

TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPCK), A CONCEPTUAL FRAMEWORK FOR AN INCREASINGLY TECHNOLOGY DRIVEN HIGHER EDUCATION?

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Abstract. Higher Education (HE) professionals generally work in an ICT rich environment. There are expectations that the existence of ICT benefits them, their students and the overall learning environment. These assumptions are often left unchallenged due to a lack of developed theoretical frameworks. This paper introduces and critiques the TPCK framework by reviewing the origins of the concepts used in its formulation and by experimenting with the model in the context of a HE course. Although the TPCK framework raises and focuses the debate about technologies in education this paper suggests some key issues are potentially missing. The paper suggests that pedagogic design needs a clear focus on the role of the learner in the process and that HE requires collaborative communities of practice that include ICT 'enthusiasts' within any course team. The paper suggests these are key factors in enhancing the capacity of the HE staff to engage positively, collaboratively and critically with the growth of learning technologies and in turn design appropriate and successful online components within their courses.

Keywords: e-learning, pedagogy, technology, teacher education

Introduction

Mishra and Koehler (2006) propose a conceptual framework which they have named Technological Pedagogical Content Knowledge (TPCK). They have developed Shulman's (1986, p. 9) formulation of Pedagogic Content Knowledge (PCK) by introducing 'technology knowledge' as an explicit component. This TPCK framework, it is argued, can enable a more theoretical robust way of designing, implementing, analysing and evaluating the use of Information and Communication Technologies (ICTs) in education. The main aim of this work is to 'unpick' and 'critique' this framework from both the academic and professional perspectives within the context of Higher Education (HE).

I have structured my approach to this work in the following way: Firstly I provide a rationale and a context which includes reference to my professional teacher educator role and my academic researcher role. Secondly I will briefly review some of the current thinking in relation to research in the field of ICTs, pedagogy and practice. Thirdly I outline in more detail the TPCK framework that Mishra and Koehler propose. I will then refer back to Shulman's original work as the TPCK framework implicitly relies on the validity of the concept of PCK. Following this I plan to 'experiment' with and critique the potential of the TPCK framework as a design and analysis tool within my own professional practice. I will conclude this work by discussing the potential (or not) of how TPCK might be used or adapted to be used both as a research and a course design tool.

Rationale

There are three different but interconnected strands to my rationale for investigating the TPCK framework. The first is in terms of my professional role as a teacher educator on courses that increasingly use technologies. One of these courses, the Master of Teaching (MTeach), is 'mixed mode' in the sense that both face-to-face (f2f) sessions and e-learning are used. This course was designed from the outset to use learning technologies in an integrated way, rather than being 'converted' to e-learning. As a module leader and tutor I am motivated to maximise the potential of learning technologies on this course. The TPCK framework seems to offer a model for critically thinking about the design and integration of learning technologies on such courses.

The second strand of my rationale is my research interests which are more specifically focussed on the design of online tasks. By investigating the TPCK framework (and its origins) I hope to assess the potential of TPCK as a tool for course design, research and analysis.

The third strand of my rationale is motivated by the rapid growth, and perhaps unquestioning use of ICTs in education. Potential benefits are possibly overstated, under researched and there is a lack of theoretical models and frameworks to enable a critical assessment of the use of learning technologies. TPCK emanates from research in the USA by teacher educators, given the earlier educational use of the internet in the USA, such a framework may well be more developed (and tested) than its European counterparts. It may well be a useful addition to the current academic debate about critically engaging with the use of learning technologies.

Research Background

Technologies in education have often been seen and used as providing the answers we are all looking for and ICT is no exception, often being promoted by politicians (and sold by retailers/software manufacturers) as the solution to „efficient“ and „effective“ learning. However the rhetoric often neglects the serious point that it is not the availability of the technology, which is important, but how it is used. The increased use of ICTs especially in creating and developing more online courses can mean the expansion of markets including those for overseas students. Higher Education (HE) (where my research is located) has the potential to expand courses quite rapidly by using part-time staff on short-term contracts. This is what we have tended to see in contemporary HE: an expansion of modes and methods of delivery. However with this rapid change it is important to consider the design and pedagogies involved with such course developments.

Leading UK academics in the field are aware of these issues and the need to move the research agenda forward. In the preface to her book on the effective use of learning technologies in HE Laurillard sets the scene by saying:

[T]he Web has become established, interface design has matured, and PC access has become widespread. The demands of technological change have hindered the theory and practice of its application, however. Learning technologies are unfamiliar and complex. Few of the current generations of academics have ever learned through technology, so practice develops slowly and theory hardly at all. (Laurillard, 2002, preface)

Laurillard makes important points here, which resonate with one of the issues raised in my rationale and she also highlights the need for research and theory to develop. The lack of conceptual frameworks and the variability of academics engagement with ICTs almost certainly reduce the potential pedagogic gains they might offer. A book by Seale et al (2003) investigates learning technologies in post-school education. In this book in concurrence with Laurillard, Oliver argues that continual change does not provide stability for research of practice, which has consequently tended to be limited.

[L]earning technology often seems an amnesiac field, reluctant to cite anything 'out of date' (Oliver, 2003)

Although, there is a concern over the lack of theoretical frameworks, interestingly Oliver suggests there is a consensus view but this is has not yet developed into a theoretical position.

[G]enerally, learning technologists just do not believe the 'default', transmissive model of education...They believe that learning arises from thoughtful experimentation (experimental learning), from questioning (critical thinking), from the intertwining of practice and reification, debated with peers (communities of practice). By deeming transmissive e-learning to be 'of questionable value', we have taken a theoretical stand- but are we, individually and collectively, aware of what stand we have taken. (Oliver, 2003)

There is also within the debate in this book recognition of the potential tension between technology and pedagogy. Most software used is designed for commercial rather than educational use. Even software aimed at the education marketplace is often designed using a self-teach model. The danger is that technology drives the pedagogy and that it encourages a 'transmission' approach whether this is via presentation package or within a virtual learning environment (VLE). Wilson refers to 'pedagogic poor' applications of technology.

[I] groan at the thought of students faced with death by PowerPoint both in the lecture theatre and now in the VLE' (Wilson, 2003)

The snapshots above give exemplars of contemporary academic debate concerning research of ICTs and pedagogy. The intention is that the investigation and critique of TPCK will address some of the issues raised and add to the wider debate in this area.

Technological Pedagogical Content

Punya Mishra and Matthew Koehler work at Michigan State University in the College of Education; they have researched and published widely in the areas of technologies and education, with a strong focus on teacher education. In a similar vein to the views of the UK academics cited above they acknowledge the lack of theoretical grounding of research in the area of educational technology. They flag up three issues which have perhaps restricted the development of more unified theoretical and conceptual frameworks. One being the (over) focus on the technology

[P]art of the problem, we argue, has been a tendency to only look at the technology and not how it is used. Merely introducing technology to the educational process is not enough. (Mishra & Koehler 2006, p. 3)

The second is the large number of case study approaches to reporting developments and practice which they argue only provide the first step in building understanding. The third being the rapid change in technologies available.

They propose a conceptual framework to address some of the shortfalls in analysing the role of ICTs in education, which they have named Technological Pedagogical Content Knowledge (TPCK). They have used Shulman's (1986, p. 9) idea of Pedagogic Content Knowledge (PCK) which I will look at in more detail in the next section. The argument is that teachers, to be effective, need to know not only about the subject matter and about how to teach, but they need to understand appropriate pedagogies for that particular subject, topic, or concept. Mishra and Koehler have introduced Technology Knowledge (TK), which is knowledge about the technology and how to use it. Below is Figure 3 from their paper.

Mishra and Koehler propose that the figure above represents what generally happens in both educational practice and debate about the use of technologies. Thus technologies are seen and treated as separate from content and pedagogy. They argue that this is not a useful way of treating learning technologies and the relationships are 'complex and nuanced' and that technologies may actually constrain content. They suggest that TK needs to overlap as shown in their Figure 4 below. They argue this framework allows a potential model for analysing as well as designing resources, methods, structures and desired outcomes, especially where ICTs are an integral or growing part of a course.

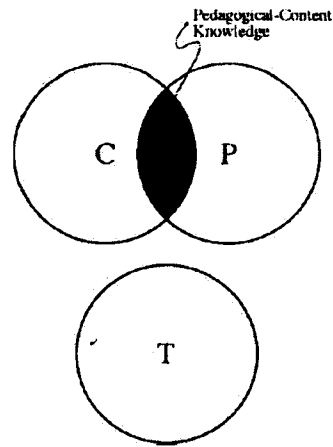


Figure 3. The three circles represent Pedagogy, Content and Technology knowledge. Content and Pedagogy overlap to form Pedagogical Content Knowledge while Technology is seen as being a separate and independent knowledge domain.

At this stage I am not going to comment too much on what they say about Shulman's model of PCK as I want to discuss this via comments on his original work rather than one mediated by Mishra and Koehler. It is fair to say that they do not accept his work without question and refer to some of the criticisms and developments of it and the lack in Shulman's own words of 'great cross-article consistency'. In essence they accept the main concepts and develop them into their TPCK framework. They refer to aspects of teaching that Shulman identified as important to PCK

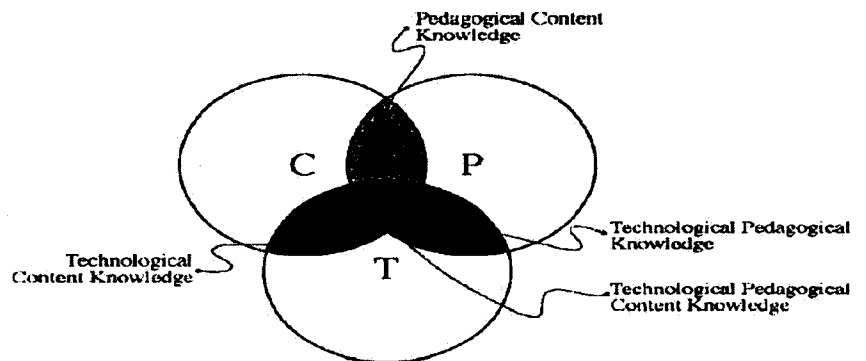


Figure 4. Pedagogical Technological Content Knowledge. The three circles Content, Pedagogy and Technology overlap to lead to four more kinds of inter-related knowledge.

[t]he most powerful analogies, illustrations, examples, explanations and demonstrations ...the ways of representing and formulating subject (Shulman, 1986),

and argue that newer technologies potentially play a critical role in relation to these aspects. Also the current rapid rate of technological change means it is unlikely that these will stabilise in the same way as the previous learning technologies. A key way they empathise with Shulman's work is that they liken the problem of 'technology knowledge' (as in Figure 3 above) being treated in discourse and practice as a separate type of knowledge and skills in the same way that Shulman claimed content and pedagogy were considered. They suggest the TPCK framework (Figure 4 above) counters this problem.

[o]ur framework (see Figure 4) emphasizes the connections, interactions, affordances, and constraints between and among content, pedagogy, and technology. In this model, knowledge about Content (C), Pedagogy (P), and Technology (T) are central for developing good teaching. However, rather than treat these as separate bodies of knowledge, this model additionally emphasizes the complex interplay of these three bodies of knowledge (Mishra & Koehler, 2006)

Their development of Shulman's model introduces four 'new' knowledges: Technology knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and TPCK. TK and how it has changed was alluded to earlier in terms of digital technologies, it could be stated simply as the skills and knowledge to use computer hardware and software, which they argue is often the focus of training workshops. TCK is knowledge about the relationship between subject and technology

[T]eachers need to know not just the subject matter they teach, but also the manner in which the subject matter can be changed by the application of technology (Mishra & Koehler 2006)

They use an example of a software package (Geometer's Sketchpad) as a tool for teaching geometry and acknowledge that in one way it just emulates previous content but has the potential to introduce new/different forms of content. TPK is knowledge about the capabilities of technologies for teaching purposes which may well include constraints as well as benefits. Where one needs to understand and consider the pedagogic appropriateness of the technology as well as being aware of how the technology might im-

pact on the desired pedagogy. TPCK then essentially is a bringing together of TCK, TPK and PCK and they adapt a description of PCK from Marks (1990) to illustrate this:

[T]PCK represents a class of knowledge that is central to teachers' work with technology. This knowledge would not typically be held by technologically proficient, subject matter experts, or by technologists who know little of the subject or of pedagogy, or by teachers who know little of that subject or about technology (Mishra & Koehler, 2006)

Throughout the paper there is an emphasis on the successful integration of technologies into teaching in a thoughtful way that develops a nuanced understanding of the relationship between pedagogy, content and technology. They are clear that separating these components out initially to then develop the TPCK framework is

[a]n analytic act and one that is difficult to tease out in practice (Mishra & Koehler, 2006)

and they suggest a less static reality.

[I]n actuality these components exist in a state of dynamic equilibrium, or as the philosopher Kuhn (1977) said in a different context, in a state of „essential tension“ (Mishra & Koehler, 2006)

They identify a change which many of us in education can possibly relate to, that in the past there was a tendency for content to be a driver and pedagogy (and technology) followed. Whereas now, and they cite the growth of the internet as an example of a technology which has forced educators to possibly re-think pedagogical issues. They posit a scenario in contemporary HE where staff are developing on-line courses for the first time. The newness of the technology may well raise new questions about pedagogy and content, and not be limited to their understanding of the new technology. The above discussion outlines the main thinking behind their formulation of the TPCK framework; the paper then goes on to look at applying the framework within teacher education and using TPCK as a framework for research. With both, it adopts a case study approach with examples and related theoretical discussions.

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Shulman and PCK

Without looking at the foundation from which TPCK was built there is a danger of accepting the mediated view without question. At this stage I want to briefly overview and pick up on some of the critiques of Shulman's work and the concept of PCK.

Pedagogical Content Knowledge a term used first by Shulman in 1986. In his address to the Carnegie Foundation his aim was to draw attention to what he called „the missing paradigm“ in the study of teachers' knowledge: that of the influence of the subject. In his initial address Shulman identified three categories of content knowledge:

- Subject matter content knowledge;
- Pedagogical content knowledge (subject matter for teaching);
- Curricular knowledge (programs for teaching, the curricular alternatives for instruction).

Most research at this time neglected what Shulman considered to be some of the most essential questions, i.e. how do teachers decide what to teach? How do „expert“ students transfer into novice teachers? How do they prepare to teach something never previously encountered? How does learning for teaching occur?

Shulman defined PCK as: „subject matter *for teaching*“ (1986, emphasis in original), the term was used to introduce

[t]he most useful forms of [content] representation ..., the most powerful analogies, illustrations, examples, explanations, and demonstrations – in a word, the ways of representing and formulating the subject that makes it comprehensible for others“ (Shulman, 1986, p. 9).

In his initial address, the content dimension of PCK was described as being teachers' knowledge of the school subject (i.e. the curriculum, textbooks etc). In his further development of the concept, PCK is listed as one of the seven knowledge bases for teaching: content knowledge, general pedagogical knowledge, curricular knowledge, knowledge of learners, knowledge of educational contexts, and knowledge of the philosophical and historical aims of education (Shulman, 1987). This development is significant as it not only represents a refinement of the concept of PCK, but also places it as a knowledge base of equal status with the others (Gess-Newsome, 1999). The

1986 quote above is used by Mishra and Koehler and I would argue they underplay Shulman's refinement and consequently neglect these other important 'knowledges' in their work. This is an area I discuss later in relation to the design of tasks on the MTeach course.

The idea that teachers understand their subject area differently to others is not new. Bullough (2001) points out that early movements in education in the USA, sought to professionalise teaching through the assertion that teaching a subject required a different type of knowledge of that subject area. Along with Carlsen (1999), he highlights the importance of contextualising the development of Shulman's PCK within the education debate at the time. Teacher educators were under attack and there was an urgent need to respond to the criticisms of them in the Nation at Risk report (1983).¹ In some ways we could tentatively draw some parallels with the current community of academic learning technologists who feel they do need to develop theoretical models and frameworks especially at a time when many (politicians, new managerialists, software developers) see 'downloadable education' as very cost effective, teacher-proof (and profitable).

Shulman defines PCK „most likely to distinguish the understanding of the content specialist from that of the pedagogues“ (Shulman, 1987: 8). However, McEwan and Bull (1991) argue that all knowledge has a pedagogical dimension; that scholars do not just create knowledge but have to present it in a form that makes it accessible to others. Teachers perhaps have to develop pedagogical alternatives for a wider and more diverse population but does this justify PCK as a teacher domain. The same question could perhaps be levelled at TPCK where HE teachers might argue they are clear about their subject and desired pedagogy and the technologies available do not make these relationships more complex and nuanced.

Banks, Leach and Moon (2005) argue that Shulman's conception of teacher knowledge lends itself to a teacher-centred pedagogy, rather than learner-centred pedagogy

[w]e are critical in particular of Shulman's implicit emphasis on professional knowledge as a static body of content somehow lodged in the mind of the teacher' (Banks et al., 2005).

This lack of focus on the learning process and the student I would argue is also to a certain extent missing from the TPCK model, despite a clear promotion of situated learning in the latter case studies part of the paper.

Shulman is one of the most cited academics in work on teacher education and subject knowledge and his contribution to the raising the debate and thinking in these areas is without question. The section above aimed to overview his formulation of PCK and flag up a range of questions about this formulation but also touch on the relevance of both of these to the TPACK model.

TPACK and the MTeach

The aspects I am going to focus on for this purpose are essentially about course design and development. To enable a discussion of the relevance of the TPACK model to these design issues, I am going to look initially at the way the course team plans and designs the overall course, then look at a particular module to try and evaluate the potential of assessing the level of TPACK achieved within the online tasks.

This MTeach course is relatively new (first cohort 2001), and specifically focuses on the development of teachers in the challenging early phase of their teaching careers. It aims to provide a framework of 'support for talented new teachers in urban schools'.² It enables and encourages high level professional learning to take place nurturing an enquiry approach to 'understanding teaching' and raising levels of 'research literacy' and practitioner research capacity. The academic course team is currently made up of ten staff who, all but one, are experienced Post Graduate Certificate in Education (PGCE)³ tutors from six secondary subject areas and primary education, generally work on this course forms a minority part of their contract. It has been a challenge for the course team to design and develop this course over the last 4 years. Team meetings are well-attended, open, and developmental allowing genuine debate and criticality. Staff who previously had not worked together seemed to gain confidence and value the cross subject, cross phase learning that takes place. Because this course was new and was planned with technologies as an integral part from the outset the team needed to carefully design the tasks and sessions in an integrated way taking into account pedagogies, content and technologies. The team came with varied Technology Knowledge (TK) as well as their subject backgrounds and ideas about pedagogy. The design of a new course allowed staff to work to their strengths, the sharing of knowledge and techniques about ICT or content or pedagogy was reciprocal. Aspects of the TPACK model do resonate with the way the course team worked. For example some of the team were

perhaps what we could call 'ICT enthusiasts' arguably with high TK, their understanding of the potential of particular ICTs enabled course design to have a richer TPCK than if there were no enthusiasts. Once the course was up and running and staff experienced using the new technologies (initially mediated by the enthusiasts) I would argue there was a move to higher levels of TPCK generally. An indicator of this is a special interest group (SIG) on ICT and Pedagogy, which grew out of this team in the first year of the course and is now an established group open to all University staff. However there are important ways in which the team designed the course and tasks which do not fit well with the TPCK framework. The main weakness is the lack of presence of the learner in their model. This is similar to criticisms of Shulman made by Banks and Moon (2005) where one of their concerns is that in essence the model is teacher centred. I would argue a stage further that the TPCK model also fails to highlight the importance of other knowledges that Shulman later introduced such as knowledge of learners and knowledge of educational contexts. The MTeach team for instance took great store in considering these two knowledges in the design of the course. This is firstly exemplified by the fact that the course has three routes specifically designed for teachers at different stages of an early teaching career. The 'P' route (post PGCE) for newly qualified teachers (NQTs), the 'I' route following an induction year, and the 'E' route for more experienced teachers (3 years+). To illustrate further how knowledge of the learner and their educational contexts are at the forefront of course design I will use some examples from the 'P' route. The course team knows the NQT year is probably one of the busiest and potentially most stressful in a teaching career. To avoid overload for these new teachers the 2 modules they undertake are run over the whole of an academic year rather than being completed in one term. The integration and balance of both face-to-face (f2f) and on-line elements are designed very much with the learner in mind. This allows some flexibility (especially with the on-line tasks) as to when they undertake these. Also the timings and subject focus of these tasks are carefully planned to 'fit' in with the typical issues and pressures of an NQT year. The tasks require participants to use (reflect and analyse on) their day to day experiences as new teachers. The idea is that the sharing of experiences, the grappling with classroom issues, the use of readings and theoretical frameworks encourages students to build on previous knowledge and understanding and make sense of the educational contexts in which they are situated. Evaluating (or designing) the course via a TPCK model could be simplistic and overlook crucial questions about the role of the learner in the process. The TPCK model alludes to complexi-

ties and nuances that can come from using learning technologies but fails to mention the importance of considering educational contexts, the role of the learner and their previous knowledge.

To reflect, experiment and discuss how a specific part of the course has developed against the TPCCK model I have used the Understanding Teaching (UT) module. This is for several reasons: it is the longest running 'core' module for NQTs, for most of the teaching team it was the first module they worked on with the new technologies, I am currently the module leader and thus more familiar with the content and developing pedagogy on this module and also I conducted some research with students about their perceptions of the design of the online tasks on the module.

The Table 1 below illustrates the interplay of face-to-face (f2f) and online tasks in the UT module.

Table 1. Timing of online discussions/tasks

Timing	Tasks	'Understanding Teaching' (UT) Module Activity	Mode
September		Inaugural evening	f2f
October	1	Starter task (classroom management focus)	online
November		Saturday conference	f2f
Nov/Dec	2	Classroom interactions	online
Jan/Feb	3	Learning, progression and achievement	online
February		Twilight/Saturday tutor group meeting	f2f
March	4	Evaluating teaching	online
April/May	5	Developing pedagogy	online
June		Coursework in progress conference	f2f
July/August		Coursework write up	Online/f2f

As discussed above the content, focus and timing of these tasks were carefully designed by the course team to be relevant and pertinent to the issues Newly Qualified Teachers (NQTs) encounter in their schools and classrooms. Each of these tasks, accessible via the MTeach website, follows a pattern, which has been designed and developed by the team: an opening page/section delineates briefly the aims, purpose and context of the discussion. From this, participants can move either to the task itself or to a background paper written specifically by course tutors drawing on key literature in the field and listing carefully selected, recommended background reading. The task usually offers a choice of questions as well as links to two or three

digitised core readings. Participants are encouraged to read the background paper before they choose the task and to engage with the digitised readings before composing their response to the task (usually 300-500 words) by a specific date. This is posted into a password protected online tutor group conference area. In a further step, they are required to submit at least one further posting by a specified date per online discussion in response to the contributions made by their peers.

Below is a simplified map of the UT module in terms of Technology, Pedagogy and Content.

- Technology: The website of resources, the online tasks and environments.
- Pedagogy: An underlying pedagogic ethos of the course/module is that of social constructivism. Students (the new teachers) make sense of their school experiences and reading via interaction with professional colleagues.
- Content: The UT module aims to develop students understanding of the following via (digitised and other) readings and reflections on their own teaching.
 - Classroom interactions;
 - Learning, progression and achievement;
 - Evaluating teaching;
 - Developing pedagogy.

A small scale research project has been undertaken about student's experiences and perceptions of participating in the UT online tasks. If we look at some of the main findings in relation to the TPCK framework it seems that the task design up to initial posting and reading of other postings achieves a high degree of TPCK. Students said they found these parts worked, it was useful, they felt they were developing and progressing. Interestingly this was less the case at the stage where they were required to respond to each others postings. One then needs to ask why this was. One could argue it was not the technology that was the barrier (this had worked fine earlier) but rather the design of this stage/aspect of the task. Reflecting on this I can see that this aspect of the tasks is vaguer and more open ended and needs a better structure, purpose, exemplification and perhaps a more creative approach. In other words, there exist needs to be more thought about both the pedagogy and content aspects of this stage of the task. This example of using the TPCK framework is simplistic but illustrates how it could have some potential for thinking about design issues where learning technologies are a key component of the course. However the clearest findings of this research

were about issues that are not made explicit by the TPCK model. That what was important for students was the fact that the tasks were focused around their classroom experiences, there was interaction with colleagues and the timing and flexibility of the tasks worked well. These are issues about educational contexts, the role and previous knowledge of learners which correlates with the critiques discussed earlier and consequently one should be cautious about adopting the TPCK framework in a simplistic and unquestioning way.

Conclusions

It has been valuable to approach a critique of the TPCK framework by:

- Examining the paper which introduces TPCK
- Reviewing Shulman's formulation of PCK (and other critical views on PCK).
- Then trying to look at the TPCK in the context of a particular course and my own current professional experience.

There are as one would expect strengths and weaknesses with such a model, the strengths are that it does (or can) provide a tool for thinking about the design of courses. In particular it flags up the important issues of pedagogy, content and technology. It also emphasises or reminds us of the need to consider the inter relationship between these factors particularly as the presence of learning technologies continue to grow at rapid pace.

My criticisms of the model and paper concur with some of the other writers concerns with Shulman's formulation of PCK that were mentioned earlier that have been at least partially transferred to TPCK. Such as the lack of discussion about learner's (previous) knowledge and the process of learning, TPCK seems to have also started with the less developed formulation of PCK and built on that rather than looking at some of the refinements made by Shulman. One almost feels that if they did this their model would not be so 'neat'. Overall the potential (positive) impact of technology knowledge is perhaps overstated, the suggested radical change to the nature of education neglects the issues of power, authority, and the often narrow outcomes and competence based agenda within many educational contexts. When one looks at specific aspects of the model the arguments and exemplars given seem weak in places, with TCK for example there is an attempt to explain how the technology potentially makes new knowledge (in geometry). One

can see how it allows different (quicker and more fun etc) ways of teaching but transformational aspects are not convincing. Similarly the examples used in TPK were weak and not really about pedagogy. TPCK as a research framework is underdeveloped (as yet), there were some useful examples of approaches but one felt many of the findings were rather obvious and is not necessarily down to a TPCK approach. If the educational gains of technology are to be maximised a more integrated approach to pedagogy, content and technology is needed in HE. The TPCK framework illustrates clearly the relationships and interdependence between these 'knowledges'. However the crucial next stage is the development of a course team that collaboratively and critically engages with these and wider issues in its course design. The formation of such 'communities of (professional) practice' (Wenger, 1998) where theory practice issues are discussed critically and situated learning develops offers huge potential for HE where often the staff are newer users of the technology than the students on their courses.

Notes

¹ <http://www.ed.gov/pubs/NatAtRisk/index.html>

² DfES (2001) *Teachers' Standards Framework. Helping You Develop*. London, section 6.12

³ PGCE – the standard qualification for teachers in the United Kingdom.

References

- Banks, F., Leach, J. & Moon, B. (2005) Extract from New Understanding of Teachers' Pedagogic Knowledge 11. *Curriculum J.* 16, 331–240.
- Bullough, R. V. J. (2001). Pedagogical Knowledge circa 1907 and 1987: A Study in the History of an Idea. *Teaching and Teacher Education* 17, 655–666.
- Carlsen, W. S. (1991). Subject-matter Knowledge and Science Teaching: A Pragmatic Perspective. *Advances in Research on Teaching* 2, 115–143.
- Gess-Newsome, J. (1999). Pedagogical Content Knowledge: An Introduction and Orientation. In: Gess-Newsome, J., Lederman, N.G. (Eds.) *Examining Pedagogical Content Knowledge: The Construct and Its Applications for Science Education*. Dordrecht: Kluwer, p. 3–20.
- Kuhn, T. (1977). *The Essential Tension*. Chicago: The University of Chicago Press.
- Laurillard, D. (2002). *Rethinking University Teaching, A Conversational Framework for the Effective Use of Learning Technologies*. London: Routledge.
- Marks, R. (1990). Pedagogical Content Knowledge: From a Mathematical Case to a Modified Conception. *J. Teacher Education* 41, 3–11.

- McEwan, H. & Bull, B. (1991). The Pedagogic Nature of Subject Matter Knowledge. *American Educational Research J.* **28**, 316–334.
- Mishra, P. & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record* **108**, 1017–1054.
- Oliver, M. (2003). Looking Backwards, Looking Forwards: An Overview, Some Conclusions and an Agenda. In: Seale, J.K. (Ed.) *Learning Technology in Transition. From Individual Enthusiasm to Institutional Implementation*. Lisse: Swets and Zeitlinger, p. 147–160.
- Seale, J. K. (Ed.). (2003). *Learning Technology in Transition. From Individual Enthusiasm to Institutional Implementation*. Lisse: Swets and Zeitlinger, 166 pp.
- Shulman, L. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher* **15**, 4–14.
- Shulman, L. (1987). Knowledge and Teaching: Foundations of the New Reform. *Harvard Educational Review* **57**, 1–22.
- Wenger, E. (1998). *Communities in Practice. Learning, Meaning and Identity*. Cambridge: Cambridge University Press, 366 pp.
- Wilson, J. (2003). Embedding Learning Technologies into Institutional Practices: A Further Education Perspective. In: Seale, J. K. (Ed.) *Learning Technology in Transition. From Individual Enthusiasm to Institutional Implementation*. Lisse: Swets and Zeitlinger, p. 73.

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