past, however, about the lack of impact of mass-adoption approaches on teachers' practice, and on the demotivating effects of this. The main CPD activity should be focused in response to what the teacher identifies as an area of practice where they feel it is important to develop.

2. Collaborative approaches should be core to designing ICT CPD. School leaders should ensure that time is given for small groups and pairs of teachers to talk, reflect critically and plan together on a frequent basis, and to organise their own timing for these discussions. Peer observation and time for feedback is a further important collaborative strategy. Informal and formal arrangements to facilitate this should be treated as CPD time, and staff development funding allocated to protect time for collaborative activities.

3. School leaders should be encouraged to value outward-looking relationships in their approach to ICT CPD. This is not just for school leaders and ICT co-ordinators. Teachers should have the opportunities to visit other schools and externally provided programmes to gain access to alternative classroom approaches and gain different perspectives on the use of ICT. It is recommended that a system for brokering such visits is set up by Local Authorities as part of CPD provision.

4. Subject specialism needs to be catered for on a much wider scale than is currently the case. Subject associations, Local Authorities and Higher Education Institutions should be supported to develop ICT CPD on a local basis, and to establish subject support networks.

5. There is a need for some school leaders to become more familiar with research on building learning communities within schools. Professional development for Senior Leaders needs a specific focus on what this means in practice in terms of designing CPD activities and providing time and resources to support them.

6. Strong recommendations need to be made regarding the purchasing of hardware to support professional development and student learning. Every teacher should have access to a laptop for their own use at home. In schools, the further concentration of computers in suites should be discouraged, and school leaders should be advised to invest in distributed resources which allow teachers to embed technologies in their everyday practice. Traditional views that some subjects do not need sustained access to technologies have to be challenged.

7. It is recommended that a rationalisation is needed of the amount and diversity of policy-making both within ICT and across education. This is to address the ongoing problem of conflicting demands on CPD priorities, and to curtail the surface engagement with innovations which occupy professional development time but do not yield results in enhanced learning. There is a need to consolidate the focus on pedagogy and ICT.

8. There should be a commissioned study of the contribution made by CLCs to ICT CPD. This is a very limited area in the literature.

9. There should be a commissioned study of the impact of commercial providers on ICT CPD. This is a further gap in the literature. This is a very important priority since this is set to be a significant area of influence, and there is a need to be better informed about the perceptions of commercial providers about their roles and the purposes of CPD, and about their relationships with schools and LAs and the effect this has on pedagogical development.

10. There should be a scoping study of the current use of online professional development communities for ICT CPD and the potential of online learning and Web 2.0 as a vehicle in this area. This is an area which is ripe for expansion, but there is very little evidence to date of how it might work in practice to bring about change in classrooms.

2. Introduction

This is the first report from a research project carried out by Becta into Continuing Professional Development (CPD) for Information and Communications Technology (ICT) for teachers in Key Stages 1–4. It provides a descriptive and evaluative overview of literature related to the current range of ICT CPD for school teachers in England, and refers to relevant literature in the wider United Kingdom and international contexts. A second report will be published on completion of empirical research into CPD and effective models of provision. Although it is acknowledged that a wide range of staff have an impact on students' learning with technologies (Teaching Assistants and library staff, for example), the scope of the project can only extend to teachers. Whilst the review was not concerned with research on the ICT CPD experienced by other members of the school workforce, there was an absence in the literature surveyed of references to ICT CPD for these other adults involved in the learning of students. This is clearly an area of literature which is expected to expand in forthcoming years.

The focus on ICT CPD is located within a broader literature on teachers' professional learning, which provides a wider frame of reference by which to evaluate the findings from many small-scale studies on ICT CPD which have been published in recent years. The vast majority of studies of ICT CPD included were published post-2006, but some significant work has been included which was published prior to that. The literature on teachers' professional learning includes some important work which pre-dates 2000, where it reflects key ideas about how teachers learn, and learning in professional and work-based contexts. The report is divided into three sections:

- Section A reports on the contemporary contexts which have a bearing on ICT CPD
- Section B presents key understandings about teachers' professional learning, which have relevance to the provision of effective ICT CPD
- Section C reports on the factors found in the literature which contribute to effective ICT CPD.

Where extensive analysis of relevant literature has already taken place, the review acknowledges this and has included the findings of such reports (for example, the 2005 review by Cordingley *et al.* of the potential benefits of collaborative approaches to CPD and Webb and Cox's (2004) review on pedagogy in relation to ICT). It does not aim to replicate scoping work already undertaken elsewhere, and focuses on those areas which, whilst a number of studies exist, have received less scrutiny concerning their contribution to the broader picture of ICT CPD (the micro-level factors which contribute to changing teachers' practices with technologies).

The literature takes in CPD in a wide range of contexts, including varying degrees of formality, CPD pedagogy, stakeholders and content, reflecting the varied and somewhat fragmented landscape of ICT CPD currently. It is evident that there is no overall coherence in the CPD offer to teachers in England, and the literature reflects the considerable scope of ICT CPD provision which is the result of changes in policy and funding arrangements in recent years.

3. Background

An important factor to consider when seeking to understand ICT CPD, is that CPD in general for teachers is to some degree still in its infancy. For example, only relatively recently under the wider package of Workforce reforms have we seen teachers being entitled to three days (see 1988 Education Act), later increased to five days of continuing professional development a year, establishing the principle that teachers need regular professional development. Within this is the distinction of training which focuses on the broad needs of the institution and the specific needs of each individual teacher. Clearly ICT CPD is then part of a wider CPD and workforce agenda.

In-service teachers and those who joined teaching over six years ago before the current Standards for Qualified Teacher Status (QTS) were introduced are reliant on in-service training and CPD for their ICT training and professional development. It has been, and will be, the main vehicle by which the majority of the workforce gain and update their skills and develop their classroom practice using technologies to support students' learning. In addition, there is growing evidence that the greatest influence on teachers' ongoing professional development is in fact their school environment, and the extent to which it provides the conditions for a productive learning community by which practice is developed among groups and networks of individuals (Bolam *et al.*, 2005; Fielding *et al.*, 2005; Schifter, 2008). It may well be that, even for recently trained teachers, sustainable ICT pedagogical capacity will be greatly determined by the school environments and CPD experiences to which they are exposed in their early careers, and how these are connected to external training bodies and networks of various kinds. Since the New Opportunities Fund (NOF) ICT training programme which provided training to almost all practising teachers, there has been a move away from national programmes of ICT training, to one where demand and funding is in the control of the leadership of individual schools. While this may ensure that provision is targeted to local need, it assumes that the range of appropriate training and development is available to schools and that effective mechanisms for ICT training needs analysis are in place.

At the same time, anecdotal evidence indicates that there has been greater involvement in recent years of commercial providers in offering ICT support to schools, mainly linked to the use of their own resources and products, together with a wide range of specialists providers and individual trainers with different CPD strategies and approaches. Given the nature of this provision, there is little or no evidence about the range of current ICT CPD provision, since the evaluation of the NOF training in 2003. We have little understanding of the current scope, nature and quality of provision, apart from some general overview findings. Evidence from the *Harnessing Technology Review* of 2007 and 2008 shows that:

- the majority of teachers have received training in the use of ICT in recent years

- despite this, a high percentage of practitioners reported they rarely or never use technologies to support student learning
- there was a lack of awareness of the benefits of different practice for learning, a lack of practical pedagogical skills, and possibly a lack of time and incentives to develop practice
- ICT is still a major professional development need, and one teachers wish to develop voluntarily, and the expressed need is high regardless of sector, supply teachers, class teachers and those with cross-sector responsibility
- ICT has been the most frequently selected topic for CPD in the GTC survey, being among the top three for all but the most recently qualified teachers
- almost twice as many primary teachers have attended some form of ICT training compared to secondary school teachers
- teachers tend to rate internally provided training more highly than external provision
- there is a need for a coherent approach to continuing professional development.

We also know that the views teachers have of their ICT training needs contrasts with those of headteachers. In the 2007 *Harnessing Technology* survey, headteachers felt that teachers' ICT expertise met or exceeded current needs. This indicates that a more shared view of needs and standards relating to ICT competencies and the quality and nature of provision is required.

This provides an indication that we need to understand far more about the nature of effective ICT CPD provision. If ICT CPD is not appropriate and fit for purpose it is unlikely that we will see the improvement in workforce e-maturity necessary to realise the targets and vision set out in the *Harnessing Technology Strategy* 2005 and 2008. There is a need for an up-to-date picture of what constitutes *relevant* provision and who the key players are in such provision of ICT CPD if it is to influence current and future development.

4. Methodology

This was a qualitative review of literature related to ICT CPD. Although there is an extremely wide literature on CPD in general, and despite the length of time that technology has been used in education, recent literature about ICT CPD contains few large-scale studies or studies of long-term development of pedagogy using technologies. The review focuses mainly on studies published since 2006, and most of these are small-scale. Forty-two studies of ICT CPD are included here, which are mostly small-scale (involving samples of between 10 and 40 teachers) in specific primary or secondary school contexts. Additionally, recent Becta overview reports and inspection reports are included. The review also focuses on broader generic literature on effective CPD developed over a longer period, which contains insights which are relevant to ICT CPD. This is a broad field, and forty relevant reports and reviews are drawn upon. The range of small-scale studies means that findings can at times be contradictory. The review represents an emerging evidential picture in a situation where ICT CPD provision has become devolved, with a very varied provision which has grown ahead of a comparable rate of research into its effects.

Literature was reviewed which relates to the main contexts for ICT CPD which consists of:

- school-based provision
- provision within Local Authorities (LAs)
- City Learning Centre (CLC) programmes
- regional and national programmes
- teacher education partnerships with Higher Education Institutions (HEIs)
- training provided by companies with education technology remits
- informal and formal CPD collaborations within professional communities.

Literature was selected which focused on particular features of ICT CPD which were viewed as having a direct impact on pedagogy:

- ICT which brought about changes in practice
- Networks for ICT CPD
- Informal as well as formal CPD arrangements
- Relationships between stakeholders
- Learning and teaching roles in ICT CPD contexts.

Studies within Initial Teacher Education (ITE) were included where they contained insights into factors affecting teachers' learning with ICT generally. Very limited research literature was available concerning commercial providers' programmes. Such programmes were referenced within studies of the wider CPD experiences on offer within particular schools, or featured in the CPD histories of particular teachers, but the programmes themselves were not the focus of research.

The review includes a range of literature which focuses on the ways in which teachers *engage with ICT CPD and the ways in which CPD experiences are organised to bring about developments in practice*. It includes academic articles, research reports, conference reports, as well as policy-making documents and reviews of ICT CPD. In addition, it features key 'generic' CPD literature which is of relevance to the aims of the project, that is, which has a bearing on the effective provision of ICT CPD by enhancing teachers' professional learning and practice. Given that there is an extensive literature and a considerable volume of small-scale studies of localised CPD provision, the review has concentrated on literature which can make a rich contribution to the particular focus of the project. Owing to necessary limitations in the scope of the review, we did not include subject specialist journals as a focus. There are three main types of studies of ICT CPD in the review:

1. Small-scale studies of ICT CPD in the UK. There is a considerable number of these (based around subject, phase, institutional innovations, networks and, to a lesser extent, stakeholders). These tend to be based on an intervention strategy or single-case approach.
2. International studies. Perspectives are drawn from contexts with different systemic influences. This has allowed the study to include instances of ICT CPD where different relationships exist with wider education policy, frequently involving fewer centralised or top-down drivers than in the UK.
3. Research into online CPD. The review considers what can be learnt from this smaller range of studies which includes examples of online, web-based CPD.

5. SECTION A: Contexts for ICT CPD

5.1 The socio-cultural-technological context

The UK ESRC reports (2008a, 2008b) provide evidence that a majority of young people live in changed social and cultural conditions brought about by technology, and that this has far-reaching implications for schools and teachers. The message is that educational policy-making for ICT and CPD struggles to keep up with the realities of most learners' lives, and 'the future' is a world which many young people are already experiencing:

While educationalists are rethinking formal learning environments, young people themselves are using new technologies for informal learning in a far wider array of social settings, public and private, shared and individual. (ESRC, 2008b, p. 4)

It has long been acknowledged that increasing rates of technological change pose significant challenges for ICT CPD. In 2004, Scrimshaw outlined three phases of technological innovation in education since the mid-1980s:

<i>Phase</i>	<i>Innovation</i>
Phase 1	Expansion of the types of software promoted for use in classrooms
Phase 2	The move from stand-alone to networked computers
Phase 3	Expansion in the types of hardware devices available for classroom use

Table 1: Phases of technological innovation in education, Scrimshaw 2004

The argument was that the expansion of hardware devices was a significant shift, since it was the first which left little opportunity for teachers to opt out of using technologies (for example, where interactive whiteboards (IWBs) replace traditional boards). This of course, does not mean that significant changes in pedagogy are the inevitable consequence of new devices. Teachers may still manage with minimal professional development, which remains at the level of being trained to work the technologies, rather than developing a range of pedagogical approaches which they can support.

Since then however, a 'fourth phase' of innovation has arrived, and arguably has even more significance for the CPD needs of teachers. A fourth phase can be identified as the advent of Web 2.0 technologies, by which social networking technologies have become embedded in everyday life for most young people and adults in the UK. It is the first to seriously challenge the traditional boundaries between 'school technologies' and 'real world technologies'. They are dissolving, and CPD needs to be responsive to this as it becomes harder to draw boundaries around 'educational' technological innovations and to ignore the impetus

from the outside world to develop collaborative, learner-centred ways of communicating and learning.

Where young people have access to technologies outside formal education, there is a considerable range of evidence which points out the extent of the divide between young people's experiences of learning inside and outside school. *The Horizon Report* (2008) and *The MacArthur Report* (2008) have shown the extent of immersion in digital cultures of young people in the USA, examining these as new sites of learning. *The MacArthur Report* is based on a study which explored the impact of digital cultures on the ways classroom practices need to be re-conceptualised, with huge implications for teacher education: 'New media forms have altered how youth socialize and learn, and this raises a new set of issues that educators, parents, and policymakers should consider' (p. 2).

For less advantaged sections of society, the pedagogy of teachers is crucial to how they gain access to the potentials of these technologies. The *Media Literacy Audit* (Ofcom, 2008) showed that children in the UK are familiar with the use of key media such as television, games consoles and the internet, by the age of five, but differences exist in access to technologies according to socio-economic group. There is a 'digital divide', and poorer students rely on ICT in schools to participate in 'media culture' – for example by having broadband access and use of relatively recent computers. Clearly, this picture changes all the time, as prices come down, but there is an argument that schools have a responsibility to distribute access to these resources fairly, and to compensate thereby for their unequal distribution in society.

The changed nature of personal and home use of technology therefore has implications for teachers' practice. The divide between young people's experiences and expectations of ICT and practice within schools is a further challenge for CPD. Outcomes from research for the Learner Experiences of e-Learning theme of the JISC e-Learning Programme indicate that by the time learners enter post-compulsory education, they

...seek to personalise the technologies they use, just as they control other aspects of their learning environment. In response to a variety of pressures – including shortage of time, lifestyle, personal preferences and course requirements – learners are now selecting their own blend of technologies to make their learning experiences more congenial, manageable and appropriate to their needs. (JISC, 2007, p. 32)

But these are not, in the main, expectations fostered by their school teachers – on the whole, they develop this capacity *outside of* their previous formal educational experiences. Becta (2008) reported that 74 per cent of secondary school students have social networking accounts, but few teachers explore with students how to use Web 2.0 for educational benefits, even where they are familiar with networking sites. The important issue is how teachers are enabled to critically examine for themselves the

potentials of Web 2.0, and to make informed decisions about how to work productively with the role it plays in the cultural lives of their students. Being critically informed about informal learning via Web 2.0 social networking needs to be part of teachers' professional knowledge. This involves being proactively experimental rather than 'victims of technological vision' (Convery, 2009) or subject to simplistic beliefs about technologies (Valentine, 2008). Whilst broadly welcoming the integration of informal e-learning practices in schools, Valentine has warned against over-simplified beliefs that school- and home-based learning practices can easily be integrated, and indeed argues that elements of separation are important for learner well-being:

The danger is that the more formal implementation and monitoring of home-school links might rob children's home-based ICT activities of their association with 'fun' and 'experimentation' with the result that children re-define these activities as school-related activities and consequently as 'boring' or 'uncool' things to spend their time doing (as well as blurring the association of home with leisure time and 'private' space and the school with work time and public space). There is therefore need to understand how a strengthening of the relationship between the spaces of home and school through ICT links may affect young people's perceptions of what learning is, their willingness to use ICT at home and their learning styles in this space. (Valentine, 2008, p. 17)

This scenario for ICT CPD is thus highly complex and teachers need opportunities to discuss these developments within CPD contexts and enquire into how to develop appropriate use of technologies with their learners. Undoubtedly, learners' choices about their use of technologies is a growing feature of the educational landscape, and CPD needs to take account of that, ensuring that teachers are critically informed and able to make judgements about using innovative technologies as well as developing the skills to do so.

5.2 The policy context

The challenge in providing teachers' professional learning in all school phases is to enable them to understand how they can teach effectively in a context of young people's engagement with digital cultures. The report on 27 EU countries' use of ICT in schools (Empirica, 2006) found that a 'catch up process' (p. 20) is needed, and the *use* of ICT is the third priority for ICT development across European countries, superseded only by improving student access to computers and internet connection which are not issues in most schools in England. Policy-making in the UK has seen a considerable mobilisation of funding and resources to support the development of 'e-confident' learners and teachers in schools (Becta, 2008; DfES, 2005;), who benefit from fully integrated technological infrastructures for learning. It might be concluded that, from a European perspective, in the UK we need to be concerned mostly with 'catch up' in the *use* of ICT for learning.

This is because the relatively high availability of technologies is not matched by teachers' knowledge and understanding of relevant pedagogies which can utilise them. They are not prioritised as a focus for CPD in ICT. One problem, historically, with the development of CPD has been the emphasis on techno-centric and 'one-size fits all' provision which is not well matched by appropriate pedagogical development. There is a strong need to develop teachers' knowledge, understanding and skills regarding *learning* with technologies, and hitherto teachers' professional learning in this area has been largely under-theorised and problematic in terms of effective policy and strategy (Preston, 2004).

Hustler *et al.* (2003) in a Government-commissioned report on CPD found that standardised 'one size fits all' provision was criticised by teachers. This extensive study, drawing on the results of 2500 questionnaires and in-depth examination of teachers' experiences in 22 schools, found that teachers wanted CPD that enabled them to develop their own personal interests. This raises a policy conundrum, where there is considerable evidence that ICT within pedagogical development should not be 'optional', but there is also evidence that teachers should have more control over their own practice if CPD is to be effective. If the use of ICT is 'imposed', teachers may well exercise control by resisting this imposition. If it is not imposed, however, teachers may not explore how ICT could be drawn on in their teaching.

Finding a way out of this conundrum seems crucial in developing an effective CPD strategy, but previous attempts at achieving this on a wide scale have proved unsuccessful. An historical focus on techno-centric aims for CPD, centralised direction (the New Opportunities Fund), generic skills training, top-down frameworks for CPD and 'one shot' and 'one shot plus follow-up' approaches (Jimoyiannis and Komis, 2007) has meant that the potential of technology to enhance the learning experiences of students remains largely unfulfilled (see for example reports on interactive whiteboard use in the UK, Moss *et al.*, 2007; Preston, 2004). Similarly, there has been relatively little focus on *how* school teachers learn with technologies within online collaborative contexts (Dede, 2006; Fisher *et al.*, 2006). The importance of secure subject knowledge and subject-based pedagogical understanding has been highlighted for the effective use of technologies in education (Cox *et al.*, 2003), but there is relatively little that examines how teachers' professional development with technologies might be enhanced. Preston and Cuthell (2007) have emphasised the importance of training ICT providers to adopt collaborative approaches to CPD, and have argued that accreditation is an important aspect of ICT co-ordinators' and trainers' own development.

Policy at primary level

The Rose Interim Report (2008), which proposes a major revision of policy and curriculum development in English primary schools to begin in 2011, emphasises that ICT should be embedded within the curriculum as one of

the 'skills for learning and life' (p. 37) and should also be taught discretely (p. 15):

A sound grasp of ICT is fundamental to engagement in society, and the foundations for this engagement must be laid in primary schools. Along with literacy and numeracy, the use of technology to develop skills for learning and life should be at the core of the primary curriculum.

There is an implication in the Rose Report that teachers are now ready to embed ICT in their everyday practice – an important goal of *Harnessing Technology* (2005). Despite a huge investment in providing technology resources in English schools, the learning gains have not been as great as anticipated. Whilst primary teachers report more positively than secondary teachers on the quality of their ICT CPD, the *Harnessing Technology Schools Survey* of 2007 and *Harnessing Technology Reviews* of 2007 and 2008, indicate that there is still a persistent lack of appropriate CPD experience for all teachers. The *Harnessing Technology Schools Survey* of 2008 provides further evidence that the pedagogical potentials of technologies are not taken up by the majority of teachers:

...there appears to be a need to support and encourage teachers and schools to use technology in ways that are more engaging for learners... There are some obvious barriers to developments in these areas: with regard to engaging learners, for example, teachers have frequently cited the need for more time to try out digital resources and the technologies used to deliver them. (2008, Report 1, p. 60)

There is a lack of policy regarding ICT CPD, at a time when expectations have grown about what teachers can achieve. Rae and O'Brien (2007) found that primary teachers in their study still see ICT CPD as 'going on a course'. The authors see the 'almost synonymous use of terms *CPD* and *course*' (p. 436) as a problematic factor in getting teachers to identify valuable professional development in ICT which might take place informally and within schools. There is a lack of clear policy guidelines about what counts as ICT CPD. Teachers do not recognise many of the informal, school-based activities which go on as 'CPD'. It is unlikely that all schools are ready to achieve the ambitions of the Rose Report without a coherent policy for ICT CPD being in place.

Policy at secondary level

There are more challenges for CPD in the secondary sector. The *Becta Harnessing Technology Schools Survey* (Kitchen *et al.*, 2007) found that while there are high levels of school-based CPD, primary teachers are far more likely to have positive experiences of their ICT CPD, both in-house and externally provided. There is a discrepancy in ICT CPD provision between primary (98 per cent) and secondary (55 per cent) teachers. There is a significant deficit in secondary teachers experiencing all types of ICT CPD (formal, informal, online and face to face).

Secondary teachers are more likely to suffer from poor access to technology across all subjects because of a tendency to rely on computer suites which are frequently booked by 'technical' orientated subjects. Thus while the amount of resources can appear impressive, meaningful access is not easy and this is needed for sustained embedding of technologies in pedagogy (Barton and Haydn, 2006). Barton and Haydn also comment on subject differences meaning that further differentiation is required for secondary teachers. A deeper issue is identified, however, by Pearson and Naylor (2006), which implies that, even where better access to flexible technologies in secondary schools exists, CPD is still inhibited by the inflexible nature of the secondary school curriculum.

The secondary school day is tightly regimented by a timetable which can act as a barrier to extended exploratory sessions and the division of intellectual labour into subjects, which creates particular epistemological and methodological modes (often called "subject cultures"), does not encourage the use of ICT as a tool for personal exploration and development. (Pearson and Naylor, p. 284)

The secondary school curriculum has developed within a policy climate which has emphasised 'subject cultures' within high-stakes testing environments, which are not sympathetic to cross-curricular work. Literacy and numeracy initiatives have emphasised dedicated curricular space and curriculum content. Other subjects – for example, modern foreign languages and humanities – have limited curriculum space. Pearson and Naylor report cross-curricular approaches in Key Stage 3 which lend themselves to shared planning and creative use of a wider range of technologies such as digital film-making software. This resembles more the opportunities for rich pedagogic approaches which prevail in the primary school curriculum, and which may possibly be encouraged at secondary level by the revised National Curriculum 2008 which invites a less prescriptive approach and greater emphasis on learning processes, and the abandonment of SATs in Year 9. It remains to be seen if there are positive impacts of these changes on approaches to ICT CPD, in a climate where creativity and flexible pedagogical approaches might find more support.

The potential for anomalies to exist is high where access to CPD does not correlate with teachers actually integrating it within practice, or not rating it highly when they do access it. The *Harnessing Technology Review* (2007, p. 69) warns that there is a 'pedagogical agenda' which cannot be ignored:

Whatever the reasons, the use of technology to support curriculum-based learning in schools often situates learners in a passive role in the process of knowledge creation, which represents a very different position from learners' use of technology outside of education. The pedagogical approach most commonly adopted is unlikely to encourage the range of competencies increasingly demanded by employers and the economy more generally. It also

potentially presents risks of further dislocation between learners' informal experiences at home and those in education, possibly at the expense of learners' enthusiasm for educational experiences. This is at a time when personalisation debates increasingly recognise the need for closer links between formal and informal learning.

The *Harnessing Technology Review 2008* suggests that the learner experience of technologies remains inconsistent, with a continuing deficit in teachers' pedagogical awareness of ways of working with technologies that can bring learning benefits. The Review found that a key area where change is slow is in the use of technologies for collaborative peer-learning.

5.2.1 A persistent deficit

The *Harnessing Technology Review 2008* (p.19) reports a crucial finding related to ICT CPD, regarding 'a significant deficit in practice'. It highlights the persistence of 'slow development of learning and teaching using technology':

...there are signs that the breadth of practice among teachers and FE practitioners is expanding, with more practitioners reporting that they are using technology to support learners in being creative and working together. However, the percentage of practitioners reporting that they 'rarely or never' do this is still high. There still appears to be a significant deficit in practice which is likely to be based on lack of awareness of the benefits of different practice for learning, lack of practical pedagogical skills, and possibly lack of time and incentives to develop practice. Addressing these issues is a challenge which is likely to require multiple strategies, including building a coherent approach to continuing professional development, developing a greater sense of the importance of technology-based practice in the professionalism of practitioners, building better understanding of benefits of change, and sharing related good practice among the education profession.

This stated challenge in addressing core pedagogic practice needs to be seen next to the findings in the same document regarding 'headteachers' priorities for technology use':

When prioritising the deployment of technology in their schools, headteachers tend to focus on using ICT in management and administration and then on using it in teaching and learning (Smith *et al.*, 2008). Over two thirds of primary heads (68%) report that using technology to record learner progress is a priority for them over the next few years; this is a slight increase on the 2007 percentage of 55 per cent. Using technology to inform the learning and teaching process (58%) and to promote independent learning (57%) are also high priorities for over half of primary schools. Improving communication with parents remains a high priority for

around one third of primary schools between 2007 and 2008, and the percentage of primary schools reporting that extending learning beyond the classroom is a high priority for them in the next three years has decreased from 43 per cent in 2007 to 38 per cent in 2008. Unlike primary schools, secondary schools also give high priority to the areas of communication and collaboration and study support. Just under half of secondary heads (48%) said that they are giving high priority to using technology to communicate with parents (a slight increase from 45 per cent in 2007) and over half (55%) said that using technology to provide study support for learners is a high priority. There has also been a slight decrease in the percentage of secondary heads who reported that using technology to support personalising learning is a high priority for them. This decreased from 73 per cent in 2007 to 63 per cent in 2008. (p. 57).

The issue here is that there is not a consistent correlation between headteachers' priorities and what appears to be a crucial aspect of ICT CPD which is required to address a 'deficit in practice'. The reasons why more heads do not prioritise learning and teaching requires investigation in terms of the impact of this on ICT CPD. The *Harnessing Technology Review 2007* suggested that ICT had to compete with other CPD priorities. Ofsted has expressed concern about the gap between the best and worst schools in terms of ICT leadership and management: "The quality of the leadership and management of ICT in the schools visited was better than in the past, but the gap between the best and the worst provision was wide. Few schools had outstanding provision." (Ofsted, 2008, quoted in Becta, p. 58).

A further consideration is the impact of wider policy contexts which may have an impact on teachers' dispositions and confidence to take risks in innovation and experimentation. Dual drivers exist within policy making. On the one hand, there are considerable incentives to innovate practice with ICT, including extensive resource provision through Building Schools for the Future and recognising and rewarding good practice through the Becta ICT Mark and Awards Scheme. At the same time, policy making towards improving standards has been blamed for inhibiting creative and innovative practice using ICT (Pearson and Naylor, 2006), because it encourages a cautious approach to teaching, resulting in prescriptive lesson formats, test preparation and mass-produced educational materials aimed at providing ready-made lessons and learning resources. These are argued to have reduced teachers' experience of experimentation, risk-taking and learner-directed pedagogy which is more appropriate to the potentials offered by technologies.

5.2.2 Policy tensions

The concept of 'policy tensions' (Hardy, 2008) offers a contemporary explanation of why pedagogy is hard to shift, regardless of high degrees of technology 'uptake' in schools. It reflects Cuban's (2001) argument that

CPD in fact is not sufficient to change teaching practice – it is the whole context of education which has to change. His point is that when teachers do not use ICT in formal teaching in productive ways, it is not because they lack CPD or confidence, it is because the way their job is organised and evaluated actually prohibits significant change. Without a commitment to the broader goals of education beyond preparing workers, he has argued that technologies are ‘oversold and underused’ in education institutions. ‘Policy tensions’ offers a strong argument for how that happens currently.

‘Policy tensions’ (Hardy, 2008) of two sorts affecting ICT CPD appear in the literature. These are policy tensions *between ICT and other areas of government requirements* and *within ICT initiatives themselves*. Hardy has put forward strong evidence that professional development practices suffer when schools experience pressures to work with multiple initiatives which are of a complex nature. The pressure to respond quickly to each reform agenda damages the qualitative achievements of CPD in each of them. Such pressures are actually counter-productive to making a sustainable long-term impact. They ultimately ‘militated against policy support for more context-specific, long-term, inquiry-based, collaborative professional development practices’ (p. 103). Policy tensions have significant effects on competing priorities for CPD and on teachers’ choices about what to focus on within limited time constraints. Hardy suggests that more effective policy-making needs to be developed.

Pearson and Naylor’s (2006) research indicates that the first type of policy tensions particularly affects ICT pedagogy in the secondary school sector. The high stakes testing imperative to ‘perform’ against national targets has led to a situation where ‘teaching in English secondary schools takes place in a risk averse culture, where teaching ‘to the test’ is a constant temptation and innovations using ICT are difficult to enact’ (p. 284). Where ICT CPD is not statutory, and funds for it are not ring-fenced, other policies dominate choices about pedagogical development. There is a lack of policy linkage between using technologies, enhancing students’ learning, and gaining higher grades, in current testing approaches.

Policy tensions *within* the field of ICT CPD may be a useful way to understand the problem of school leaders feeling the need to ‘move on’ to implement the most current initiative (home access, learning platforms or electronic assessment, for example), rather than critically reviewing and developing pedagogy. Hardy (2008) argues that these multiple pressures mean that certain forms of ICT CPD ‘tended to be marginalised’ (p. 110). These were the ones that focused on meeting individual teachers’ needs, and which take account of their particular teaching contexts and their individual students. Improving *educational* practices ‘for their own sake’ became secondary to the need to prepare for the latest adoption of technology. To illustrate the argument, a music teacher might use time allocated for CPD attending a whole-school staff INSET session on populating a learning platform, and not on learning how to design a lesson using podcasts to motivate students’ learning in music. There is seldom

time to do both. Ultimately, the ideal would be to have podcasting embedded in the learning platform. But the priority is to *have* a platform, rather than to improve the quality of the learning and teaching which it might accommodate.

A further argument related to this is made by Convery (2009), who claims that teachers become 'victims' of policy-makers' rhetoric about undifferentiated technological benefits for their students. They are encouraged to believe that serial adoption is a moral imperative, rather than reflect critically on what works best to meet the needs of their learners in their specific contexts. The sheer amount of policy making requiring innovation means that attempts to integrate technologies within rich pedagogical models are inhibited. This resonates with Cuban's (2001) argument that technology has been advocated in schools sometimes for the wrong reasons (that is, not because it changes in rich ways how teaching and learning take place). It may well be that the characteristics identified in the *Harnessing Technology Review 2008* are symptomatic of 'policy tensions' and how they are played out in schools, affecting headteachers' choices about priorities.

In summary, although there has been a marked increase in availability of technologies in schools and in teachers' use of them, there is a lack of impact on practice relative to the mobilisation of policy-making and resources which it has attracted. The conditions affecting effective ICT CPD are complex and involve multiple stakeholders. Teachers would seem to need considerable motivation and support to learn while navigating the contesting pressures and responsibilities they deal with. To examine this complexity, literature concerning how teachers learn was examined to identify key features which have relevance for ICT CPD.

6. SECTION B: Teachers' professional learning

It has been noted for several years that CPD provision and policy making needs to be centrally informed by deep understanding of how teachers learn (Evans, 2002; Fraser, 2005). Such understanding is an essential element of developing successful CPD approaches.

Guskey's (2002) influential framework has provided an important roadmap for evaluating teacher professional development. It is based on five levels by which professional development can be judged to be effective:

1	Participants' reactions
2	Participants' learning
3	Organisational support and change
4	Participants' use of new knowledge and skills
5	Students' learning outcomes

Table 2: Guskey's five level framework for evaluating teacher professional development

Importantly, Guskey advised that each level builds on the prior one, so that the early levels are critical to the achievement of the ultimate aim of CPD – an effect on students' learning. This framework is extremely helpful in clarifying why it is so important to focus on the personal, intuitive and qualitative areas of teachers' engagements with ICT CPD, understanding how they experience and react to it. This is a necessary foundation for examining its effectiveness and for understanding where there is a shortfall in pedagogical innovation resulting from it: '[B]ecause each level builds on those that come before, success at one level is usually necessary for success at higher levels' (p. 46). Pickering (2007) has warned, however, that this framework can be interpreted in a very 'top-down' way, encouraging CPD providers to seek evidence for students' learning outcomes as a ready measure of effective CPD. Easily observable evidence of this may be elusive, and the impact of CPD on students may take considerable time. Understanding the complex nature of change is necessary.

6.1 CPD and the change process

CPD is premised on the need for teachers to engage with learning experiences which bring about change. The nature of that change is addressed in generic literature on teachers' professional learning. This explores how changes in knowledge and understanding are related to practice-based developments which enhance learning for students. Change is fundamental to the goal of achieving 'e-maturity' (DCSF, 2008, p. 20) in schools, and an 'e-confident' (p. 24) workforce as part of the government's latest stage of its ambitious strategy to transform the education system. In order to understand how ICT CPD can most

effectively support teachers in this transformation, this review examines key literature related to the nature of change in teachers' learning.

How teachers 'manage and ride the waves of change' (Day, 2000) is argued to be a core element in successful implementation of government strategies. It is significant that research which asked students how they thought their learning experiences at school could be improved, found that the vast majority of features commented upon can be managed within the classroom (Glover and Law, 2002). Glover and Law argue that teachers can *do the most* to initiate change which has an impact on students' learning. Significant variation in practice can exist between individual teachers within the same school, and within the same policy conditions at local and national levels. This does not mean that policy is irrelevant to teachers' development, but does mean that there is a complex relationship between policy conditions, school environments and individual change. There is a need for policy making and CPD strategies to recognise that, for teachers to implement changed pedagogies which integrate ICT, they must be at the centre of their own learning (Schibeci *et al.*, 2008). CPD should take account of how adults learn, and recognise the importance of individuals taking ownership over their own personalised learning journeys. Teachers as 'lifelong learners' can be expected to learn over time and critically reflect on their current state of knowledge and competence, in order to take a proactive approach to achieving change.

Research by Pickering (2007) into CPD suggests that the most effective teacher learning is based on harnessing the experiences of teachers themselves, so that three key processes can take place:

- Self-aware engagement with their learning and consideration about their learning
- Real collaboration that leads to change in practice
- A growing sense of responsibility for their CPD.

How teachers experience their learning is critical to the development of practice, in line with Guskey's first and second levels for evaluating effective CPD (participants' reactions and participants' learning). This is a prime focus for effective CPD according to Pickering, rather than a focus on a CPD 'curriculum' of skills and fixed 'knowledge' to be acquired, which was criticised by the teachers in his study, especially where it is centrally controlled and imposed by external authorities. Clearly, ICT use demands that teachers acquire certain generic skills. To bring about pedagogical change beyond that, however, teachers need to be at the centre of identifying what it is about their practice that needs to change, and how change can be monitored, rather than being told to teach in certain ways using technologies. The conclusion can be drawn that development of practice requires extensive teacher self-awareness and active involvement in choices about relevant CPD activities. This does not happen 'naturally' in many busy school contexts. Pickering argues that CPD design needs to be built around the need for peer review and critical discussion about

practice, leading to decision-making and shared planning for changes in pedagogy.

6.1.2 Bringing about change

The challenges of bringing about significant change in what teachers *do* in classrooms are well documented (Fullan, 2001a, 2001b, 2003; Hargreaves, 1994). This is particularly true of the problems of changing teachers' perceptions of teaching and learning and their practice. Fullan states that very often learning organisations invest 'heavily in technology and possibly training, but hardly at all in knowledge sharing and creation. And when they attempt to use and share new knowledge, they find it enormously difficult' (2001a, p. 79). This well documented pattern from organisational learning has value for understanding the third level of Guskey's framework for evaluating CPD, organisational support and change. How schools work effectively as learning organisations is crucial to widening the impact of teacher learning in ICT beyond the enthusiasts who operate within pockets of excellence or 'enclaves' (Hadjithoma and Karagiorgi, 2009). This is a core reason why collaborative approaches are argued to be important to CPD design (Cordingley *et al.*, 2007; Pickering *et al.*, 2007).

Fullan's (2001a) seminal work on the 'change process' describes key features of leading and embedding change, and emphasises that there are no short cuts and that teachers must be active, collaborative participants:

- Teachers engage in frequent, continuous and increasingly concrete and precise talk about teaching practice...building up to a shared language adequate to the complexity of teaching
- Teachers frequently observe each other teaching and provide each other with useful evaluations of their teaching
- Teachers and administrators plan, design, research, prepare and evaluate teaching materials together
- Expect an 'implementation dip' (not to be confused with resisting reading the signals that a 'new idea' is actually not working!)
- A smooth implementation can actually be a sign that not much is changing
- Change is a process, not an event.

Fullan has suggested a summary of what really matters for leaders to understand in bringing about change and for recognising the pitfalls and preparing for longer-term benefits. This has relevance to the provision of ICT CPD with reference to creating sustainable pedagogical change. Leaders need to create a CPD environment where:

- 'The goal is not to innovate the most'. Long-term engagement with significant shifts in practice is important. This may not seem to be as innovative as engaging with multiple initiatives, but it is the quality of change that matters, not the amount or speed of change.

- 'It is not enough to have the best ideas'. Achieving change involves realistic and effective strategies to enable the teachers who are the actually at the forefront of initiatives to be included; authoritative leaders need to see the weaknesses in their approaches.
- 'Appreciate the 'implementation dip''. Worthwhile change frequently brings disruption and difficulties before the benefits are felt. A smooth transition may be a sign that not very much is really changing in a fundamental way. New ways of working may take time to achieve more than the old ways did. Quick implementation and immediate successes can be false indications that real change has occurred in complex areas like pedagogy.
- 'Redefine resistance'. Where participants are 'resistant', it is important to consider the underlying reasons. Collaborative engagement with change inevitably opens the way for diverse views. Learning from the issues raised is important.
- 'Reculturing is the name of the game'. Sustainable change requires developing a culture which is open to review and enquiry about practice within a school, rather than focusing purely on infrastructure and reorganization.
- 'Never a checklist, always complexity'. Change that is meaningful cannot be simplified in order to meet demands for 'quick' ready-made solutions. If it is easy to tell if change has happened, then it is probably not a significant change.

Dealing with the 'implementation dip' is extremely relevant to teachers learning to use technologies effectively, where immediate benefits are often elusive, and where the education system is intolerant of 'dips' in general. Introducing new technologies and new ways of working frequently disrupts an established practice which is seen to be working. There can be limited tolerance of reduced levels of competence and control, and even student performance, in the short term. Short-term evaluation of ICT CPD may provide little helpful information about its success. Longer term monitoring of its effects may reflect the need for teachers to persevere through difficulties which come with the degrees of change demanded.

There is strong criticism in the literature of instances where CPD is something which is 'done to' teachers (Pickering, 2007) to exercise pressure to change. Pickering found that this is still the majority experience. Understanding how teachers learn by taking ownership of their CPD experiences is fundamental to designing professional development. Pickering argues that they need to be critically aware of their own learning, proactive and actively engaged in their learning and in its evaluation.

The literature suggests a role for strong personal relationships as a basis for learning to practise with technologies. This is important for emotional support in overcoming the 'implementation dip' which can accompany serious change. It is also important to recognise the limitations of the 'Hawthorne' effect' of achieving short-term increases in performance associated with an intervention. The real challenge is developing the long-

term professional orientation of teachers towards working with change, which will sustain their learning and practice beyond 'dips' and 'peaks' of performance associated with CPD.

6.2 Leadership

The effective leadership of change therefore is crucial in achieving effective CPD. Historically, this has been seen as located in headteachers' personal leadership, but more recently, research has shown the importance of 'teacher leadership'. With reference to headteachers' leadership, the Strategic Leadership of ICT (SLICT) programme (Becta and NCSL) focused on creating networks among heads who 'hosted' exposure to e-confident practices in key schools. The emphasis was on developing strategic leadership for embedding ICT, by heads learning about effective models for ICT in other schools. In excess of 40 per cent of heads took part. Comber (2007) makes it clear, based on examining leadership and teacher professional learning in ICT and evaluating the SLICT programme, that there is an 'essential difference' between successful and unsuccessful 'visions' of school leaders which has an impact on teachers being able to learn to use ICT effectively in schools. This is between 'vision dissemination (the head has a vision for ICT that is 'given out' to staff)' and 'vision shaping (the head develops a vision through a process of consultation)'. Working collaboratively with staff and giving them genuine choice, control and participation in the process of change is core to effective leadership of ICT CPD, whatever effective models in other schools headteachers are exposed to. Effective senior leadership is vital, but teacher leadership is also vital – a concept by which teachers are enabled to be proactive and facilitated to learn from each other and address individual differences.

6.2.1 Teacher leadership

Harris and Muijs (2005) have conducted research into 'teacher leadership', which is participatory and seeks to do more than delegate responsibilities for 'rolling out' the strategies of headteachers or external agencies. The argument is that teachers need to be the main agents of change in a proactive sense, rather than as managers in reaction to external or internal policy making. This is where an emphasis on increasing the 'demand' side of professional development activities is relevant. The revised government framework of professional standards for teachers (Training and Development Agency for Schools, 2007) has re-emphasised the importance of reflection on practice. There are responsibilities allocated to grades of teacher (Advanced Skills and Excellent Teachers) to lead the development of their colleagues, but teacher leadership extends to the responsibilities of *all* staff to be leaders of change in their classrooms.

The concept of 'teacher leadership' is about partnership, collaborative development and participatory practice which capitalises on the skills and qualities that enhance the learning of teachers and students alike. According to Harris and Muijs, it involves teachers leading other teachers

by: coaching; mentoring; leading wider groups; leading developmental tasks that underpin learning and teaching; and, crucially, leading pedagogy by developing and modelling effective teaching. This calls for a significant change of culture in many institutions, so that teachers become participants and leaders in change – rather than subject to it.

Leadership approaches affect morale and motivation to learn to use technologies (Cogill, 2008; Pachler *et al.*, 2009 forthcoming). Morale and motivation, which is frequently downplayed in strategic approaches, is linked to teachers having creative, proactive, choice-led and flexible experiences. A final implication of this is that there needs to be a clear link between the emotional and the practical – teachers are motivated and become less threatened by having access to equipment and software which is transferable between their personal and professional lives, enabling them to ‘play’ with new technologies outside school hours.

Fullan’s (2001a) emphasis on ‘moral purpose’ and ‘relationships’ as crucial factors which enable change is vital. This relates to how teachers ‘own’ changes in their practice. They develop them through networks of enthusiastic individuals who support risk-taking in blame-free conditions. It is important for teachers to ‘believe’ in the changes which bring so much potential disruption. This is also why they need to develop confidence in using ICT at home – to ‘inhabit’ the new practices, and develop an attitude to technologies where they are part of their identities as teachers as well as being part of everyday life.

6.3 Schools as learning communities

There is a growing international literature which reflects research into schools as learning communities, based on a perceived need for ICT CPD to enable effective pedagogy to ‘break out’ (Scrimshaw, 2004) of small groups of innovative practice, and ‘infect’ the wider community. It is essential for CPD to make a difference beyond enclaves which affect only part of the curriculum or include only particularly enthusiastic teachers. A significant influence on this perception of CPD is the concept of ‘Communities of Practice’ (COPs) (Wenger, 1998). This proposes that a group of individuals build knowledge together about their practice, based on sharing their experiences within a work context such as a school. Multiple formal and informal interactions take place over time between varying members of the COP. They come together in a variety of groups, and their ideas about practice become a shared ‘history’. Individuals are bound together by common goals and a store of experiences related to practice. Newcomers learn how to become part of the community by being involved in collaborative talk about practice.

Much work in applying these ideas to teachers’ CPD originated in Australia. Doecke and Gill (2001) claimed that the notion of the ‘individual professional’ is ‘paradoxical’. To be professional is to be collaborative. Their work explored the potential of COPs to ‘demonstrate a model of collaboration’ (p. 8). Further Australian research identifies ‘Teachers’

Professional Learning Communities' (TPLCs) (Lingard, 2003). Lingard emphasised the importance of collaboration in the culture of staffrooms and adult communities throughout the school – TPLCs include the entire school-based workforce of teachers, heads, students, parents, teaching assistants, mid-day supervisors etc. There is a lot of interest in the idea of 'community' in teachers' learning, although the realities in England can be argued to be somewhat at odds with this.

In England, the concept of a 'professional learning community' (PLC) has only recently become established in practical and theoretical terms, though Sergiovanni's (1999) theorisation of 'learning communities' established the features of learning communities within school contexts as rooted in bottom-up interactive enquiry involving teachers. Haberman's (2004) focus on community, links the teacher as a person with the teacher as a professional, claiming that a teachers' learning community 'encourages teachers and staff to grow personally and professionally' (p. 52). The work of Fielding *et al.* (2005) on 'joint practice development' in schools, and Bolam *et al.* (2005) on effective PLCs, has focused on the benefits of collaborative, learner-engaged practices for teacher learning. Webb *et al.* (2007) claim that professional learning communities need to be 'outward looking' and to 'actively find out about practice', building on 'diversity' to prevent them being 'closed cultures' (p. 181). It is important to acknowledge the reality of the situation in many schools regarding learning communities. The challenges of bringing them about cannot be underestimated, and may be significant considering that so many successful schools have strong elements of collaborative learning and strong collegial culture. Pearson and Naylor (2006), in their study of secondary schools and ICT innovation, claim that transforming schools into learning organisations 'is extremely difficult in the current political climate' (p. 284).

Despite this, it may be that an emphasis on supporting schools as learning communities will have the greatest impact on ICT CPD. The concept of schools as learning communities also has origins in Hargreaves' (1999) work on the 'knowledge-creating school'. The argument is that disseminating good practice will not be enough to sustain a school's capacity to meet the learning needs of its students in contemporary contexts of continuous social and technological change. A school needs to be able to create new knowledge, adopting new ways of learning. Hargreaves is critical of 'transposability' (the idea that professional knowledge and skills can be moved by one person from one place (school) to another) and 'transferability' (the idea that it can be carried over for another teacher to reproduce it). Teachers learn about their own practice by seeing and engaging with the practice of others – not simply reproducing what other teachers do. Teachers should be involved in creating new knowledge based on their practice. Teachers and students are learning in a changing society, where they are required to be autonomous and innovative and to use networking to learn more quickly and flexibly. He defines the key knowledge-creating processes as:

- *Auditing* professional working knowledge
- *Managing* the process of creating new professional knowledge
- *Validating* the professional knowledge created
- *Disseminating* the created professional knowledge.

These processes ensure that professional learning goes beyond personally effective practice. Hargreaves develops the idea of the 'tinkering' teacher, to say that teachers ordinarily develop through fairly haphazard individual processes of trial and error based on 'good ideas'. More is needed for 'tinkering' to become a systematic and managed process which is shared with colleagues – thus becoming 'knowledge-creation'. The idea that teachers can *create* professional knowledge based on sharing expertise in focused ways is core to a learning community.

The organisation of the school thus has a vital impact upon the shared learning capacity of teachers, by supporting the ability to reflect upon practice in an informed way, to initiate shared reflection, and to manage the sharing and creation of knowledge. These features affect how well students, teachers and schools support learning and pedagogical change to meet the constantly changing needs of contemporary society. The important thing is to see teachers' active participation as core to schools being effective places for them to develop as 'people' as well as 'professionals' – teacher identity combines both.

6.4 Collaborative CPD

There is a considerable consensus in the literature that collaborative approaches are at the heart of effective CPD design (Cordingley *et al.*, 2005, 2007) and reflect the pedagogical potentials of technologies (Scrimshaw, 2004). Cordingley *et al.* have conducted systematic reviews of the CPD literature concerning both collaborative CPD and the intervention of specialists in CPD programmes. Collaborative CPD, according to their research, involves at least two teachers working together on a planned and sustained basis. Where this involves specialists, they undertake a variety of tasks such as planning, observation, feedback, shared reflection, modelling and classroom enquiry. Such approaches provide benefits which lead to the adoption of new practices. Benefits result from:

- the use of peer support
- explicit use of specialist expertise
- applying and refining new knowledge and skills and experimenting with ways of integrating them in day-to-day practice
- teachers observing one another
- consultation with teachers either about their own starting points, focus of CPD, or the pace and scope of CPD
- involving specialists in observation and reflection

(Cordingley *et al.*, 2005, pp. 65-66).

Also significant are Cordingley's findings about the organisation of collaborative work, 'that shorter, smaller and more frequent collaborative work is more effective than larger, infrequent meetings' (cited in Devereux, 2009). Devereux (2009) comments on the multiple and complex ways this happens:

An approach that operates through multiple small collaborative networks, and works with a specialist to experiment with, share and develop approaches that extend beyond the curriculum, to engage teachers and their students in learning about learning. This suggests that knowledge based CPD at fixed times in fixed places is not the best way to proceed. Instead, informal small groupings of professionals, ready to push themselves further in the search for new ways of learning – for themselves and their students – is the way ahead. (Devereux, 2009, p. 19-20)

A further finding from the review by Cordingley *et al.* of the use of external experts in CPD (2007) is that when specialists (such as HE or LA experts, subject specialists, technology experts) contribute to CPD programmes, teachers learn more about their subject, more about learning and new ways of teaching. By working with a specialist in their own classroom, a teacher can directly observe the incorporation of innovative teaching approaches using technology, and see how the expert works flexibly when equipment does not work. Developing 'the ability to experiment' is cited as a benefit of working with experts in schools to learn to use technologies in innovative ways. The challenge is to develop models where collaborative learning can be achieved which is 'shorter, smaller and more frequent' and in which judicious use is made of a range of specialists, so that learning about technologies for teaching is embedded in both local school networks and in external expertise.

Pickering (2007) has also identified the need for collaborative and teacher-generated opportunities for teachers to learn from and with each other. He found that their main experience however, has been of training from an 'outsider', driven by centralist goals and delivered by external authorities, with minimum opportunities for teachers to talk together in ways which recognise their experiences as a foundation for learning. Reeves *et al.* (2005) have argued that, where collaboration is 'enforced' through government initiatives, it fails to establish genuine mutual purpose and shared notions of moral purpose among teachers. Reeves makes the point that collaborative approaches to CPD should not seek consensus, and that collaboration should foster criticality, challenge and change. This can be hard to achieve in practice, particularly if the stakes for perceived 'failure' are so high. In schools, collaboration can sometimes seek to achieve consistency and compliance in an inward-looking, risk-averse way rather than critical and independent thinking among teachers. Criticality requires an openness to challenge which can only be sustained in an environment in which disagreement is acceptable, rather than something that has to be resolved or overcome. Consequently, there is real tension

between promoting criticality and promoting normative standards of practice.

6.5 Online teachers' learning communities

There is evidence of recent growth in teacher 'networks' (Johns-Shepherd and Gowing, 2007), both electronic and face to face. Electronic communities for teachers have proliferated in recent years, but their role in changing practice is not clear. There is growing interest in online learning communities and web-based learning for professional development based on their capacity to support bottom-up interactive learning approaches. Systematic research into the effectiveness of online learning communities for teacher CPD however, is as yet very undeveloped (Fisher *et al.*, 2006; Kao and Tsai, 2009):

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. (Fisher *et al.*, p. 2)

Research exists into collaborative online discussion about practice for accredited CPD (Daly and Pachler, 2007; Pachler and Daly, 2006) which suggests that critical and independent thinking about practice is enhanced but further research is needed into the impact on practice. Although Fisher *et al.* (2006) have a conviction that digital technologies will enable teachers 'to act as knowledge builders, as collaborators and as reflexive practitioners' (p. 1), they admit that currently this remains a projected ideal. As well as the lack of UK research into this area, international literature provides little further help. Grunberg and Armellini's (2004; 2005) studies in South America found that online communication has the potential to support the development of 'collegiality' in school teachers via 'social exchange', but that this does not necessarily support learning. Frequently, 'sharing' is limited to the exchange of resources, rather than explicit reflection on practice and critical debate. They point out a serious obstacle to teacher learning is the ways that teachers tend to 'privatise' responses to each other online. Essentially, communication was found to lack collaborative discussion of pedagogy or theoretically informed beliefs about learning and teaching (Grunberg and Armellini, 2005).

In the USA too, this vacuum exists: 'We found ourselves dismayed by the dearth of empirical research into online teacher professional development' (Ketelhut *et al.*, 2006, p. 237). This vacuum reflects the relative newness of teachers' online learning communities, by which their early impact is mostly in terms of networking and exchanging information and resources. It is hard to gauge their effects on transforming knowledge, skills and pedagogy. In the USA, research has identified this as a 'tension' in the development of online professional development programmes for teachers, identified as 'design for incremental learning versus design for transformation' (Ketelhut *et al.*, 2006, p. 238).

Preston and Cuthell (2007) and Preston *et al.* (2009) have described successful online networking cultures as 'communities of practice' which achieve a deep level of reflection on pedagogy among 'digitally experienced teachers and advisers who are members of the professional organisations: Naace, MirandaNet and ITTE...although the majority of the members still confined their activities to email list discussions' (Preston *et al.*, 2009, p. 1). They record the growth in informal, loosely structured web-based learning communities supported by Web 2.0 technologies, where professionals come together in gatherings or 'Mods' to share ideas and practices about learning with technologies, convened by the professional organisation. These MirandaNet gatherings are mostly held in collaboration with universities and partner companies with a digital technology remit. The observation of these online professional practices has led to the development of an emerging model of collaborative knowledge and policy building, called 'Braided Learning' (Cuthell and Preston, 2007; Haythornthwaite, 2007; Preston, 2008). Cuthell (2008) has further described a model of voluntary collaborative online CPD, which takes place via a learning platform across international contexts. Teachers can take part in online sharing of project-based self-directed learning. The model is based on the importance of 'learning by doing' and usually attracts self-selecting ICT enthusiasts. There is evidence that when teachers see transparent benefits for themselves and their students, they use online learning environments with enthusiasm, for example when they are able to gain rich insights into approaches to prepare their students to take exams, provided by the exam board itself (Riding, 2002). Such access is clearly valued by teachers because it is extremely focused on informing practice, is led by experts in a very defined domain, with a clear means of gauging what effect it has. Riding found, however, that further informal professional development can then happen around questions about practice which arise in the online exchanges between the teachers. A wider professional discussion, involving reflection on practice-based knowledge, is a 'by-product'.

The challenge appears to be to embed online and web-based CPD approaches with classroom teachers who are less motivated, who are not 'experts' or 'enthusiasts', or where the CPD aims are more reflective and aimed at developing pedagogy rather than gaining information from experts. There are several moves in this area. Russell and McGuigan (2008), as part of a call for 'creativity' to be at the centre of students' and teachers' learning experiences for embedding ICT, argue for a hosted and supportive online 'community of practice' which includes teachers 'collaborating' and 'sparking ideas' off one another. Exactly how such a community becomes sustainable and reaches less than enthusiastic teachers is a challenge. They see a need for national stakeholders to take a lead:

A strategic approach to any such programme of professional development will need to be done through the relevant agencies. This would include the Training Development Agency (TDA), the National College for School Leadership (NCSL) and the General

Teaching Council (GTC). The programme should also encourage collaborative working between BESD and mainstream schools (p. 7).

There is a need to be 'strategic' at national policy level and involve all these agencies. They recommend the following to support the establishment of a creative pedagogy for students and teachers alike, based on developmental work with teachers of students who are 'hard to reach':

1. Students' creativity should be harnessed by giving them a training role
2. Teachers need to learn to use social software such as blogging and podcasting to support enquiry into their practice
3. Teachers need to learn how to work with Web 2.0 and integrate technologies into their everyday lives.

Online and sustained support for CPD pedagogy is still very much at a developmental stage, however. Carr and Chambers (2006) suggest two main reasons for why online communities have been slow to develop effective support for CPD among the majority of non-specialist school teachers: 'Schools do not adequately value collegial reflective sharing of practice, and classroom teachers do not use online communication tools as an integral part of their professional practices' (p. 269). A lack of a reflective culture, and lack of time to devote to developing one, were key obstacles to changing these factors. Although online learning communities in teachers' CPD are now gaining momentum (see for example Lindberg and Olofsson, 2009, forthcoming), this is still very undeveloped in terms of evaluation of impact on transforming knowledge to change practice. A further issue is that online forums often are not self-managing. There is an unresolved and under-researched question here, of who should be managing or moderating these, and under what conditions?

7. Teachers' knowledge about using ICT

This section briefly reviews key literature about how teachers become knowledgeable about using ICT for learning and teaching, which relates to Guskey's fourth level of evaluating CPD – using new knowledge and skills. Shulman (1986) proposed the concept of 'pedagogical content knowledge' (PCK) by which teachers' subject knowledge is transformed by practice, so that the content area of their knowledge is developed into 'pedagogical knowledge' – understanding and 'know-how' about how ideas and content are 're-presented' for learning and become meaningful to learners. Mishra and Koehler (2006) developed their framework for teacher knowledge to include ICT, to become 'technological pedagogical content knowledge' (TPCK). The framework describes their adaptation of Shulman's (1986) concept of 'pedagogical content knowledge' and argues that teachers learn to use technologies as a further dimension of this. They propose that professional knowledge of subject content, pedagogy and the role of technology is deeply inter-related. Engaging with technologies has a transforming effect on what it is to 'know' something, and on how teachers think people learn. Pedagogy changes along with transformations in teachers' knowledge about the 'content' aspect of their work. They come to realise that further subject complexities need to be explored for example, and that group work is an effective strategy which can be supported by a particular use of technology for students to record and present shared outcomes. The implication is that teachers learn in a continuous integration of developing subject knowledge, application of technologies and deepening understanding of effective pedagogy. It is a holistic process.

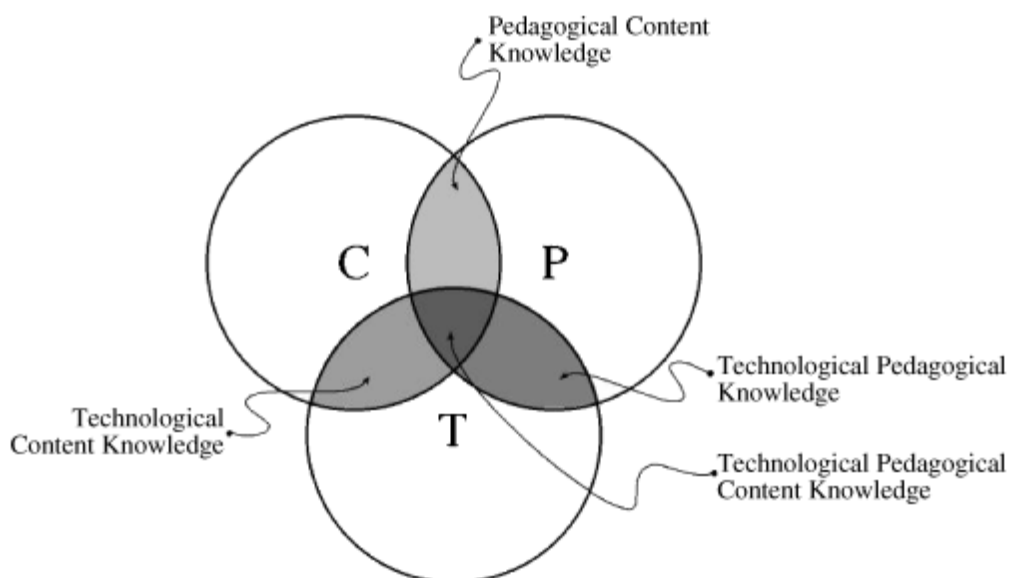


Figure 1: Pedagogical Technological Content Knowledge. The three circles, Content, Pedagogy, and Technology, overlap to lead to four more kinds of interrelated knowledge. (Mishra and Koehler, 2006)

They argue that:

Most scholars working in this area agree that traditional methods of technology training for teachers – mainly workshops and courses – are ill suited to produce the “deep understanding” that can assist teachers in becoming intelligent users of technology for pedagogy...context neutral approaches are likely to fail because they overemphasize technology skills . (2006, p. 1031-3)

Professional development needs to be context-specific, and teachers need to actively focus on redesigning their teaching for authentic purposes. To develop TPCK on a practical level, they developed the idea of ‘Learning by Design’

...whereby teachers learn about educational technology by engaging in authentic design tasks in small collaborative groups. Our approach goes beyond the simple acquisition of skills (something that has been criticized in the teacher education literature). The acquisition of skills approach does not address what we and others believe is a critical issue: that teachers need to develop pedagogical understandings. (Koehler and Mishra, 2005, p. 97)

This process may involve redesign in the light of critical reflection on trial lessons using ICT. By ‘design’, teachers learn to use technologies in innovative ways, and tailor their use to achieve goals which are specific to their learners. Examples include teachers making digital films which demand the same skills they might expect their students to use, and redesigning a website as an educational resource in a subject-specific area, thus developing judgements about effective learning activities at the same time as developing ICT skills. ‘Deep understanding’ and ‘intelligent’ use of technology for pedagogy involves continuous feedback and review by trying out the methods, and cannot be taught by demonstrations. The teachers need to ‘live with’ the technologies they intend to use with the students.

Angeli and Valanides (2008) argue that the TPCK framework only presents part of an extremely complex picture of how teachers learn to practise with technologies. They argue that TPCK should acknowledge the particular effects which technologies can have on learning. They refine the model, calling it ‘ICT-TPCK’ and admit that the development of ICT-TPCK ‘is not an easy task’. ‘Restructuring’ of old teaching practices is necessary, and this requires active engagement with risk-taking within a learning community. They thus incorporate a review of original ideas about PCK by Shulman and Shulman (2004) which recognised the importance of Teacher Learning Communities, in which teachers are supported to ‘learn

from experience' and which link individuals with shared and institutional reflection:

Teachers must be trained in powerful learning environments where teaching is situated in real and authentic tasks, and in ways where teachers themselves constitute a part of a larger learning and professional community for the purpose of exchanging perspectives, resolving dilemmas, and confronting uncertainty in transforming classroom practice. (Angeli and Valanides, 2008, p. 166)

This is why schools as learning institutions are critical to developing professional knowledge of how to use ICT effectively, because it is just one aspect of an overall ethos and infrastructure which supports these conditions.

Beyond the context of the school, Couros (2006) has captured the notion of 'the networked teacher' as existing in potential connection with a range of contemporary technologies and resources for their own learning and in relation to the learning of others (Figure 2).

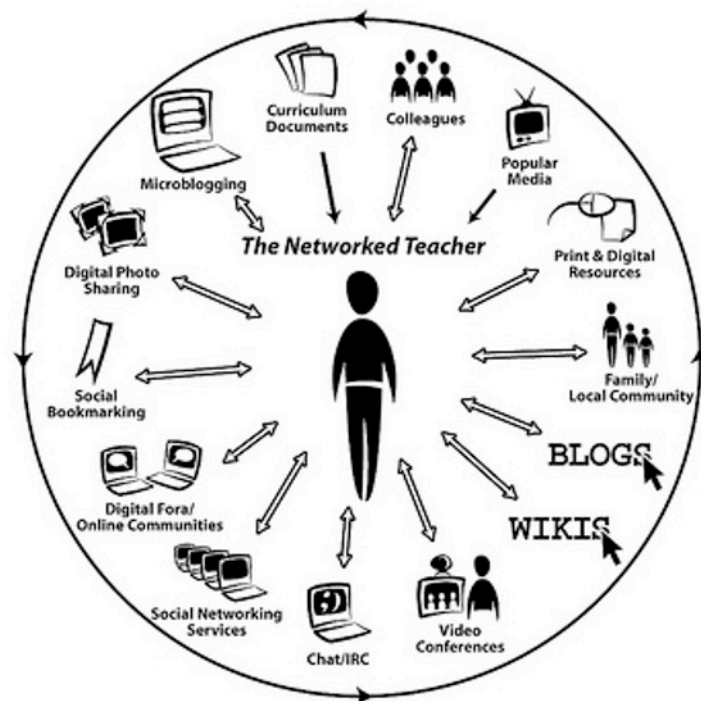


Figure 2: The Networked Teacher (updated version). (Couros, 2006)

The image may be a long way from the range of technology opportunities that are made available to a teacher both in their professional and home life to support CPD, but Couros argues that contemporary approaches to teacher learning need to be aligned with such a 'worldview'. It signifies the possibilities of finding support, collaboration and creative inspiration in the

various connections, both online and face to face. Technological *and* social resources are needed for teachers to develop deep knowledge and skills shaped by new collaborative practices, and engage with informal as well as formal learning opportunities. These factors need to be reflected in the learning practices of the teachers themselves. The concept of the total learning environment for teachers and technology becomes a critical focus.

7. 1 An ecological view of teacher learning with technologies

An ecological view of teacher learning with technologies appears in research which is concerned to explain the relationship between the teacher and the environment in which they practise and learn. This view looks at the learning environment as a set of processes which are inter-related with each other in complex ways. The environment is made up of a range of social, cultural and technological resources which are not fixed but are dynamic and affect the evolution of practice. If one aspect of the environment is changed, all of the processes are altered in some way because they are linked with each other, and all elements within the environment are affected. When applied to teachers' learning, this means that it is impossible to simply focus on developing one element, for example individual teachers' skills or access to technology or the provision of an expert mentor. No one element within the environment works alone, but in relationship with others. A study by Hammond *et al.* (2008, n. p.) argues that it is the interplay between the teacher and the environment which makes professional learning effective:

Becoming a very good user of ICT is not something 'done to you' but something that you do, albeit strongly influenced by environmental factors. This is an idea that has some resonance with earlier research which looks at personal factors when considering in service teachers who are seen as exemplary users of ICT...However, the present study goes further and looks at the development of very good use of ICT in a more ecological manner; it is not the student teacher and it is not the environment, it is the interaction of the two.

This is not a new assertion, but highlights the challenges of designing effective CPD where the crucial factors lie in the 'ecology' of the learning environment. The metaphor of ecology, or natural systems processes whose separate parts are in complex inter-relation with each other, has been long-established in education, and is summarised by Zhao and Frank (2003): 'The ecosystem metaphor emphasizes interaction, complexity and the need to understand systems as wholes rather than a collection of parts...natural ecosystems can achieve harmony or become disrupted'. The advent of technologies has brought additional complexity to the range of processes and factors which are brought into consideration. An 'ecological' perspective means that the factors for effective ICT CPD which emerge from this review need to be seen as inter-connected and context-specific. Schools are 'unique' places for

teachers to develop practice with ICT (Schibeci *et al.*, 2008). The recommendations are mostly to do with *helping to shape the learning environment* therefore, in which a variety of practices may take place, each of which have variable impact on the teachers' learning according to a host of other factors in the environment, which are related to the individual teachers, schools and wider networks of influence.

Davis (2008) reminds us that for any ecological model, success lies in the subtle and shifting balance in relationships between factors, and unique permutations are constantly developing and evolving. The lesson to be learnt for effective ICT CPD is to recognise the danger of believing that a very small number of factors can be isolated as creating an effective environment for ICT CPD. In reality there are many factors and, more importantly, each one is related and interconnected with the others. It is important therefore to avoid over-emphasis on single-strategy 'solutions'. Over-emphasis on some factors can in fact inhibit the growth of, or even 'kill off', other potentially beneficial factors, because they upset a balance or over-prescribe the conditions of the environment. A focus, historically, on technology, headteachers, standardisation etc., has not addressed the complexity of the teachers' own learning which is at the centre of any effective change in practice, and which will be experienced uniquely and variably within even constant external environmental factors. Flexibility, responsiveness, creativity and respect for difference are core ingredients in successful ICT CPD. So too is the recognition that the teacher is a whole person, whose relationship with the environment is shaped by personal attributes and experiences. The teacher brings their individual 'inclinations' to the environment. For this reason, they should be encouraged in their personal use of technology at home, so that use of ICT becomes an accepted and commonplace experience. This has an impact on how they interact with the range of factors they encounter as part of ICT CPD.

Davis presents an ecological view of the ICT CPD environment, at the level of the classroom, school, wider education district/authority, regional and national factors, all of which are populated by different groups of stakeholders (parents, local and national government organisations and professional groups).

Across all these, she identifies four strands of influence on ICT CPD – political, bureaucratic, professional and commercial. Her model for this shows how teachers, learners and technologies exist at the centre but practice is developed within a set of relationships with all of these dimensions.

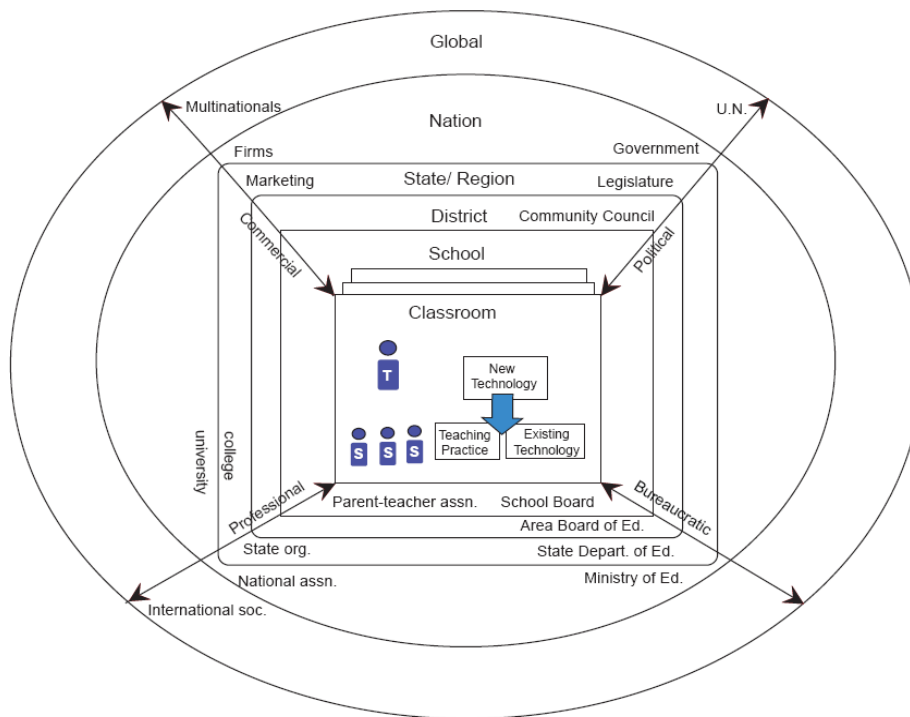


Figure 3: An ecological model of teacher learning and technologies. (Davis, 2008)

This 'ecological' view of teachers' learning in ICT does not mean that the teacher is passively positioned within the environment. Findings by Hammond *et al.* (2008, n. p.) with student teachers who were 'very good' with ICT has wider significance for understanding how all teachers are constantly 'negotiating practice' within all the environmental factors as they learn to use ICT effectively. Hammond's point is that teachers' learning is:

...the responsibility, or...the achievement of, the student teacher him or herself. In a wider context it suggests that learning to teach, and learning to teach well, can be considered not only as an apprenticeship, a kind of induction into a community of practice, but a more proactive process in which the student teacher is negotiating a practice within an environment which encourages some activities and discourages others.

Teachers are, like the other parts of the ecology of the classroom, a dynamic element. This means that they need support from a range of sources and strategies to be able to develop and to be proactive rather than reactive to the environment.

7.2 Changing deep-seated beliefs as a key to effective ICT CPD

The persistent lack of engagement of many teachers in innovative practice needs to be understood as a key to understanding what makes for effective ICT CPD. Lack of engagement is despite the fact that the positive

effects of ICT are now well documented, which has been summarised by Russell and McGuigan (2008):

Condie and Munro (2007) undertook a meta-review of over 350 literature sources and have summarised some of the positive impacts of ICT on teaching and learning. Positive benefits are reported on attainment in national tests by Becta (2006a); on motivation (Becta, 2006b), Passey *et al.* (2004); on self-esteem, interest, attendance and behaviour among hard-to-reach students (Passey *et al.*, 2004 and Ofsted 2004) and on writing (Dunsmuir and Clifford, 2003). In 2006, Passey reported a range of impacts on learning as a result of digital video experiences offered to hard-to-reach learners. Loveless (2002) reported some of the ways ICT was being used to support creativity in art. Webb (2005) analysed the affordances for meaning-making provided in the ICT-rich classroom environment. (Russell and McGuigan, 2008, p. 10)

The persistent lack of engagement needs to be seen in the light of studies which suggest that the majority of teachers *are aware* of such benefits of ICT for their students (Holmes *et al.*, 2007; Rae and O'Brien, 2007; Slaouti and Barton, 2007). In addition, as a result of sustained and ongoing funding for technologies in education over a period of years (currently Building Schools for the Future, for example), students in the vast majority of schools have access to a range of hardware and software, and teachers are increasingly skilled in including technology in their planning and teaching. None of this is enough in itself, however, to shift deep-seated beliefs held by teachers that change in their practice is not really necessary. Scrimshaw (2004) identified a core reason for this as being that embracing technologies means developing a student-led pedagogy, focusing on group work, based on a belief that students should actively construct their own learning. Where teachers have relied upon teacher-centred approaches in their practice, they are being asked to make a fundamental shift in ideas about how students learn. This is a major challenge and involves significant change, as opposed to using technologies to continue to underpin a teacher-centred approach.

Webb and Cox's (2004) review of teachers' pedagogy and ICT use suggested that teachers' values and beliefs about how ICT will affect their students' learning is core to their adoption of technologies. This is a core factor influencing the effectiveness of CPD, and one which is still frequently underestimated, despite their comment on reviewing a number of studies which send this message: 'Enabling teachers to adapt their pedagogical reasoning and practices in response to learning opportunities provided by ICT is likely to be a very difficult and complex process' (2004, p. 278). Values and beliefs affect willingness to 'adapt pedagogical reasoning', and this continues to appear as a significant factor in a number of studies of ICT CPD carried out since Webb and Cox's review. This issue can be summarised by what Holmes *et al.* (2007) call the need for CPD to focus on changing 'hearts and minds'. This is a complex area, indicating a range of emotional and psychological factors which affect

teachers' attitudes to ICT. Teachers' deep-seated beliefs about how they should teach are linked to values and convictions which have been developed in a variety of personal and professional contexts over time. They have 'folk beliefs', or a deeply held subconscious affiliation with certain ways of practising, which can be based on early life experiences of home and school (Belland, 2009). Teachers' 'beliefs' about how their students learn are linked with pre-service life, and are very difficult to shift without sustained focus on practice with technologies, including exposure to new ways of working over time. 'Attitude' was reported as the most crucial factor among teachers for learning to use technologies (Almås and Krumsvik, 2007). Their own individual histories create differences between teachers which go far beyond a simple view of differing skill-levels in ICT and which affect their readiness to learn. Jimoyiannisa and Komis (2007) found that 'personal factors (subject matter, teaching experience, ICT use and experience and gender) are strongly associated with teachers' beliefs and perceptions about ICT in education' (p. 151). Although teachers recognise the significance of ICT in society at large, and recognise its benefits for student learning, this is not necessarily reflected in beliefs that their own practice needs to change. In initial teacher education scenarios, Belland (2009) argues for the need for far more time to be devoted to sustained engagement with technologies and focused practice with technologies in schools in order for deep beliefs to be challenged.

Hammond *et al.* (2008) have identified the importance of cultivating 'an inclination' to use ICT in initial teacher education. Deep-seated beliefs continue to affect CPD throughout teachers' careers. Cogill (2008) has identified the importance of a 'learning disposition' which can overcome barriers to developing with ICT, and Hansson (2006) has highlighted that 'motivation' to want to improve professionally through ICT CPD can be cultivated by 'reflecting as a teacher' and asking "What is in it for me? How can I improve my teaching using technology? What are the benefits for the students?" (p. 562). 'Self-efficacy' is a learner's beliefs, confidence and expectations about their ability to carry out a task. It has been identified as an important but under-researched aspect of web-based ICT CPD (Kao and Tsai, 2009). These psychological factors are impossible to regulate, but not to influence, and working to change beliefs needs to be a fundamental aim of effective CPD. Based on this, models can be developed not around learning about each new wave of technology as an 'event', but around embedding technology as an everyday 'process'. A process model of CPD is argued to result in long-term changes. According to Evans (2002) CPD as a process brings about two core requisites of teacher development: attitudinal development and functional development. Both are required for long-term changes in teachers' pedagogy.

Such models have a basic premise that *it takes time to make worthwhile changes*. Dispositions and inclinations *can* be cultivated, but not without sustained engagement with technologies and practice with new pedagogies. Hammond *et al.* (2008) explain the ways in which 'an inclination' to use ICT in the long term is affected by easy and frequent access at home:

Experience with personal use of technologies provided trainees with 'an inclination to use ICT' or a propensity to see ICT as of value. This would seem to be of much greater importance than acquisition of a specific set of ICT skills. (n.p.)

It has been important to emphasise this aspect from the literature as a context for specific ICT CPD related factors which emerge in Section C. To conclude Section B, we outline four generic models of CPD which contain a set of approaches which are relevant to studies of ICT CPD. Each of them contributes to the development of teachers' 'self-efficacy' – the beliefs, confidence and expectations about their own abilities which are necessary to change practice. The models which follow in the next section are:

- *Principled*: reflecting educational values and responsibilities, so that teachers can be discriminating in their choices about technologies and primarily concerned with student learning
- *Theoretically informed*: dealing with conceptual issues, so that teachers exercise critical thinking about their practice in the light of deeper understanding about how technologies help students to learn
- *Evidence-based*: relating to practice-based research, so that teachers actively interrogate their practice and can see their own experiences count as valuable sources of professional learning for others as well as themselves, and
- *Situated*: recognising that professional learning has strong context-specific elements and is individual.

The models which follow clearly contain many overlapping features, but contribute distinctive insights into effective CPD in contemporary contexts of continuous change.

8. Models of CPD – a summary

8.1 Communities of Practice

Wenger's (1998) concept of 'Communities of Practice' (COPs) offers a model of practitioners' learning which has become almost commonplace but is not always used accurately. Learning in a COP goes beyond increasing a person's capacity to function efficiently or develop further skills within the workplace. Being able to 'do' something within a COP means developing judgements and becoming discriminating in deciding how to practise. Individuals draw on a common store of professional knowledge about how things should be done. This common store is built by the practitioners themselves, by collaborative talk and exchanging experiences over time. Becoming good at something involves developing specialised judgements about what is involved in particular professional actions. When these become shared in a community of practice, this allows participants to negotiate appropriate ways to carry out tasks and behave within the community (Wenger, 1998, p. 81). Within a COP, CPD should be socially binding between teachers. A genuine COP is established by 'a way of talking' among members. Communication is core to establishing shared understanding among participants about the nature of their work, and enables them to take future actions. This concept of 'a way of talking' becomes fundamental to understanding professional learning. Ideas about COPs have been over-simplified in the wide application of Wenger's theory to various social learning contexts. Wenger makes it clear that a *community* does not necessarily imply a shared *practice* and that this must be forged over time. A school COP can create a culture for how individuals can practise within that school, in relation to what risks are allowed, what support is likely etc... Frequent, informal talk is essential to learning within a COP and cannot be artificially engineered, but rather grows out of an ethos of regular consultation and shared experiences.

Rae and O'Brien (2007) identified the presence of a COP as an important factor underpinning ICT CPD. They describe how it grows where teachers 'frequently referred to working with their colleagues...although management were responsible for the installation of the equipment [IWBs], the teachers themselves were responsive to the technological change and defined their own professional learning' (pp. 436-437). They identified important features in the ways a COP enabled teachers to develop their use of ICT:

These teachers demonstrated collective autonomy by developing fluid, informal, collaborative learning opportunities where the shared aim of how to incorporate the boards into daily teaching and learning created the common ground to establish the community of practice...This did not appear to develop intentionally, but rather in response to more teachers being confronted with the same problems and requests for information....The community teachers were clearly committed to engage collaboratively even when the

learning was not consistent with the expectations of their management. (Rae and O'Brien, 2007, p. 437)

Hadjithoma and Karagiorgi (2009) identify 'communities of implementation' as being a specific application of the concept of a COP to ICT CPD contexts. They are concerned with how school-wide communities (SWCs) are developed, which appear to be more successful in implementing change, rather than 'enclaves' involving only small numbers of enthusiastic or confident teachers. In schools with successful school-wide communities of implementation, there was a high degree of informal contact between staff regarding their development of ICT use; headteachers had open and relaxed leadership styles and supported the exchange of ideas and expertise; there were strong staffroom cultures of conversation; one school was highly involved in ICT projects with other schools. There was less perceived need to rely on ICT 'staff experts' and more involvement of a wider range of staff in helping each other with ICT development.

A critical point is that much of the professional learning which takes place through these informal arrangements is 'hidden' and not recorded anywhere, and the strength of the CPD is in its informal structure. Other models of CPD – teacher enquiry, critical reflection and case-making – are frequently situated within the over-arching concept of a COP. These models involve frequent collaborative talk but also record the learning activities in a variety of ways which are controlled by the teachers themselves, so that the CPD is more 'visible'. It is therefore possible to see a variety of collaborative approaches, some more 'hidden' than others, which involve sharing practice and critical thinking as part of a COP. A COP is not a fixed group of people, or a fixed set of activities, but grows out of a range of ways of participating among individuals, where they are allowed to be autonomous and grow an ongoing capacity for their own learning. It thus becomes enduring and can respond to frequent demands for change, rather than seeking immediate 'solutions' for problems of implementing initiatives.

8.2 Teacher enquiry model

Teacher enquiry into practice in the classroom has also been found by Pickering *et al.* (2007) to be an underpinning factor in successful CPD, integrated with collaborative and teacher-generated activities. This model rejects traditional separation between university-based educational 'theory' and 'practice', and emphasises that pedagogical change is brought about by teachers developing the skills to critically review and research their own practice. This has been recognised in the way that teacher research is core to participation in CPD innovations such as the London Chartered Teacher programme, as well as Higher Education programmes such as the Master of Teaching at the Institute of Education, University of London, and the accredited CPD Chartered Teacher Programme (CTP) in Scotland. Research into successful teacher learning on the CTP emphasises the key role played by teacher enquiry:

Professional enquiry as an approach to classroom practice offers an opportunity for teachers to develop their self-confidence and to exercise agency by trialling new ideas and approaches and engaging directly with current trends in professional practice. (Buchanan and Redford, 2008, p. 29)

The relationship between changing teachers' dispositions and carrying out teacher enquiry is one further crucial element of effective CPD. In the example of a teacher enquiry model, Buchanan and Redford propose that, in CPD contexts, teacher enquiry has three stages which enable teachers to learn new practices: preparing, intervening and sense-making. Different stakeholders play their part of different stages in enabling enquiry – peers and colleagues; senior school leaders and experienced educationalists.

It is less likely, however, for teachers to carry out enquiry where CPD is entirely school-based (Cordingley, 2008). Pachler *et al.* (2009, forthcoming) report on a case study into a borough-wide ICT CPD programme, in which teacher enquiry was a key component of the CPD design. Teachers attended skills training sessions provided by the local CLC, and decided on individual development projects which met the needs of their subject backgrounds, their own learners and their own developing levels of ICT competence. These projects were highly differentiated and developed in negotiation with the CLC ICT specialists and Senior Leaders in their schools, and discussed with their peers on the programme. The teachers had a high degree of autonomy in deciding where to focus their development of ICT and the enquiry into it, within a supportive framework. They received advice on carrying out enquiry from the CLC, which worked with Higher Education Institutions to support this. Teachers prepared accounts of the development and their findings regarding its impact on their learners, which are shared on the programme VLE and can be used for future CPD within the programme and within their schools. The idea is that by carrying out enquiry, the teachers become 'thinking' users of ICT and are in a position to take on a role in developing ICT within their schools. They are not 'experts' in ICT but they are expert learners. Teacher enquiry supports a positive and critical attitude towards learning how to use ICT for real purposes.

Teacher enquiry is recognised as requiring specialist support and peer discussion to enable teachers to develop focused questions about developing an aspect of practice and then conduct classroom research. By working with a university education department, an LA, or a government organisation, teachers gain access to specialist input to developing practice and carrying out enquiry into the change. This is also viewed as important to support outward-looking development in schools, and to support subject needs. It is important in contexts where in-house ICT CPD is difficult to provide because schools in challenging circumstances may have several competing demands for school development, or lack choice in the range of expertise available within the school. Teacher enquiry can take place within schools in less structured ways, but there has been

found to be very little practical support for it when left to school resources alone. Cordingley (2008) found that, in practice, very few school-level strategies adopted teacher enquiry as a core instrument for teachers to take control over new pedagogy and experiment. This is an important 'missing link' between individual professional learning and school strategies:

Although heads and teachers were reported to have rated action research very highly, there is no evidence either from this report or from subsequent whole-school evaluations (Ofsted, 2006), studies of teachers' perceptions of CPD (Hustler, 2003) or meta-studies such as Bolam and Weindling (2006) that their enthusiasm has influenced CPD policies and practices at a whole-school level. (Cordingley, 2008, p. 5)

This accords with Pickering's (2007) findings about teachers' experiences of CPD, where teachers reported very limited opportunity to carry out enquiry-based approaches within school-level strategies. Enquiry was most likely to result from initiatives outside the school – by individual participation in Higher Education courses, CLCs or LA programmes. **8.3 Critical reflection model**

Developing dispositions and changing beliefs about learning and teaching are crucial aspects of ICT CPD. Intellectual engagement with ideas about learning and the 'quality' of mental activities involved in the collaborative activities seems to determine whether a teacher can learn from CPD. This has been described as 'scholarly teaching' (Daly *et al.*, 2004), adapted from Hutchings and Shulman's (1999) concept of a 'scholarship of teaching', involving sustained critical review of practice within a peer context:

It requires a kind of 'going meta,' in which [teachers] frame and systematically investigate questions related to student learning – the conditions under which it occurs, what it looks like, how to deepen it and so forth – and do so with an eye not only to improving their own classroom but to advancing practice beyond it. (Hutchings and Shulman, 1999, p. 12)

It involves teachers in asking their own questions to regularly evaluate and analyse their approaches to take a critical view of what they are doing. Such questions develop a healthy scepticism towards 'quick-fix' solutions and remedies which avoid disrupting established ways of doing things.

This model is based on actively promoting the value of the reflection itself as a CPD process (Levy, 2006), so that the actual learning activity is viewed as transformative in itself because it brings about deep changes in dispositions. Results are seen to grow in the long term, and changes in practice are more sustainable. It is based on the premise that teacher learning is an intellectual as well as a practical activity, and that teachers

need to engage with reviewing their practice and use their reflections as a basis for action. It goes beyond the familiar concept of the 'reflective practitioner'. The 'reflective practitioner' is now a commonplace term, but Furlong *et al.* (2000) have argued that teachers need to go beyond what they term 'lay reflection' if knowledge gained from experience is to play a role in teacher learning. Reflection needs to be critical and informed.

It is argued that critical reflection in CPD enables teachers to become advanced in their ICT pedagogy, and able to be proactive in innovating practice with ICT and contributing to change. Interestingly, studies which give accounts of this in practice exist outside the UK context (Almås and Krumsvik, 2007; Schibeci et al, 2008). In these studies, teachers become advanced in using ICT because they are supported in growing explicit, reflective consciousness about their pedagogy. Almås and Krumsvik's (2007) study called this high state of professional knowledge about ICT 'digital literacy'. Here this means a combination of 'practical proficiency' and 'self-consciousness'. Teachers progress from 'adopting' technologies to being able to 'invent' practice, because they have grown in consciousness about their pedagogy. They are critically aware of their own use of technologies and the ways the learners engage with them. Teachers in Almås and Krumsvik's study of leading-edge schools in Norway became digitally literate by actually experiencing first hand the technologies and the types of tasks they were asking their students to use. In their study of teachers who had become highly digitally literate, they found most of their learning took place in the workplace where there is a 'culture for learning among teachers' (p. 489) alongside hands-on everyday experience in schools where technologies are embedded in the infrastructure of everyday work. Almås and Krumsvik claim that critical reflection takes place through 'necessarily long-term' programmes for ICT staff development, which include coaching work and strong interaction between the teachers' individual needs and the whole-school priorities. Teachers engage in regular discussion with peers about their teaching with ICT and build on student feedback. For critical reflection to take effect in practice, school leaders need to support the growth of autonomy: 'Teachers were expected to reach their goals through their own solutions and methods, instead of carrying out nationally developed proposals...Discussions and reflections on their own actions, *in action*, are a part of teachers' professional development' (p. 493). They go on to criticise ICT CPD where there is a 'lack of follow-up for teaching staff with conversations'.

The concept of the lone practitioner undertaking introspective reflection is problematic. Following up practice with conversation is vital to this CPD model. (For more information see Kolb's (1984) 'cycle' of reflection, by which teachers are encouraged to systematically think about their practice in order to learn from it.) Watkins's model (2002) develops Kolb's cyclical model 'Do, Review, Learn, Apply' and includes an extra 'cycle' of reflection which promotes learning about learning and collaboration. It addresses the complexity of the process whereby the teacher learner becomes in fact a 'meta-learner', who is more versatile, learns with others, and is able to

apply new learning across a range of contexts. These ideas incorporate a move from the individual to collaborative CPD.

The notion of 'criticality' implies that peers play an important role in critical reflection, and places high value on sharing questions and perspectives on practice. It requires:

- time to reflect, before as well as after practice
- input which prevents 'lay reflection' (Furlong *et al.*, 2000) and prompts teachers to go beyond their 'comfort zones'
- questions to be research-informed
- a cycle by which practice is constantly revisited.

The model frequently benefits from a team approach across stakeholders (Eaton and Carbone, 2008). The argument is that external stakeholders can provide an impetus for reflection which is genuinely critical, which can be lacking in schools: 'A team approach is employed in which teacher educators, subject specialists and experienced classroom practitioners develop a research-led programme for practising teachers' (p. 261). Eaton and Carbone claim that there are examples of current provision in parts of the UK and the USA which make educational research inform CPD and show how it can be relevant to classroom practice. Critical reflection can thus be established via a programme of CPD to be sustained over a set period of time, as well as a general CPD approach adopted within a school. Either way it requires schools to invest time in releasing teachers to spend time on critical and reflective activities, either through group facilitation during staff training time, or by allowing teachers to attend programmes off-site. Ideally, both would be in place, and feed off each other so that teachers who could not attend an off-site programme would benefit from the insights and approaches developed by those who could. There are, of course, costs entailed, seen in financial terms or in terms of face-to-face teaching. In the USA, teachers spend less time in class, leaving more time for CPD. This is also the model in France, but this is not currently popular in the UK. The policy context in the UK treats teacher time in class as a badge of quality, but this might need to change if more time is to be found for such CPD activities.

8.4 Case-making model

Case-making is a particular approach to conducting teacher enquiry into teaching, based on making narratives of practice. It is viewed as taking place within collaborative contexts (or COPs) but it has a particular emphasis on narrative and 'sense-making' as a key element in CPD. It is viewed as essential that teachers are enabled to articulate episodes from their practice, and adopt a 'case methodology' approach towards their learning (Shulman, 1996). It stresses that teachers are individuals with autobiographical aspects to their practice. They need to 'make sense' of what happens to them in their classrooms, and experiences become a focus for 'storying' in learning about teaching. Shulman (1996, p. 208) sees 'cases' as a 're-collected, re-told, re-experienced and re-flected

version' of direct experiences. Case-making links individual experiences with collective responsibility for teacher development. Peers are involved in 'making sense' of a teacher's story about their classroom practice as a focus for CPD. According to Shulman, it is possible to think about case-making as teachers participating in three main stages, or 'Acts' in CPD which are built directly around working systematically with the fact that changing practice is hard and usually presents problems and difficulties:

Act I sets the scene, context, intentions...It ends on a note of high expectation with the (often ambitious) goals of teaching explicit.
Act II provides an account of 'what happened', complete with unexpected events, problems and difficulties. It can be rich in classroom dialogue and interaction. It ends in a state of unresolved tension, uncertainty and possibly conflicts.
Act III 'resolves' the tension in some way – either by describing what actions were taken or what actions may have been taken, or by sifting through emerging insights about the problems that occurred. It ends striking a note of being on a different level of understanding from where the author was at the beginning.

A 'case' is *not* a 'victory' narrative, and embraces the notion that difficulties and failures when trying something new can provide valuable CPD experiences, provided a learning focus is adopted rather than a judgemental one. This seems particularly relevant to the ICT CPD of Newly Qualified Teachers, who have expressed concerns about classroom management and failed lessons as a major obstacle to developing their ICT use (Slaouti and Barton, 2007).

Similar ideas about systematically learning from experience are contained in Tripp's work on 'critical incidents'. Tripp (1993) clarifies that what makes a 'critical incident' for teacher learning is not the event itself, but rather 'the way we look at a situation: a critical incident is a value judgement we make, and the basis of that judgement is the significance we attach to the meaning of the incident' (p. 8). He stresses the frequently commonplace nature of incidents that become significant for teachers when they 'story'. Such incidents can be called critical because 'they are indicative of underlying trends, motives and structures'. Teachers need to examine what appears commonplace about an aspect of their pedagogy with ICT in order to develop it, as well as difficult episodes. There are two stages in Tripp's approach:

1. The production of an incident, which is closely described or 'storied'
2. The critical analysis of the incident by bringing scholarly and academic perspectives to bear on it, placing it in wider contexts.

Case-making and working with 'incidents' both place high value on workplace learning, in the sense that teachers can learn directly from what happens to them in the classroom, but that events should be given the significance they deserve and time should be dedicated in CPD for teachers to give accounts of what happened and consciously focus on

learning from them, rather than learning from external expert accounts of what should happen or what happened to an 'expert'.

9. SECTION C: Factors which contribute to effective ICT CPD

The factors reported here have been extracted from the range of studies of ICT CPD. They apply across contexts (school in-house provision, LAs, or external input from national or HE providers) unless specified as particular to only one type of CPD provision. They emerge within an ecological view of teachers' practice, and are thus not to be seen in isolation, but as overlapping and bringing combined effects when interacting with different learning environments. They are presented in three groups of factors accompanied by recommendations:

- Factors stimulating teachers as individuals
- Factors developing the school as a learning community
- Factors affecting wider CPD provision.

9.1 Factors stimulating teachers as individuals

- *Teachers differ in the ways they learn and what they need to learn, and all levels of pedagogical competence can be progressed where support for teacher learning is differentiated (Hoekstra et al., 2009, p. 10).*
- *Backward-mapping (Hadjithoma and Karagiorgi, 2009, drawing on Elmore, 1979) is a factor in 'bottom-up approaches' to developing ICT pedagogy. Objectives for change are rooted in an analysis of the target group's behaviour, rather than externally. Discretion is used to determine the most appropriate actions necessary to support development, and reactions to new behaviours are observed. This indicates that a review of current strategies for identifying ICT CPD activities as part of whole-school development plans is needed. Cordingley (2008) collected evidence from studies which raise doubts about the effectiveness of school-based priorities as the main driver for effective CPD for teachers, and the tensions between school goals and teachers as individual learners are largely unresolved.*
- *Localised, 'bottom up' initiatives are linked with successful pedagogical innovations in ICT (Sutch et al., 2008) in which teachers are able to take risks and be innovative. It is acknowledged that innovations require new practice to be developed in line with broader educational visions, and that policy changes are needed to encourage and support greater pedagogical innovation; but, there needs to be a shift to a model of bottom-up or 'backward-mapping' innovation coming from practitioners themselves to ensure a sustainable culture of change and development. A more open approach to the development, sharing and refinement of materials and resources is needed, as this is more likely to encourage a set of localised solutions to educational challenges suited to particular contexts. Teachers are then more likely to experience intellectual stimulation, by taking a problem-solving approach to issues affecting learning in their own contexts. Localised solutions will only work, however, if teachers are allowed*

to take risks and are supported within their schools to try out new things.

- *Teachers should not 'learn alone'. Informal opportunities for teachers to learn together are an effective part of meeting different needs.* 'Their learning should be facilitated by giving these teachers ample opportunities to interact with peers, to report about their learning and to access resources for learning' (Hoekstra *et al.*, 2009, p. 10).
- *Schools need to be sensitive to how individual teachers experience whole staff professional development sessions* (Schibeci *et al.*, 2008, p. 324):

...sessions tended to significantly fuel anxiety among ICT-inexperienced teachers and had very little real impact in the classroom. In one school, teachers involved in whole-school PD [Professional Development] were impatient to access individual PD. Small group PD proved to be popular as this was responsive to individual needs. Teachers were learning alongside colleagues in a non-threatening environment and were able to communicate particular problem areas without fears of holding up the group. This type of PD is probably vital to ensure teachers do not become lost or overwhelmed by ICT introduction.

- *Teachers with greater needs can be supported by being targeted for mentoring and peer feedback to guide interpretations of practice.* A mentor could be a non-'ICT expert' but should be an accomplished pedagogical practitioner (Pachler *et al.*, 2009 forthcoming). Mutual learning benefits exist in such a mentoring relationship.
- *Teachers are motivated by their subject enthusiasms being catered for* but subject-specific pedagogy is not sufficiently explored in much ICT CPD provision. Subject-specific needs have been met by access to outside experts, subject associations and peers in other schools. This is especially important for secondary school teachers who do not get sufficient access to stimulating CPD which is informed by the latest subject developments (Smith, 2008; Tearle and Golder, 2008; Valanides and Angeli, 2008).
- *Teachers with a wide range of skills and confidence can benefit from actively undertaking enquiry into their practice*, whatever level of innovation they are ready for. This might be in the form of 'Action Learning' which requires them to record changes in practice and increasingly reflect on pedagogical effectiveness as confidence grows (Schibeci *et al.*, 2008).
- *There is some evidence in the literature that ICT skills auditing has a relationship with improved pedagogy* (see for example Valanides and Angelis, 2008), where it leads to carefully planned formal programmes in which external providers play a part. More generally though, it appears that allowing teachers to negotiate their individual priorities for CPD is essential, with or without reference to

an audit, and that CPD based largely on audits of skill levels needs to be approached with caution. Pedagogical development is often neglected in this approach. There is a lack of research into the relationship between auditing and bringing about change in practice. Studies emphasise that teachers need to work out what they really need to learn to do next by discussing with peers, and setting an agenda for professional development over which they have ownership. Similarly, ICT skills tests and PGCE course handbook information on developing ICT pedagogy have been found to be 'irrelevant' to pedagogical development according to student teachers (Barton and Haydn, 2006). They lack clear links with developing context-specific practice in classrooms.

9.1.2 Recommendations on factors stimulating teachers as individuals

- Planning for teachers' ICT CPD should take account of the centrality of the teacher in their own learning experiences and the need for teachers to have agency by taking responsibility for choices about what they need to learn. They should be allowed to negotiate individual CPD priorities, based on their skills level, subject enthusiasm and knowledge of their students' needs. This needs to be the basis of ICT development for performance management and in professional development plans.
- A balance is needed between whole-school development sessions, individual support and small group work, with most time reserved for individual and small group work.
- Appropriate degrees of mentoring should be put in place to support pedagogical development as well as skills mastery.
- CPD provision should include opportunities for enquiry such as trying out new software and new teaching approaches in the classroom, and then reflecting on the activity with peers and/or a mentor. This needs to be supported by providing time and guidance about enquiry from a suitable member of experienced staff, or through links with a LA or HEI.

9.2 Factors developing the school as a learning community

There are multiple components which contribute to developing ICT CPD at the level of the school. A wide variety of effective school-level strategies were reported in an Australian study which responded to a government report and stated:

Teachers' skill levels varied considerably and were linked to the size of the school, school resources and technology support. Also, teachers were more likely to take advantage of training if it were school based, in the form of short courses or workshops (rather than over a longer time) and through small group tutorials or large group instruction. (Schibeci *et al.*, 2008, p. 314).

It is not only in school-based approaches that the organisational culture of the school makes an impact, however. School-level support was identified as particularly significant in its impact on ICT CPD in the re-analysis by Davis *et al.* (2009) of data collected to evaluate the national ICT teacher training government initiative in 1999–2003, the ‘New Opportunities Funding’ (NOF) programme (Preston, 2004). They comment that, where external stakeholders are involved in providing teacher training, there is strong evidence that the school as an organisation is a determining factor in its success: ‘It appears that teachers change their practice with ICT more easily when ICT teacher training is accompanied by organisational support and change’ (p. 147). The same was found by Pachler *et al.* (2009 forthcoming) regarding borough-wide ICT CPD provision.

Whether CPD is entirely school based or involves external stakeholders, a distinction has been drawn between ‘enclaves’ and ‘school-wide communities’ in developing pedagogy with ICT (Hadjithoma and Karagiorgi, 2009). Drawing on previous studies which coined these terms to describe ICT implementation, the research took place in Cyprus, in a context where directions for ICT implementation is distributed to individual schools, thus making the choices schools make about CPD critical. Although this is a study based on schools in Cyprus, the way ICT implementation and responsibility for ICT CPD is devolved to individual schools is not dissimilar to the current situation in the UK. The study focuses on ‘communities of implementation’ as a mechanism for CPD at the micro level. Scrimshaw (2004) identifies a similar challenge for CPD in the UK:

Where only a small minority of staff are innovating with ICT what kinds of support are needed to ensure that they continue to do this? What is needed to enable the innovation to “break out” of this small group and be taken up more widely within the school? (Scrimshaw, 2004, p. 4)

Components of effective ICT CPD at school level can be categorised as:

- effective leadership of a learning ethos, by which the headteacher greatly influences how the school works as a learning organisation. This includes how the headteacher’s vision of bringing about change is shared with staff, and what types of formal structures are put in place to support ICT CPD, as well as how school leaders encourage informal professional learning and risk-taking.
- the effective deployment of staff expertise in the provision of CPD
- the effective use of time and resources
- effective design for CPD
- effective relationships with external stakeholders including LAs, subject associations, professional bodies, HEIs, CLCs and commercial providers.

Each of these components contains a range of key factors which contribute to its effectiveness. These key factors are identified below.

Effective leadership of a learning ethos

- *The headteacher's leadership is very influential in determining the school culture of ICT CPD* (Comber, 2007; Cogill, 2008; Hadjithoma and Karagiorgi, 2009). Cogill's (2008) comparative study of newly-appointed primary school teachers and their use of IWBs found that this was seen as the key driver in establishing a close collaborative school community. Headteachers can also foster collective disillusionment about the use of ICT. In schools with ineffective ICT CPD, improving students' examination results was seen as more important than CPD, and headteachers failed to see the longer-term potential of ICT to improve results by enhancing pedagogy.
- *Student teachers are heavily influenced by the culture of the school in learning to use technologies.* Hammond *et al.* (2008) outlined how important it is for student teachers to practise in schools with an innovative ethos and where the headteacher is committed to ICT. Considering the difficulties of shifting 'deep-seated beliefs' about technologies which are held pre-service, the experience during initial training is significant. The culture of the school is a vital factor in professional learning: Lawson and Comber (1999) see the commitment of the senior management to the use of ICT as an encouraging factor for student teachers – in contrast, a lack of vision (Almas and Nilsen, 2006) is a key restraint. Other studies have shown however, that 'commitment' is not enough (Comber, 2007) and that it is the ways in which headteachers foster inclusive, collaborative and teacher-led approaches which makes CPD effective.
- *Management which is encouraging or at least 'non-obstructive', combined with a 'sympathetic and competent team of ICT support staff...and sufficient ICT resourcing'* (Crook and Harrison, 2008, p. 26) is likely to help foster an ethos where teachers develop enthusiasm for learning to work with Web 2.0.
- *Successful leadership of ICT CPD focuses on people and relationships, and strategies which have an impact on feelings, attitudes and beliefs.* Hadjithoma and Karagiorgi (2009) called this 'transformational leadership' because it led to changes in practice in the classroom. They establish a link between 'personal and professional' effectiveness which helps establish a collegial culture. They show how individual needs of teachers can be addressed within school level policies, by a leadership style which promotes 'communities of implementation'. The type of community appears to affect the quality and extent of implementation. School-wide communities of implementation are more effective in helping teachers to develop pedagogies with ICT; headteachers avoid hierarchical approaches to developing ICT, and teachers actively engage with establishing the school action plan for ICT development. Where the head is largely responsible for the plan, with senior school leaders, the tendency is for 'enclaves' to emerge, with reduced opportunities for whole-school change.

Effective deployment of staff expertise

- *The effective deployment of existing expertise within the school is a core factor. This includes three categories of staff: technology support staff, those with ICT pedagogical expertise and those who support innovation even if they do not use technologies much in their own practice.* None of these on their own is enough to support broad pedagogical development across a school. Slaouti and Barton (2007) found that, particularly for new teachers, it is important for a school to have clear networks of technical support staff or ICT co-ordinators who can provide help. Their study in secondary schools found 'in most contexts there seemed to be rather ad hoc provision' (p. 411) and a degree of chance in finding support from key personnel who happen to be available when needed. Excellent classroom practitioners also have an important role as catalysts for the learning of others, and can lead whole-staff training but also contribute to groups and individual needs by mentoring and observation. These do not have to be designated ICT personnel: ICT Learning Co-ordinators can be too busy dealing with supporting basic competence and confidence with the technology to provide pedagogical support (Schibeci *et al.*, 2008). In fact, Slaouti and Barton (2007) found that teachers reported there being 'little time' for clearly demarcated pedagogical support in most secondary school contexts, even for Newly Qualified Teachers (NQTs) where it might be expected there would be a greater concentration of support.
- *Pedagogical support led by the heads of subject departments at secondary level was found to be an important aspect of ICT development because it provides a 'sense of purpose' in using ICT.* This includes: liaison between the head of department and the ICT co-ordinator to make resources available to the subject team; advice on using ICT for subject-specific purposes; discussion about the role of ICT in the subject; and shared planning that supported the individual development needs of teachers. Departmental level support for ICT CPD is important as it can overcome feelings of alienation caused by access problems and give teachers the incentive to carry on despite frustrations (Slaouti and Barton, 2007).
- *Teachers rate informal support from colleagues highly.* The *Harnessing Technology Schools Survey 2008* found that 'informal, in-school ICT support from colleagues clearly emerged as the form of training rated most positively by teachers. Almost all teachers had accessed this form of support' (Smith *et al.*, 2008, Report 1, p. 6).
- *An important feature of growing 'communities of implementation' is the role of individuals, such as the school ICT co-ordinator or regional ICT adviser. It is critical that individuals are involved who have a catalytic impact.* This can take a number of forms. Personal commitment was the most important factor, as was 'voluntary' leadership of development by ICT specialists. Hadjithoma and Karagiorgi (2009) found that enforced co-ordination by a directive

head was less effective, and led to 'enclaves' in schools rather than a school-wide community of implementation.

- *'Non-expert' staff can act as catalysts for new pedagogies, with technical support.* Pachler *et al.* (2009) report on teachers who joined a borough-wide CPD ICT programme, having been identified as excellent practitioners by their headteachers, but not necessarily experienced with ICT. Having been part of the programme's learning community, teachers were expected to act as innovators in their schools. They did not have the skill levels of the school ICT co-ordinators, but had developed a commitment to change. Having a vision of how technologies can enhance pedagogy was more important than being an ICT 'expert', providing technical support was available. It was more important that the catalytic roles were held by excellent practitioners who had developed reasonable ICT skills and were good at communicating with colleagues. It meant that more schools could feel the effects of the programme because a body of teachers was developed within the borough to initiate pedagogical change within their own schools. The roles of 'catalysts' within effective learning communities for technology-related CPD are vital and complex, and include non-specialist teachers regarding ICT, who can assume a hands-on role in the development of pedagogy. Similarly, Barton and Haydn (2006) argue that mentoring is important but the mentor need not be an ICT 'expert' as long as other proficient role models are available to work with trainees.
- *Informal, on-the-job training was very effective when supported by in-school champions,* according to the Test Bed Evaluations of long-term embedding of ICT in schools (Somekh *et al.*, 2007).
- *NQTs can bring positive attitudes towards ICT and willingness to experiment. Their arrival can be a good time for a department to evaluate its practice* and consider the special contributions which many of them can make to team development of pedagogy (Slaouti and Barton, 2007).

Effective design for CPD

- *'Hands on' experimentation with technologies is important, but so is CPD activity which focuses on planning lessons which incorporate ICT with subject-specific relevance.* CPD needs to include a focus on lesson planning and review. Otherwise CPD becomes just an exercise in learning how to use the technology, with no time for thoughtful adoption and even results in lack of adoption (Valanides and Angelis, 2008).
- *Flexibility is a key factor in designing ICT CPD* (Scrimshaw, 2004). *Both individual and whole school needs should be the focus, rather than a single-level approach to identifying and meeting needs.* Scrimshaw argues that both types of needs can be met by local networks and training and that opportunities for informal learning are part of this. To date, however, there is insufficient effective local networking to bring about the wide scale provision that is needed.

ICT requires such fundamental shifts for some teachers that networking which is perceived as 'peripheral' is not effective.

- *Shared development planning for the school is important.* A school action plan is not effective in itself for developing teachers. The process of planning is a development activity in itself:
Planning should not be regarded by leaders as mechanical and rational...but rather as a retroactive process, encompassing humanistic organic and qualitative aspects...The development of shared vision and commitment amongst school personnel leads to the emergence of ownership for the innovation and can help overcome mismatch between top-down and bottom-up processes (Hadjithoma and Karagiorgi, 2009, p. 8).
- *Linking evidence about student learning with planning CPD is a positive strategy.* This was recommended by the GTC-commissioned report by CUREE (Cordingley, 2008) which investigated school-level strategic planning and evaluation of CPD. It appears, however, that schools, on the whole, do not have productive ways of doing this.
- *Digital creativity needs to be embedded in approaches to ICT CPD* (Russell and McGuigan, 2008). This is both pedagogically important and affects teacher motivation and engagement. Hardware and software needs to be flexibly available according to individual needs and enthusiasms (Pachler *et al.*, 2009 forthcoming).
- *Student knowledge about technologies should be harnessed* and students have a role to play in contributing to teacher knowledge about technologies. This means a revision of traditional teacher-student relationships in developing teacher expertise (Russell and McGuigan, 2008).
- *Where new technologies have been introduced into all of a school's classrooms at the same time, a culture of shared learning and mutual support developed* as the whole staff faced the task of embedding the technology into their pedagogy. Collective need led to collective solutions being found and shared (Somekh *et al.*, 2007).

Effective use of time and resources

- *Time is a critical factor* underpinning the design elements described above. It was cited in the *Harnessing Technology Schools Survey 2008* as essential to teachers trying out new technologies. There is nothing new in this finding. As noted by Holmes *et al.* (2007), it has appeared persistently in studies of impediments to ICT integration in practice, but it continues to be unresolved as the main pressures on headteachers and teachers appear to emphasise a process of continuous adoption rather than meaningful engagement. Giving staff sufficient time to 'play', try out, and then develop a critical and reflective approach to new pedagogy is vital. This needs to be before, during and after implementation (Fraser, 2005) Long-term approaches to development are important to overcome anxieties

and disillusionment around 'implementation dips' and the temptation to opt for surface level immediate 'solutions'.

- *Technical support is an essential element of building teacher confidence at a basic level of willingness to try out technologies in the classroom:* 'It appears that teachers were more confident in tackling classroom use if they thought that the technology would work and if they had assistance in the classroom... Breaking through the confidence barrier appears to have been very important.' (Schibeci *et al.*, 2008). The *Harnessing Technology Schools Survey 2008* confirmed this: 'Having dedicated on-site technician support in a school appears to have a positive effect' (p. 6). The amount of technical support had a direct relationship with willingness to try out new approaches.
- *Ready availability of reliable hardware and software is essential* (Tearle and Golder, 2008). In the study by Hammond *et al.* (2008) problem-free access to technologies is a 'necessary condition'. Access to reliable equipment is an important factor in building confidence in NQTs (Slaouti and Barton, 2007), for whom anxiety about classroom management is a major concern when technology fails. It might be supposed, from evidence that technologies are now widely available in schools, that problem-free access to technology is the 'norm'. This gives a misleading picture of the availability of technologies *for use*, however. There is still a concentration of resources in computer suites (Haydn, 2006; Slaouti and Barton, 2007) which is not helpful to developing pedagogy among significant numbers of staff. This is a factor contributing to less exposure to effective development in secondary schools. In the ICT Test Bed Evaluation studies (Somekh *et al.*, 2007), not only access to technology but daily use was found to help teachers to develop skills. Having their own laptops is a further significant aspect of securing confident, problem-free access to technology for teachers (Almås and Krumsvik, 2007).
- *For teachers to feel confident about experimentation and using ICT in everyday practice, there needs to be a move away from the 'booking' mentality regarding the use of computer suites.* 'Booking' access to computers weeks in advance in competitive contexts militates against embedding ICT within practice across subjects in secondary schools (Almås and Krumsvik, 2007). Slaouti and Barton (2007) found this to be the case even within a technology college setting. The redistribution of hardware is part of achieving the 'necessary' condition of access.
- *Web 2.0 technologies have been used to facilitate innovative collaborative CPD, combined with allowing teachers to take equipment home, and use laptops and portable devices for home familiarisation* (Pachler *et al.*, 2009 forthcoming).

Effective relationship with external stakeholders

- *It can be equally successful for schools to use an external ICT adviser or expert as well as internal ICT co-ordinators who*

volunteer to co-ordinate support for change in the staff (Hadjithoma and Karagiorgi, 2008).

- *Senior management have a critical role in ensuring that stakeholder schemes are successful, and their active and focused investment in the CPD from the start is critical to its success.* This is not only in supporting staff to gain access to externally provided CPD, but in ensuring that time is provided in school for implementation. The co-operative link between the school and external programmes is extremely important (Pachler *et al.*, 2009 forthcoming; Smith, 2008).

9.2.1 Recommendations for factors developing the school as a learning community

- There should be a significant review of the rate of policy-making with regard to ICT implementation, and an extension of time between each new initiative while pedagogical consolidation takes place and basic infrastructure is in place to support CPD.
- Leadership training is needed which emphasises vision-sharing and planning with staff, rather than the 'delivery' of a vision for ICT transferred from elsewhere. Leadership training which emphasises outward-looking development as well as the use of internal expertise is also helpful.
- There should be a realistic estimation of the time and human resources (technical support) that are needed to support the least confident teachers. Without this, their needs either become a drain on staff development as a whole, or they are not met in a way which makes enough difference to confidence levels.
- There should be incentives for a range of staff to adopt ICT mentoring roles, based on their pedagogical expertise. Incentives may be the allocation of time and career enhancement as well as financial.
- School leaders should give more consideration to the effective deployment of external advisers and consultants who can provide active approaches to CPD by co-teaching within the school.
- There should be open and transparent planning of flexible CPD with staff which includes appropriate amounts of time and regular opportunities to collaborate with peers.
- Work is needed to help schools understand how to use evidence about student learning as a basis for designing CPD provision.
- Students should be encouraged to act as mentors and trainers in formal and informal roles.
- A very strong steer is needed on future hardware purchasing so that the 'booking' mentality which prevails in secondary schools is removed. Flexible hardware and software should be distributed within the school, and teachers should have access to portable devices such as laptops to take home to increase familiarisation with technologies. Where 'booking' remains a hurdle to using

computers, it should be managed to ensure all teachers have appropriate levels of access.

- Web 2.0 should be recommended for staff CPD, to support collaborative learning and model pedagogical innovations.

9.3 Factors affecting wider CPD provision

It is not desirable to rely on individual schools to provide the entire CPD experience for their teachers. There are schools where leadership is not sufficiently focused on ICT CPD; where conflicting demands obscure a clear 'vision' for ICT; and where staff turnover is a considerable obstacle to achieving a rich learning community. Even where schools have excellent human and technological resources, learning institutions need to be outward-looking (Webb *et al.*, 2007), and teachers need to experience other ways of working for themselves.

- *The development of ICT CPD 'projects' within local and national contexts can give priority to ICT development and create more sustainable attitudes to change* (Jimoyiannis and Komis, 2007; Pachler *et al.*, 2009 forthcoming; Schibeci *et al.*, 2008; Smith, 2008). 'Implementing ICT projects at the whole school and district level also appears paramount for effective change over time' (Schibeci *et al.*, 2008, p. 324). Rates of progress made by teachers on projects can vary greatly, but the emphasis on the 'learning journey' is the important factor in improving confidence levels. A project approach specifies learning over time towards common goals and often includes a reflective enquiry element.
- *Being exposed to the use of ICT by others is important* (Hammond *et al.*, 2008). This is different from narrower concepts of working with 'models'. It implies being immersed in the ways other professionals use the technologies. Hammond's findings are in the context of trainee teachers, but the 'contagious' aspect of this seems to be significant for CPD contexts. Hammond's study makes it clear that these 'others' can be in several places: '[in school] they included mentors, other teachers and, sometimes, student teachers; at university 'others' included tutors and peers. Others were influential in raising expectations to use ICT; extending awareness of ICT use; modelling examples of ICT use; and offering feedback on ICT use' (n. p.). The study by Pachler *et al.* study (2009, forthcoming) found that the use of ICT by teachers in other schools as well as their own was influential on developing practice.
- *Collaborative learning is a very important factor in effective ICT CPD*. This is a complex area which has much to do with developing schools as learning communities, but also takes in CPD arrangements outside individual schools. It includes several sub-factors, each of which supports the roles of teachers as actively involved in each other's development across schools. A range of approaches aims to support groups or at least two teachers in talking together. Group learning has been identified by Schifter (2008) as a key factor in ICT CPD, and working in 'mixed ability'

groups of teachers is seen as beneficial (Barton and Haydn, 2006). Group work is important to: identify CPD objectives; agree priorities; plan innovations; share lesson preparation and resource-making; and critically review progress. Collaborative CPD arrangements include:

Informal learning opportunities and networking built into off-site CPD time

Working in subject- or phase-based groups

Using non-specialists as catalysts and mentors

Peer observation

Peer consultation.

- *It is extremely important for teachers to gain access to subject specialists.* Subject areas should be catered for more equitably. Some are not well catered for (physical education, for example), particularly in the secondary curriculum, which has been linked with limited perceptions of what ICT can do to enhance subject-specific pedagogy (Tearle and Golder, 2008).
- *LA ICT advisers have an important role to play and can provide models of collaboration for pedagogy by working with students and teachers. In turn, effective, co-ordinated training for the advisers in collaborative pedagogy is needed* (Preston and Cuthell, 2007).
- *Wider networks of stakeholders have a part to play in supporting ICT CPD in schools in difficult circumstances.* Pachler *et al.* (2009, forthcoming) report on factors which enable a borough-wide programme hosted by an inner-London CLC to motivate pedagogical change. Support for morale, valuing teachers and recognising a common sense of challenge were important factors within ICT CPD when bringing together teachers who work in challenging schools. Giving them time and space out of school to plan and reflect on their pedagogy was particularly important.
- *Cross-institution links for ICT CPD can be supported by effective cross-institution collaboration based on a common purpose and leadership from the top* (Somekh *et al.*, 2007). These are enabled by plenty of time for staff to meet and establish the trust needed to work together, with roles and responsibilities clearly identified.
- *Teacher educators who run CPD programmes need to choose tools which are relatively easy to learn*, so that time is available to spend on pedagogic planning rather than skills mastery. They also need to make the enhancement of learning explicit, rather than based on 'things you can do' with ICT. The responsibility is considerable and teacher educators are expected to 'explicitly teach the connections between computers, content, pedagogy and learners' (Valanides and Angelis, 2008).
- *Modelling has an important role to play but needs to be used with care:* there is contention around modelling as an effective ICT CPD strategy. Several reports describe the benefits – or necessity – of exposing teachers to good models of practice (Hammond *et al.*, 2008; Belland, 2009). Russell and McGuigan (2008) recommend the preparation of resource material, especially video, which illustrates effective practice. In their reporting of effective teacher

learning in BESD schools (for students with behavioural, emotional and social difficulties), this had impact on teachers' capacities to develop creative pedagogies. But other studies have shown that pedagogical models need to be treated with caution to avoid surface adoption. This is because of two main issues:

- i) a perceived gap between the teacher's pedagogical beliefs and those of the model, and
- ii) a surface-level adoption of a new practice which does not result from changed beliefs, but only imitating what has been seen.

De Freitas *et al.* (2007) found that the adoption of a model needs to be 'situated' within the teachers' particular learning contexts, and that best use is made of pedagogical models where teachers adapt or even create new ones – in ways they would not have been able to do prior to discussing the original. The most important development takes place through the critical review of what is presented: 'The important thing to recognize is that practitioners *interpret* the resources they are given' (p. 38). This requires time for reflection and review as well as time spent on experiencing the model itself – but the latter is frequently the main or only focus of CPD activity.

This exemplifies the problems of 'transposability' and 'transferability' of 'good practice' as outlined by Hargreaves (1999). Models need to be consciously examined within communities of teachers. Meaningful use of models is based on creativity. It is highly personal, by which teachers are encouraged to adapt ideas and practice to their *own* contexts, learners and skill levels. It rejects the reproduction of practice as something which is 'fixed' and raises problems around the concept of 'best practice'. Imitating 'best practice' models may solve problems of poor practice in the short term. Pressure to quickly adopt an 'effective' practice from another teacher, however, can be an obstacle to long-term change. This is because the teacher does not consciously and critically engage with problem-solving about their practice. This takes longer, but builds capacity for future learning in a range of situations, as opposed to immediate 'transfer' of a particular practice which may become outdated when technologies change again.

- *Electronic networking, locally and nationally, has strong potential to support collaborative CPD across contexts and stake-holders.*

9.3.1 Recommendations for factors affecting wider CPD provision

- A 'project' approach to ICT CPD is recommended as a useful strategy. Guidance should be made available for school leaders on ways of conducting this in conjunction with external stakeholders.
- Teachers should be given opportunities to visit other schools and observe practice beyond their own institutions. They need opportunities to experience first-hand the ways that teachers in other schools are using technologies. This should be at a local and

wider level between schools with shared challenges, contexts and priorities.

- School leaders should be trained in providing collaborative CPD, including judicious use of group work and in-house sharing of expertise.
- Schools that do not work with their LA should ensure that staff have access to information about services available which may be of benefit. A historic severance of contact with the LA should not mean that new opportunities for staff to develop pedagogy are missed.
- Significant investment is needed in subject-oriented ICT CPD provided by a range of bodies – subject associations, LAs and HEIs.
- A significant investment is needed in research and development into electronic CPD networks and web-based services.
- There should be a commissioned study of the contribution made by CLCs to ICT CPD. This is a very limited area in the literature.
- There should also be a commissioned study of the impact of commercial providers on ICT CPD. This is a further gap in the literature. This is a very important priority since this is set to be a significant area of influence, and there is a need to be better informed about the perceptions of commercial providers about their roles and the purposes of CPD, and about their relationships with schools and LAs and the impact this has on pedagogical development.

10. Analysis – what is the range of models for ICT CPD?

There is doubt about whether familiar ‘models’ of ICT CPD can have any particular value without first dedicating time to helping teachers to see how ICT can make a difference in their own particular contexts. This seems to be the most important factor which underpins success in a range of widely differing approaches. Holmes *et al.* (2007) argue:

Time after time...the traditional forms of continuing professional development (the ‘training’, ‘deficit’ and ‘cascade’ models for example) have proven to be ineffective. Concentrating more effort on seeking convergence between the teachers’ values and their perceptions of the utility of the ICT professional development, before beginning the conventional professional development activities, should ensure that more teachers have the necessary readiness and receptiveness to be committed to engaging with change. (Holmes *et al.*, p. 402)

The argument is that CPD should focus on developing ‘readiness’ to learn to teach with ICT and ‘receptiveness’ to new ideas. Rather than identifying a set of relatively fixed models for how to ‘do’ ICT CPD, it seems important to build principles into the design of ICT CPD which can be flexibly applied in a range of settings. Each school is unique, as are all the teachers and headteachers who work in them. Teachers experience the same ICT CPD provision differently (Holmes *et al.*, 2007), which affects their perceptions of whether the time it takes to learn how to use ICT is a worthwhile investment. The effectiveness of various types of provision is affected by a range of factors, including teachers’ previous experience of ICT; personal attitudes to change; deep-held beliefs about learning; and being exposed to informal opportunities to develop skills which are learnt formally. It is therefore not surprising that the literature offers contrasting, and sometimes even contradictory, findings regarding the effectiveness of particular types of provision within small-scale studies. Teachers may experience effective CPD from external providers who meet needs where expertise is not available within the school, or where there is a more motivated impetus provided by committed outsiders rather than less enthusiastic school-based colleagues. At the same time, teachers can find that external provision does not take account of the specific issues the teachers deal with on a day-to-day basis in their schools, with their particular learners and resources. The sheer complexity of this picture is acknowledged (Rae and O’Brien, 2007) and the focus needs to be on identifying principles of effective CPD which can be achieved in diverse contexts.

ICT CPD therefore needs to be recognised as a complex, social, intellectual and practical activity which brings about change in teachers’ beliefs and understandings in relation to changing practice and developing skills. It takes place within a range of locations and modes which provide cultural contexts in which to learn. It involves re-evaluating learner–teacher roles and overall classroom pedagogies. It brings changes in

aspects of professional identity. For these reasons, simplistic models of ICT CPD are not helpful – it is highly situated and success is subject to many inter-related human and social factors which vary across locations, strategies and relationships. From the factors identified in the literature, a pattern emerges of ICT CPD taking place within two types of frameworks which have key features. The features do not necessarily determine success or failure. They interact with other features of both frameworks, and they have effects on each other within an ecological view of CPD. This means that we identify CPD as depending on how different aspects interact with each other, bearing in mind all the time that the teacher is a vital element within the ecology. The frameworks are *pedagogical frameworks* and *frameworks of players*.

Pedagogical frameworks are characterised by the degree of collaboration and hierarchical approaches which underpin the learning design of the CPD provision. This determines the relationships, roles and responsibilities of the various players involved. It shapes the design of CPD, in terms of engagement, activity, duration and intellectual commitment. It is essentially about the extent to which a 'vision' of ICT pedagogy is developed *with* staff, or is 'delivered' by others, who may be internal to the school (a headteacher or ICT co-ordinator) or external (a body which provides a course). This determines the way CPD activities are designed and the degree of autonomy, relevance and differentiation which teachers may experience.

Frameworks of players are characterised by the degree to which CPD involves a range of players. It determines the various roles of people involved in ICT CPD, the importance attributed to different types of expertise and choices about where expertise comes from. Frameworks of players determine how far the CPD is 'inward' or 'outward' looking in terms of the school environment. It describes the extent to which teachers engage with CPD which involves external sources of help and advice which can ensure that the sources of knowledge on which ICT is based have a broader and more informed perspective. This is not just about whether the CPD is provided 'in house' or at an external location. It is possible for an 'in house' school-based CPD programme to involve much outside support and help from the LA or a local HEI.

In Figure 4 we have developed a diagram which shows these frameworks. The diagram consists of two axes. One represents the 'collaborative' aspects (horizontal axis) of pedagogical frameworks for CPD, ranging from 'high' to 'low' collaboration. The other shows the 'players involved' (vertical axis) in frameworks of players and aspects of those, ranging from exclusively school-based to fully engaged with external players. Where the frameworks are more or less collaborative and more or less involved with external players, different features of ICT CPD appear within the diagram. The diagram therefore offers a way of seeing the current landscape of ICT CPD, as identified from analysis of recent literature. Four key areas represent the patterns of CPD provision which exist where the two

frameworks intersect. These areas show the features of CPD which frequently appear, in the form of four models:

- High Collaborative School-Based
- Low Collaborative School-Based
- High Collaborative External Players
- Low Collaborative External Players

These are not intended to represent deterministic models for CPD. They are descriptive, and several features of the models will appear to greater or lesser extents, and cross boundaries. They are intended as a guide to considering the core features of ICT CPD which are consistent with prevalent types of provision. It is not claimed that all of the features described appear consistently within the prevailing models. They rather represent the CPD 'tendencies' which appear in the literature.

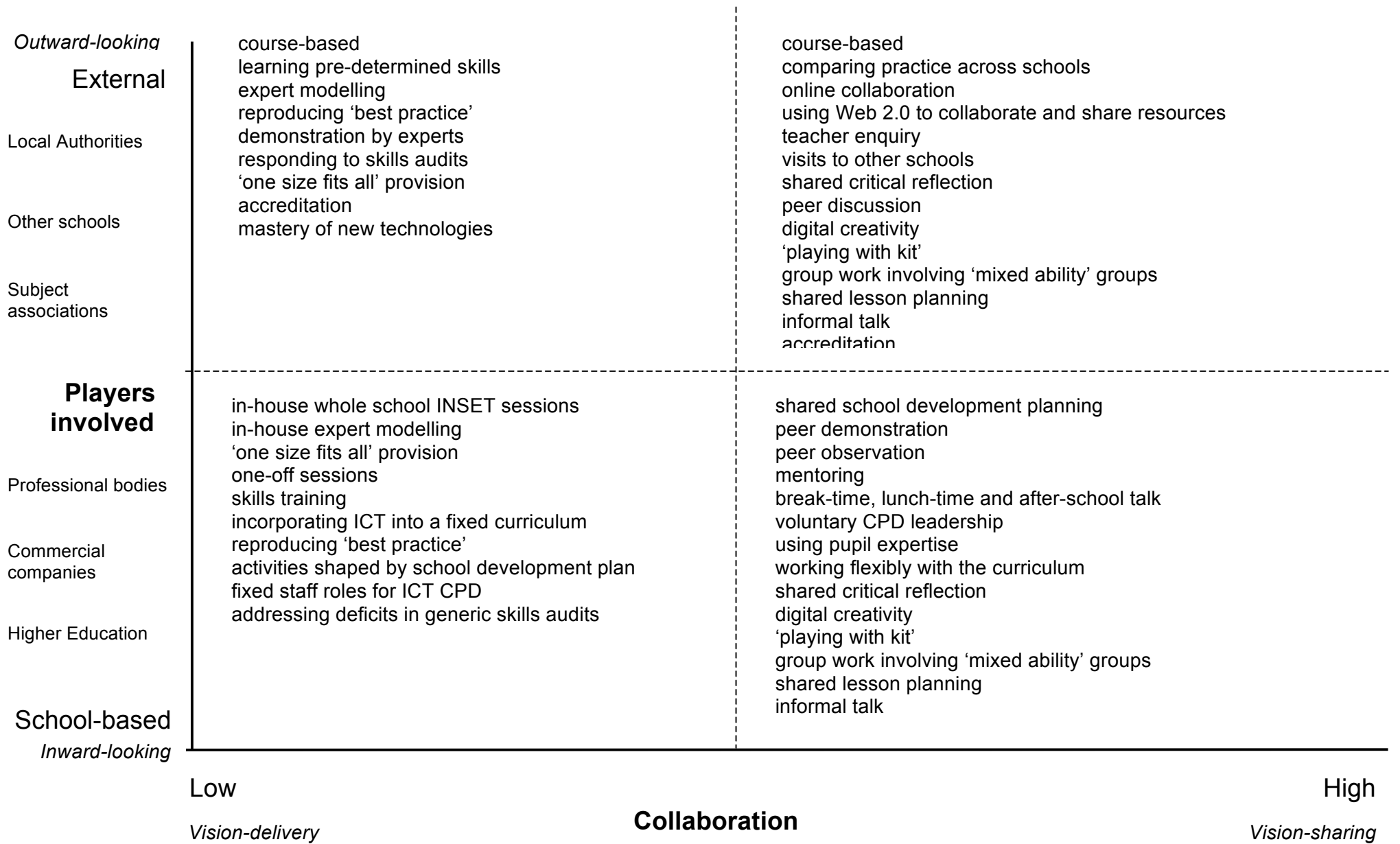


Figure 4: The ICT CPD landscape

Each model is composed of three key design elements of CPD:

Envisioning: the processes involved in establishing a view of what is necessary and desirable regarding ICT pedagogy, and how it can be developed. A range of players can be involved here, ranging from: the headteacher making a lone decision which is informed to varying degrees by external policies, models and stakeholders; the ICT co-ordinator, with varying degrees of consultation with external bodies and the school staff; the whole school workforce, informed by a range of school-based and external drivers; or external bodies which act as the main drivers of what is required.

Planning: the role of the school development plan and teachers' individual plans for professional development have varying degrees of prominence in different models. This is an important component of ICT CPD, as these sets of plans are frequently used as tools to determine resource allocation, types of provision and the monitoring of CPD. Planning may be a collaborative process involving a high degree of teacher involvement in contributing their own needs and priorities, and in planning the activities, both school-based and externally provided, which are going to help them achieve their goals. Alternatively, CPD planning may be a mostly managerial experience, and be directed largely by the school development plan or external providers' programmes, and involve little teacher input to the design of the CPD.

Enacting: the implementation of ICT CPD takes a multitude of forms, which can be broadly categorised as comprising:

- i) deployment of catalysts, or key staff inside and outside schools who take on a variety of critical roles in the learning of teachers (mentors, models, ICT champions, ICT co-ordinators, external experts, LA advisers, etc);
- ii) activities, which take on a range of forms of individual and shared ways to develop practice both on- and off-site, such as attending whole-school hands-on skills training; shared lesson-planning; peer-observation; 'playing with kit'; and
- iii) exposure to others, which is the way provision builds in opportunities for a range of forms of inter-personal interaction around pedagogical development, for example, expert-learner, learner-learner, learner-'new' expert.

Compared with envisioning, planning and enacting, it is noticeable that studies of ICT CPD provision have focused little on providers' approaches to evaluation beyond the use of questionnaires and skills audits. Evaluation as a discrete part of the CPD models does not feature extensively in the literature, and more effective practitioner and school leader approaches to evaluating CPD are needed. This is possibly because the studies have reflected the difficulties of understanding the impact of CPD in terms of students' learning outcomes. Davis *et al.* (2009), from a research perspective, noted the difficulties of applying Guskey's (2002) fifth level (see Table 2, Section 6, page 23) of evaluation of effectiveness of CPD (students' learning outcomes) to evaluation data collected from teachers and providers. It has been noted by Pickering (2007) that this level of 'students' learning outcomes' is problematic because there is not necessarily a straightforward 'cause and effect' relationship between teachers' CPD and transparent improvements in learning. A focus on teacher learning is of primary significance. Almost certainly, any evident 'improvements' in students' learning will involve a number of factors where ICT has been embedded within changes in pedagogical approach and teacher disposition. The majority of the literature points to the need for sufficient time

and culture change to take place before change becomes embedded and sustainable improvements can be achieved.

10.1 High Collaborative School-Based model

This model of CPD captures many of the features of the COP, and reflects the school as a learning community. At its most developed, high collaboration underpins each stage of CPD design within the school – ‘envisioning’, ‘planning’ and ‘enacting’. School leaders are most likely to include staff in ‘vision-sharing’ which shapes the school development plan and the teachers’ individual professional development priorities. A range of collaborative arrangements are supported, both formal and informal, so that staff can learn from each other. Opportunities for purposeful talk are plentiful, and take place in small groups which focus on specific aspects of using ICT to enhance learning. Ideas are generated by self-review in consultation with key staff (such as subject or phase-level peers) who help learning conversations develop around what it is possible to achieve with technologies. These staff may be ICT enthusiasts or specialists, but it is equally or more important that they are experienced in working with innovative pedagogies. In its most school-based form, the model relies almost exclusively on in-house expertise to develop staff, with only key members interacting with external input – usually the headteacher or ICT co-ordinator. A version of this school-based model works occasionally with external stakeholders by, for example, inviting a commercial provider to run whole-school INSET on a particular type of innovation such as IWBs. On the whole, however, teachers do not leave the school to engage with CPD. Individual teachers might attend a masters course at a university in their own time, which may involve an aspect of teacher enquiry. Enquiry however, is not something which is generally built into school-based provision and is not viewed as a key part of collaborative approaches to professional development. There are generally weak links with outside subject specialists, professional bodies, universities and LAs.

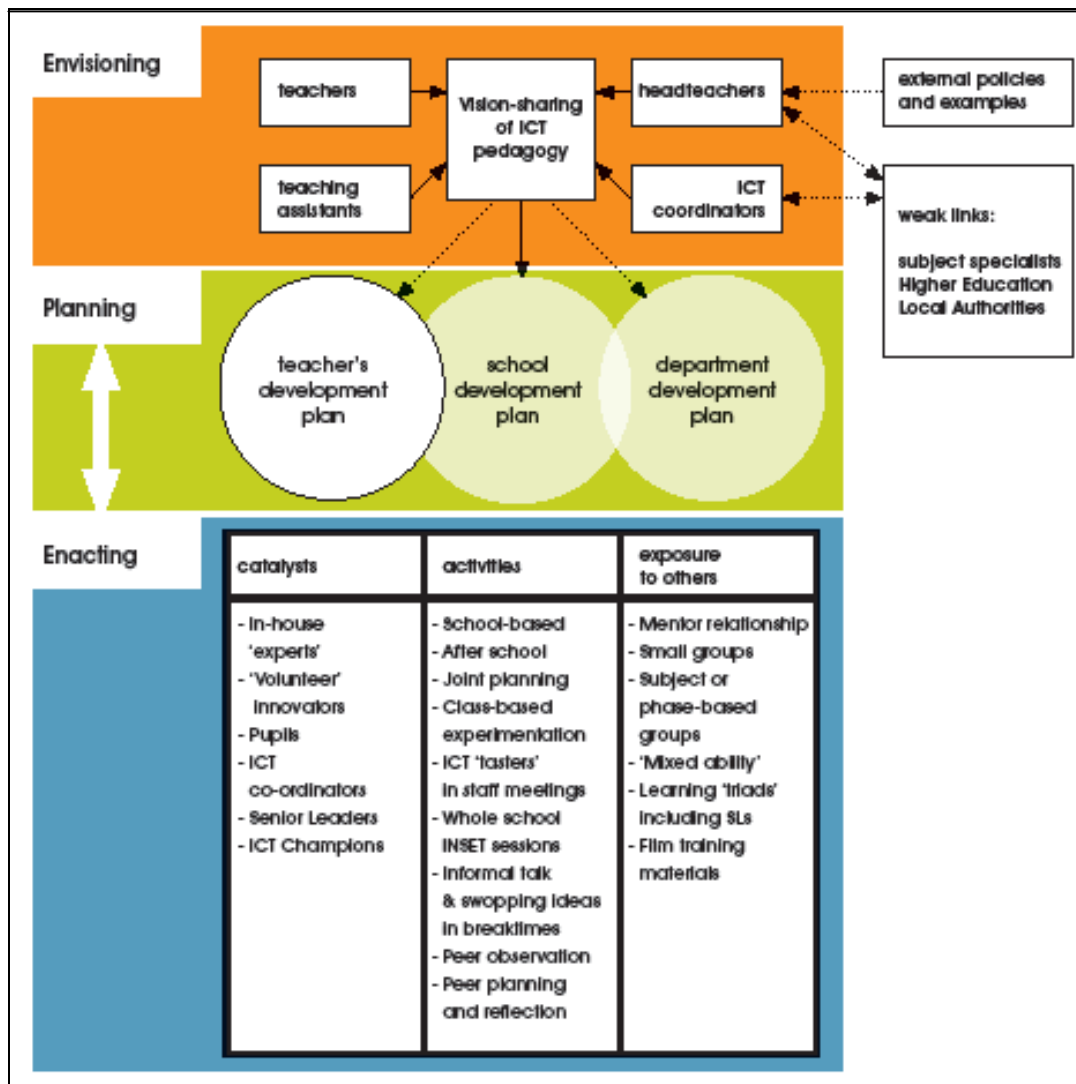


Figure 5: The High Collaborative School-Based model

10.2 Low Collaborative School-Based model

Senior leaders and/or ICT leaders decide on ICT CPD priorities, according to external policy guidelines at local or national level, individual enthusiasms or Ofsted recommendations. The school development plan tends to be constructed mostly by senior leaders, and it forms the main guidance for setting individual teachers' CPD priorities. Low levels of collaboration exist generally in approaches to school development, and CPD is mostly designed in response to external pressures to incorporate ICT, or to fulfil a particular vision of ICT pedagogy espoused by the headteacher. Responsibility is either given to individuals to improve their practice within school guidelines, or subject leaders in secondary schools take responsibility for development within their departments. Little time is dedicated to learning with peers. The curriculum is regarded as fairly inflexible, and opportunities for experimentation can be limited. Models of practice are made available by in-house experts, sometimes in

conjunction with external expertise, but this remains on a non-collaborative footing, with minimum negotiation between the external provider and the school about individual needs and differentiated activities. Enthusiasts are able to develop, and so can subject departments where ‘enclaves’ of expertise grow. There can be a strong reliance on ‘showcase’ examples of effective ICT pedagogy, which do not necessarily reflect the practice of teachers across the school as a whole. There are weak links with outside bodies, although individuals may attend external courses in their own time which involve an element of teacher enquiry, for example.

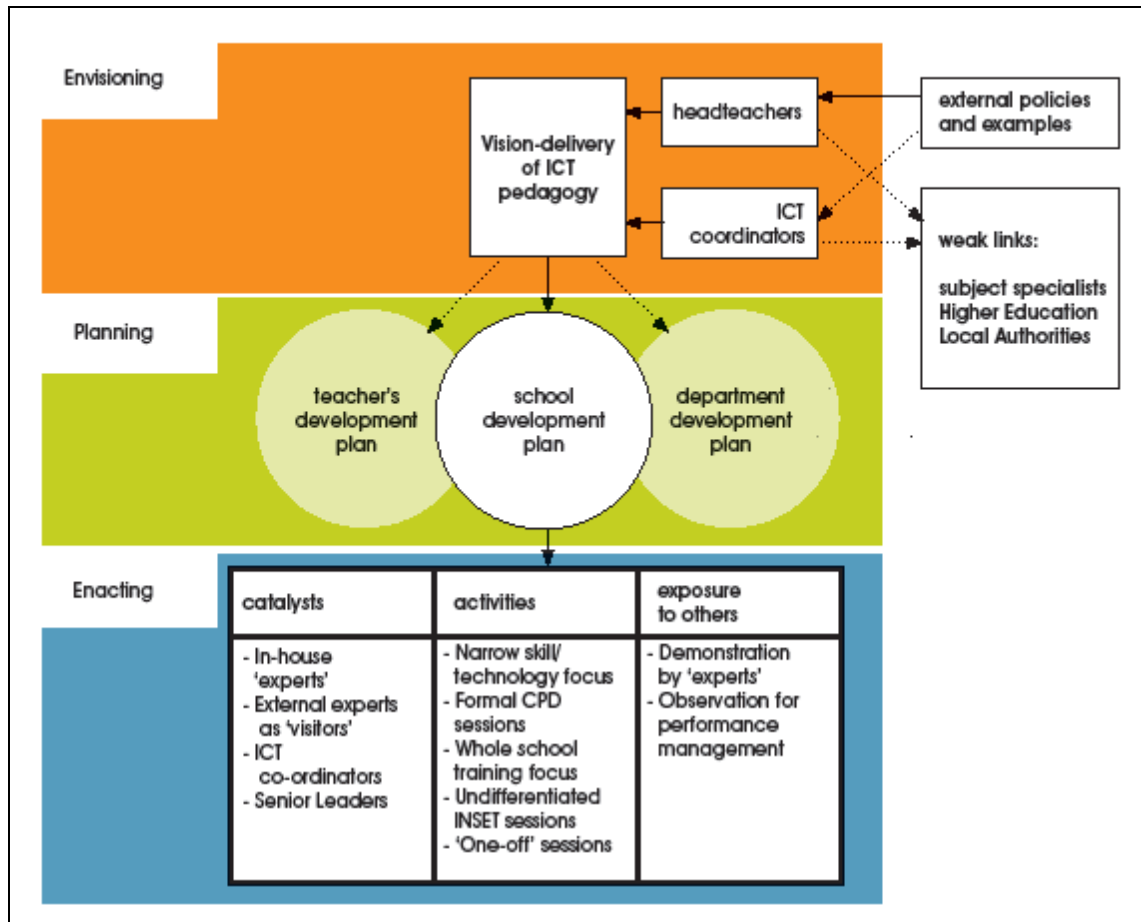


Figure 6: The Low Collaborative School-Based model

10.3 High Collaborative External Players model

This model has multiple forms, because of the widely varying types of external stakeholder involvement in ICT CPD (for example, LA ‘courses’, sustained ‘expert’ or commercial involvement in CPD, accreditation with HEIs, online learning communities, subject association courses and CLC programmes). What they have in common is two features:

- i) An imperative from the CPD providers for teachers to work collaboratively to develop practice
- ii) A flexible and differentiated approach to CPD which addresses the teacher’s individual needs.

This is important in introducing collaborative CPD to teachers who would not normally

experience it where it is not part of their school's CPD approach. It is most effective in contributing to teachers' development, however, where the approach of the school is supportive of collaborative CPD and provides time for teachers to engage in follow-up activities or ongoing collaborative practices. Nonetheless, the model still provides opportunities for staff to access directly expertise which may not be available within their school (such as subject-based ICT pedagogy and collaborative teaching approaches). Exposure to teachers from other schools and their experiences is an important aspect of this, through off-site training in LA accommodation, CLCs, school visits, higher education sites or via online communication. CPD activities may be in the form of programmes of sustained development, informal online discussion, structured courses leading to accreditation, targeted LA support, or core LA provision. Sites of learning may move between the school, partner schools, and providers' locations. The model thus includes key components, but there are multiple variations within this according to each individual CPD context.

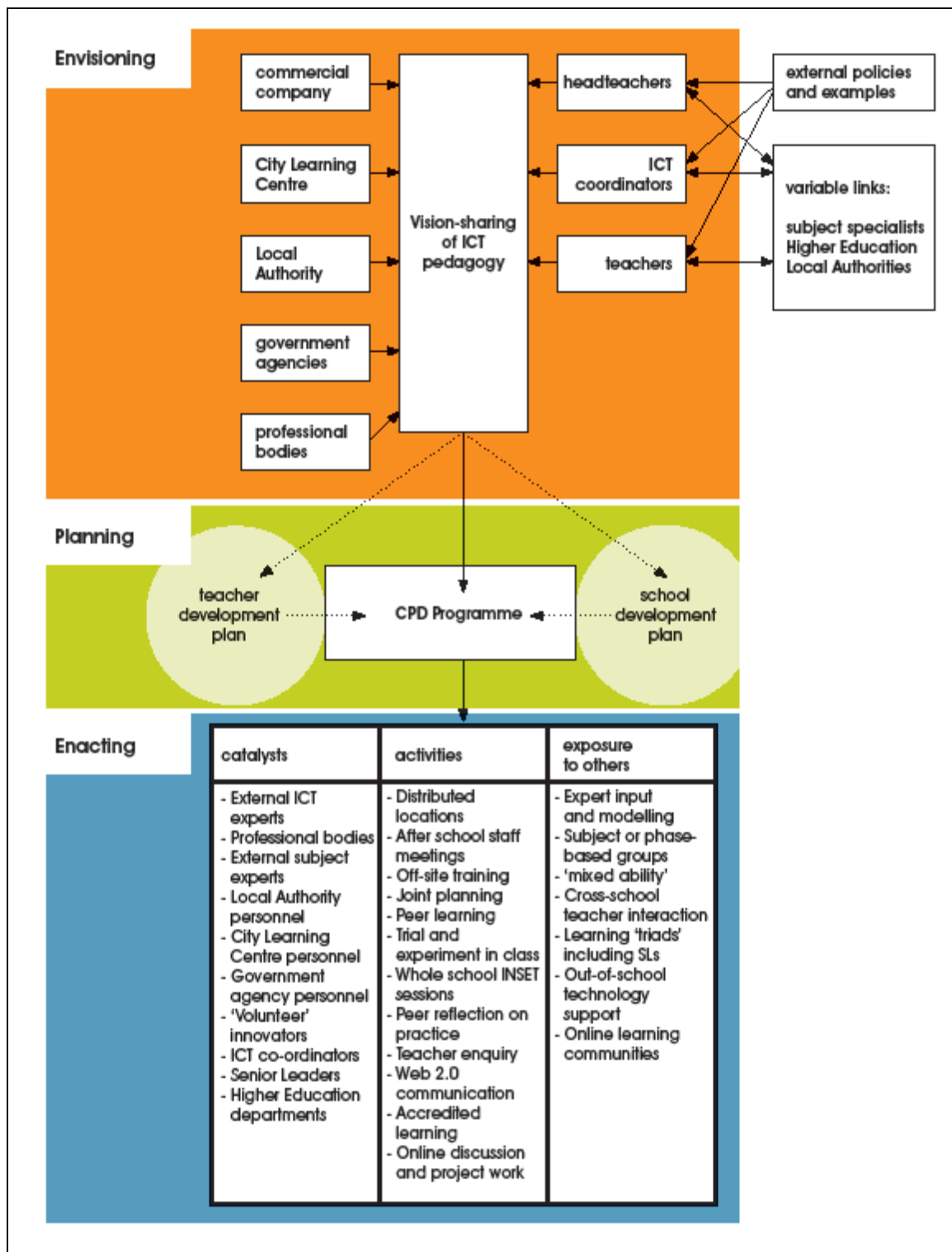


Figure 7: The High Collaborative External Players model

10.4 Low Collaborative External Players model

The same arrangements can be in place with an external provider as in the 'High Collaborative External Stakeholder model', but the ethos of the school, relationship with the external providers and leadership approaches can determine whether CPD takes

place within a 'low' collaborative context. In 'low collaborative' contexts, the external provision is frequently viewed as 'one-off' or as not a core aspect of teacher development and is not supported with follow-up time within schools for staff to experiment, reflect with peers and embed new practices. External stakeholder input can have limited impact where the school curriculum is fairly inflexible and practice is not a focus of peer review, even where the input itself reflects innovative and engaging pedagogies. There can be a lack of engagement from staff if the relevance of the provision is not apparent, and where there has not been any negotiation about the teachers' needs as individuals. There can also be frustration where the teacher attends a course and is exposed to pedagogical possibilities which are exciting, but where technology resources or technology specialist support are lacking within the school to support innovations. Where the responsibility is left to individual members of staff to develop practice following the input, this can diminish the impact of even the most inspirational external provision. Even where a provider returns to the school, or staff return to a course, it is mostly regarded as the individual teacher's lone responsibility to implement change in their classroom, though this may extend to department level or may include working with an ICT co-ordinator or technical support personnel. Where there is a basic level of school support, the model can support the development of 'enclaves' where groups of staff gain access to subject-focused training and develop with enthusiasm as a result of that.

The model can also support the development of highly skilful individual practice, but there are limited opportunities for the wider staff to benefit from that. For example, a teacher might attend a higher education programme, possibly undertaking an individual teacher enquiry project leading to personal accreditation, but is not working in a school culture where this expertise can feed into the learning of others. These low collaborative scenarios involving external stakeholders lead to inconsistent or limited development across the wider school.

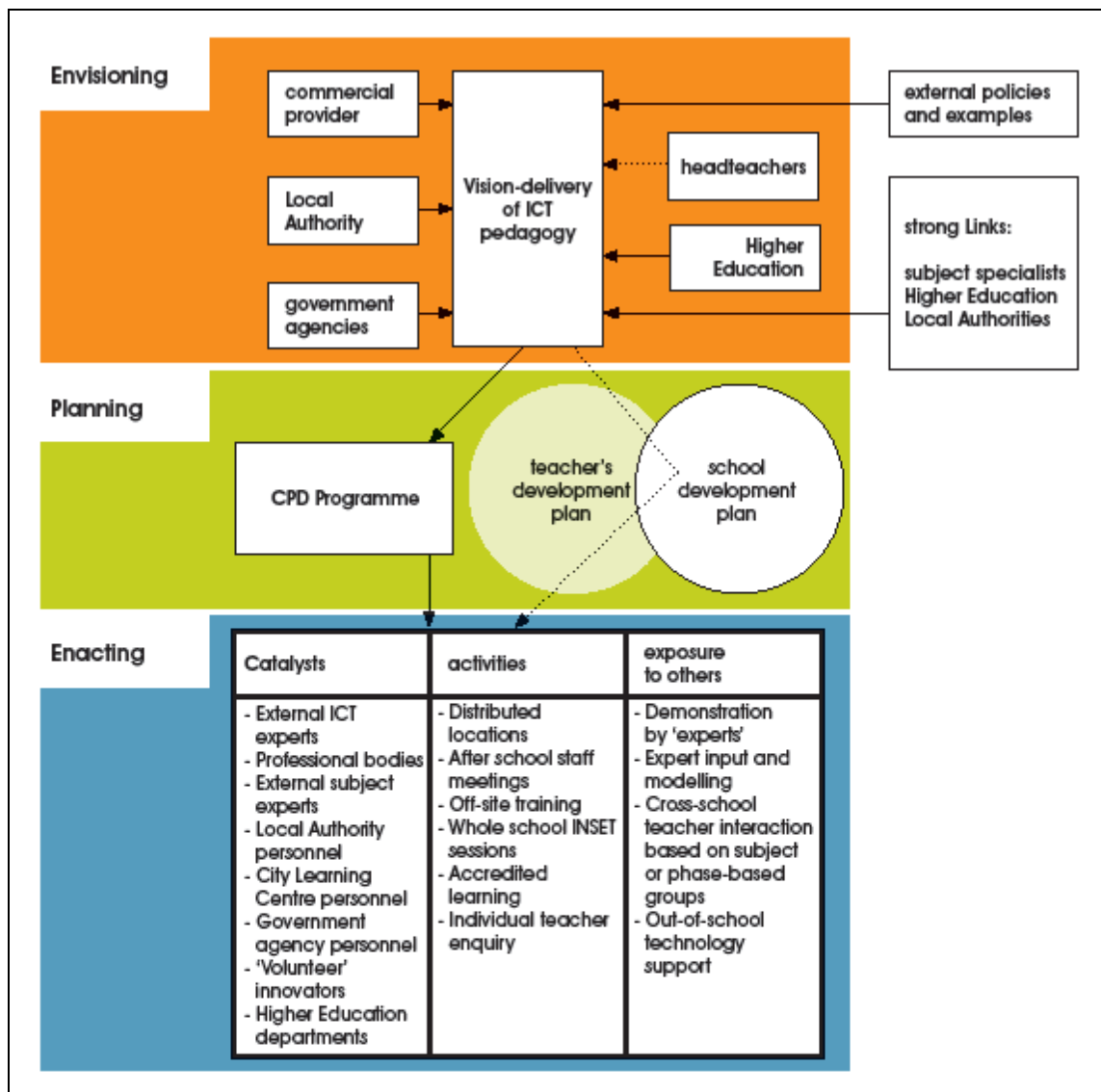


Figure 8: The Low Collaborative External Players model

11. Final reflections

Reports on future trajectories for technologies suggest that ICT CPD needs to involve recognising the permeable boundaries between school and the rest of the world, between formal and informal learning, between 'schoolwork' and 'homework' in e-learning contexts and about the impact of learning platforms in schools which extend 'school-learning' into 'anywhere learning'. Policy-making and review documents regarding technologies in the workforce provide ample evidence of government awareness of the importance of these issues, but recognise a gap between intentions and the realisation of sufficient progress in teachers' development of effective practice which uses technology.

Constantly striving to familiarise teachers with the introduction of new technologies in ever-widening domains of the school (online reporting and home access, for example) has an extremely influential impact on skills-based CPD, but is not an appropriate priority where it overshadows a focus on pedagogy and distracts from concentrating on improving the student learning experience. CPD needs to be designed so that it is not constantly running to keep up with new technology, which exhausts motivation and resources while not necessarily changing pedagogies in a lasting way. CPD needs to be in touch with everyday life involving teachers in using technologies outside school, so that their practice is informed by real-world knowledge and applications (though it may never keep up with that of their students).

There is still an evident need to improve ICT CPD so that it is embedded as part of normal practice. From the evidence in the literature, this is still an aspiration for many schools, which mostly strive just to 'keep up'. Specific factors which detract from the effectiveness of ICT CPD have been shown to be embedded in wider contexts which shape teachers' experiences:

- An over-emphasis on skills development without sufficient opportunity to reflect on learning and teaching as part of development activities
- A lack of pedagogical focus in the vision for ICT espoused by some school leaders
- Conflicting priorities within ICT policy initiatives, which can mean that pedagogy becomes relegated in awarding time and resources to teacher development within schools.

Significantly, many of the factors of effective ICT CPD reported here were found to be inhibited by what Hardy (2008) has called 'policy tensions'. In his study, policy tensions tended to cause headteachers to organise more one-off workshops, obtain input from external speakers as a 'ready made' solution to the next challenge, and spend money on whole-school sessions and outside speakers. This ensured the policy had been addressed by 'everyone' rather than spending money on teacher release time to support observation and group learning by the teachers so that deep understanding develops alongside practice. Teachers' work overload led to increased individualism, reluctance to collaborate and 'inertia' within groups which had been set up to implement initiatives. Collaborative arrangements were 'forced' and less effective. Although policy support might exist for collaborative, inclusive CPD, in reality managerial policies overrode these in response to multiple pressures to perform quickly. Hardy finds that policy-making which supports context-specific initiatives and resists general demands is more likely to

foster effective CPD. This is a major factor, and requires significant shift in understanding the nature of teachers' professional development by policy-makers.

There are considerable differences among teachers in their levels and needs. These can be broadly categorised as:

- i. *Teachers who are increasingly products of the 'Net Generation' (Oblinger and Oblinger, 2005), who are confident and familiar with Web 2.0 and other technologies.* For these teachers, the gap between their immersion in technologies and what and how they are enabled to learn in school is part of an anomaly and likely to become an increasing source of frustration and lost opportunities as time goes by. They do not necessarily possess advanced pedagogical expertise, however, and their development needs are important.
- ii. *Teachers who have the skills and the access to technologies, but are not motivated or not convinced of the benefits (Empirica, 2006) or who, for 'unspecified reasons', do not engage with technologies.*
- iii. *Teachers who are lacking skills and confidence.*

This suggests that models for ICT CPD need to be able to address major individual differences between teachers' needs and motivation levels. Re-invention of practice is vital but extremely demanding and more appropriate, embedded support is needed for teachers to do this. Teachers need to learn what works for them – their learning is highly situated. Examples of 'best practice' can be daunting and deflect from a development focus which grows out of a teacher's own needs and deep knowledge about their learners in their school. Within an ecological view of ICT and the classroom, effective CPD requires a reassessment of what helps teachers to learn at all levels: as individuals, within whole-school approaches, and within wider networks such as external programmes and online communities.

In 2004, Scrimshaw focused on the need to understand the inter-relations between the three levels of ICT CPD, identifying four areas to be addressed. There is little evidence of substantial widespread change in the intervening years, and the same issues are still current now:

- Ways of enabling individual teachers and schools to make better use of ICT are largely treated as separate problems.
- The overriding importance given to using ICT to facilitate the emergence of a student-centred curriculum focuses most of the school-level research on the small proportion of schools that are finding ways of doing this successfully. This leaves under-researched the use of ICT to reinforce and enhance the existing curriculum, whether this is viewed as an important step towards assisting the emerging curriculum, or as a possible alternative final destination in its own right.
- By focusing attention upon either the individual teacher or the whole-school experiences of successful schools, the literature leaves under-researched the circumstances in which the innovation can succeed with groups of staff within schools.
- By focusing largely upon examples of schools already at the most complex level of development as exemplars, the literature does not help in understanding how schools made the previous transitions from level to level, or what role ICT might

be playing in schools that in more general terms face considerable difficulties in their quest for greater e-maturity. (p. 3).

Long-term evaluations of CPD are needed, of the type carried out by the ICT Test Bed Evaluation studies (Somekh *et al.*, 2007). These studies looked holistically at how new pedagogies were embedded within a longitudinal view of change in 30 schools and colleges over a four-year period. Within a longitudinal approach, meaningful insights could be gained into how ICT is being embedded within schools, including a focus on practitioner perspectives. The Evaluation Studies found that well co-ordinated and sustained professional development opportunities were important in developing ICT skills and confidence of all staff in embedding the use of ICT. Specific infrastructural strategies were identified which supported staff development, such as shared server areas and virtual learning environments which made it easier for teachers to find, store, share, create and reuse resources and lesson plans. This is important in maintaining motivation and relevance of development activities which take considerable time during early stages of change.

11. 1 Conclusions

The literature indicates that effective CPD requires immersion in complex learning experiences, which are made of many parts. There has been a lack of significant progress towards designing CPD which takes account of this, despite the fact that this has been recognised for many years. Recent studies show, however, that successful strategies exist at all levels of CPD, but they remain localised and minority experiences for most teachers, especially those in secondary schools. On a wide scale, providing effective CPD which goes beyond learning basic skills has remained a fairly intractable issue

Factors suggest that the social context for CPD is vital, and that human relationships and deployment of a variety of individuals are central to establishing a productive ICT CPD culture across environments. This, of course, raises troubling questions about how possible or desirable it is to replicate successful models. In the future, effective models are unlikely to be located in one place that is easily defined as 'school-based' or 'off-site'. CPD is likely to continue to take place in increasingly distributed locations as market forces continue to privatise the whole operation. CPD activities may involve fluctuating cohorts of participants who come into contact with each other in varying ways at different times for differing purposes, in different groupings, in different patterns of partnerships, including expert–learner, learner–learner, and learner–'new' expert. Models already have multiple locations – online learning environments (which can be accessed, increasingly, by mobile devices); government-sponsored centres; cluster schools; the classrooms of the teachers; and teachers' homes. Strategies move between different constellations of teachers – whole cohorts, the groups they join for workshops etc, cluster groupings, school pairings, triads and so forth. All such collaborations have roles to play in developing pedagogy, and this gives a glimpse of a possible future CPD scenario which is highly complex. The kinds of CPD interactions and activities which are emerging within this scenario are multi-layered and 'multi-layered'.

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