Lesson Design Research – An Innovative Approach to Embedding Technology in Classroom Environments

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Abstract

This small-scale case study considers the continued barriers to the successful integration of technology within classroom pedagogies. Technological Pedagogic Content Knowledge sees the successful use of technology in classrooms as resting on a clear understanding of the interplay of subject knowledge, pedagogy and technology. However, there is little evidence of this theoretical framework being put into practice within classrooms. This study combined the use of Design-Based Research and Lesson Study, an approach we name as Lesson Design Research to consciously bring together medium-term design with in-depth planning, observation and evaluation of learning in a small number of lessons.

Results from the study suggest that Lesson Design Research helped the teacher researcher overcome barriers to the successful use of technology, leading to greater confidence in the use of blogging and a clear and more in-depth pedagogic understanding of how that technology could be embedded to aid successful student learning.

Finally, we argue that rather than seeing Lesson Design Research as a way of practically applying the theoretical principles of Technological Pedagogic Content Knowledge, it should be thought of as part of a wider notion of 'pedagogic literacy' (Cajkler and Wood, 2013).

Introduction

'….key questions remain in education: has the range of technologies helped improve learners' experiences and the standards they achieve? Or is this investment just languishing as kit in the cupboard? And what more can decision-makers, schools, teachers, parents and the technology industry do to ensure the full potential of innovative technologies exploited?'

(Luckin et al, 2012, p.8)

The use of technology within classrooms has promised much but has often only delivered in a discontinuous way. The quote above from a review of the use of technology within classrooms in England is a typical sentiment and characteristic of a situation where a minority of teachers appear to be both comfortable in using technology and perhaps more importantly appear to have a clear

understanding as to how that technology can be embedded to extend the potential of pedagogy in positive and meaningful ways. As Luckin et al (2012) suggest the use of technology is still not integrated into many classrooms. Gray et al (2010) conducting research in the USA, found that less than half of teachers who took part in their study used technology within the classroom on a regular basis. Other studies have demonstrated that where teachers do use technology on a regular basis, it is more likely to be for the purpose of administration or creating resources (e.g. Russell et al, 2003). Kopcha (2012, 1109) synthesises a number of studies to suggest that some of the main barriers to the use of technology in classrooms relate to:

- access, relating to experiences of technology not working, or a perceived lack of utility in the use of technology in the act of teaching;
- vision, with those teachers having a clearer perception of its use being more resilient in the face of technical difficulties;
- beliefs, the teachers who believe that technology has clear utility are more likely to use it within the classroom;
- professional development, where training lacks a clear link to the classroom or focuses on the technological aspects of pedagogic use

Technological Pedagogic Content Knowledge (TPACK) has been one conceptual attempt to consider how technology relates to other aspects of the work of teachers and therefore how technology might become better embedded within classroom pedagogy. However, as it is argued below, whilst TPACK might offer a useful conceptual model it is less certain that it relates clearly to a practical approach which can operationalise the ideas contained within the theory. This paper reports the development of a classroom approach which relied upon the fusion of elements of design-based research (DBR) with lesson study (LS) to provide a vehicle (Lesson Design Research) by which a classroom practitioner and researcher could work collaboratively to integrate the use of technology, in this case the use of blogging, within classroom pedagogy.

Developing a practical framework for integrating technology and pedagogy

Mishra and Koehler (2006) developed a conceptual framework which brings together the work of Shulman (1986, 1987) focusing on Pedagogic Content Knowledge (PCK) with their own interests on the integration of technology within classroom pedagogy. Whilst PCK focuses on the interplay between pedagogy and subject knowledge, and an understanding by the teacher as to how they can best convey knowledge to others through these, Mishra and Koehler (2006) extended this thinking to include the use of technology in pedagogic processes. They emphasise the importance of seeing technology as a separate entity, as it has its own complexities and restrictions and as such can have an explicit impact on chosen pedagogies within the classroom. Therefore, they stress that '…. It may be inappropriate to see knowledge of technology as being isolated from knowledge of pedagogy and content.' (p. 1025). Consequently, the successful use of technology within the classroom is identified as being part of the wider consideration of how that technology relates to, and is embedded within, decisions about subject content and pedagogic approaches. Others, who have subsequently used TPACK have argued that whilst it has a great deal of potential, as a conceptual framework it is still not fully understood (Angeli and Valanides, 2009) and requires a greater degree of application to illustrate and strengthen its practical application.

Cox and Graham (2009) completed a conceptual analysis of TPACK focusing on clarifying its meaning and demonstrating its practical use. Their work developed both a more elaborate framework for TPACK and also demonstrated how this might be used to represent and understand the use of technology by practitioners. However, their work suggests that much of the research centring on TPACK is focused on building a clearer, and more detailed conceptual framework rather than considering how some of the main concepts and processes might be applied to increase teacher understanding and expertise in the use of technology within classrooms. Perhaps the most crucial insight which TPACK offers is the importance of recognising that successful use of technology in the classroom emerges out of an explicit consideration of subject content and pedagogy as the basis for discussion and development. As Kopcha (2012) suggests, one of the major barriers to the successful use of technology is the result of a lack of pedagogic understanding as a result of technology being seen as divorced from the teaching and learning process.

The integration of technology within the classroom through development centred on pedagogic discussion would appear to be the natural focus of design-based research (DBR). DBR '… advances design, research and practice,…' (Wang and Hannafin, 2005) through the use of design experiments where researchers work in collaboration with practitioners to design interventions. The intention is not only to produce high-quality artefacts but also reasoned design principles. Two distinctive features are the complementary but somewhat different roles of the researcher and practitioners, the former acting as the theoretician and designer whilst the latter acts as the implementer, the intention being to develop inductively driven educational/technological theory from the iterative implementation cycles. DBR has been used extensively to develop the use of technology (Hung, 2011; Hamalainen, 2011) and also the implementation and development of curriculum (Tiberghien et al, 2009; Leeman and Wardekker, 2011). DBR may be one potential approach for practically realising the conceptual framework ideals of TPACK. However, much of the literature appears to focus more on the complexities of ensuring the iterative development of resources and artefacts, together with understanding the processes of teaching and learning within the classroom. The development of sustainable practitioner change is less explicit and therefore whilst DBR may indeed have much to offer in developing the pedagogic understanding of practitioners in their use of technology little consistent and explicit evidence exists that this has been a direct consequence of the use of DBR. However, where DBR does show some signs of being part of a framework in aiding pedagogic understanding and development is in its synthesis with lesson Study (Lewis et al, 2006).

Lesson Study is a common approach in Japan, used to develop student learning through collaborative development of lessons. It is based upon a simple cyclical process where two or more teachers act together to identify learning challenges experienced by students which then acts as a basis for collaborative planning, teaching and evaluation (figure 1).

Planning is completed as a group, leading to the design of a 'research lesson' which is developed with the express intention of attempting to ameliorate the learning challenges faced by the students. Such planning meetings rely on detailed and critical discussion of approaches to learning and how these will aid student understanding. Once the research lesson has been planned, it is then taught by one member of the group, whilst the remaining individuals observe the students to assess the degree to which the learning is occurring as was predicted during the planning meeting(s). In

some variations of lesson study, each observer will only focus on two or three specified students in an attempt to concentrate their attention.

Once the research lesson has ended the lesson study group meets to evaluate the evidence from the observation focusing on the degree to which learning has taken place; the activity of the teacher is of secondary importance as it is the learning which is being considered rather than the 'performance' of the teacher. The discussion within the evaluation meeting may lead to suggestions for amendments within the lesson plan, and where possible these are tested in a second research lesson with a parallel group.

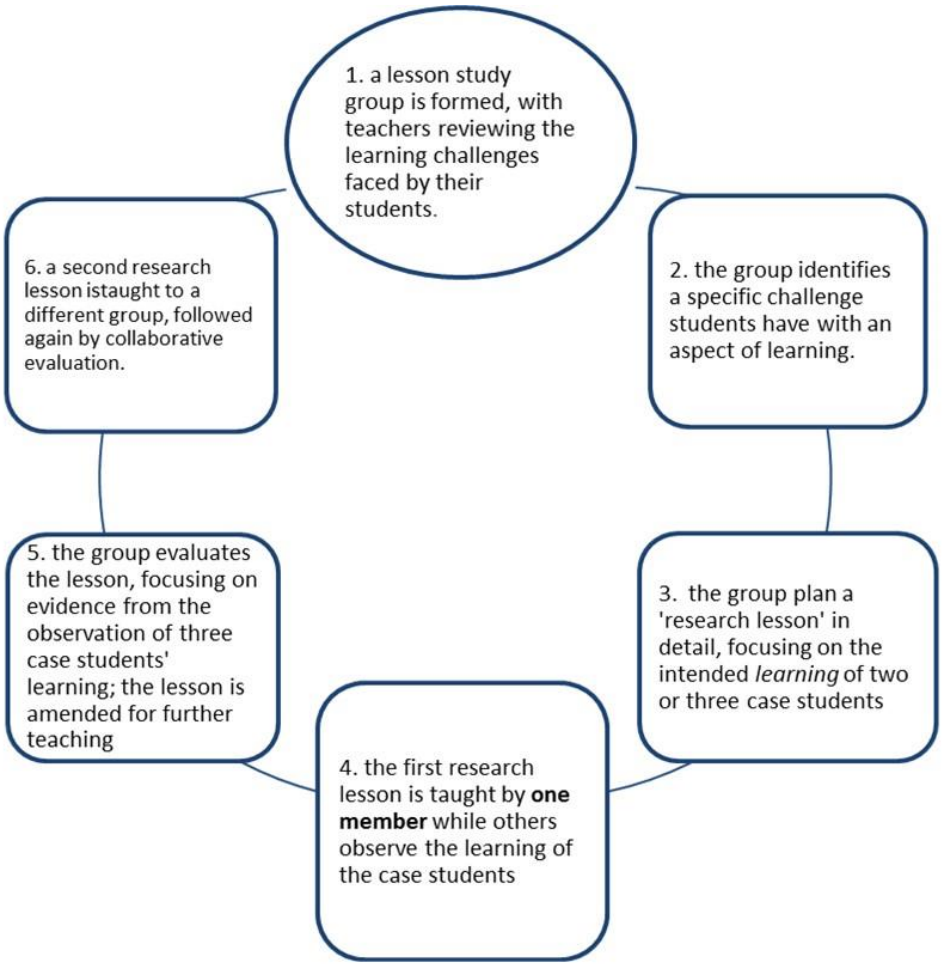

Figure 1. A basic Lesson Study cycle

The focus of lesson study collaborations centres on understanding learning and developing pedagogy. Following on from the work of Lewis et al (2006) this small-scale case study centred on attempting to bring together elements of both DBR and Lesson Study as a potential methodological vehicle for realising the conceptual potential of TPACK. The bringing together of these two methodologies has initially been termed Lesson Design Research.

In attempting to establish initial small-scale evidence for the utility of this approach the research questions posed in this project were:

1. To what extent can a hybrid Lesson Design Research (LDR) approach aid in the integration of technologies and pedagogy in classrooms?
2. How successful is LDR in aiding the development of:
    - Student centred learning
    - Greater understanding of the curriculum by students
3. To what extent can LDR aid sustainable development and utilisation of technologies in classrooms?

Context

This case study was undertaken during the 2012-13 academic year and was completed at an urban sixth form college (a school for 16-19-year-olds) in the East Midlands, England. The curriculum area under consideration was an AS-level module focusing on UK politics and government, part of a wider Advanced Level (16-18 year olds) politics course. The student group (20 students in total) was diverse both academically, ethnically and included students who had come directly from school as well is a small number of individuals returning to education having previously left full-time study.

The study involved research and development conducted by two educational professionals. The full-time classroom teacher is an experienced professional who has taught across a number of subjects within the social sciences, predominantly with 16 to 19 year-old students, as well as having wider responsibility for school-based teacher training in partnership with several universities within the region. However, this individual has shown little confidence in the use of technology as a pedagogic tool, with little initial technical knowledge or understanding of pedagogic application. The second collaborator is a senior lecturer at a local university who has been involved in both technology-based research and practice, specifically as the programme leader for a distance learning Masters course in education and who previously worked for 10 years in secondary schools (11 – 18 years old) in the East of England.

The project

The project was intended to foster an approach to curriculum and pedagogy which would develop the ability of students to make the link between political theory and political current affairs. This is a core element of their A-level study within the politics course, as they have to be able to demonstrate an awareness and critical appreciation of current political events as part of their examination response. However, the teacher identified this link between theory and current affairs as being the central learning challenge faced by the students within their studies. As a consequence, we began by considering ways of developing the link between these two issues and it was decided at an early point that an approach integrating the use of technology would make this element of the course more attractive to students and help them develop their learning. It was at this point that a basic form of DBR was used to consider the development of the medium-term curriculum plan which would then underpin the development of the link between political theory and current affairs. As part of this plan, it was decided to utilise some basic technologies as a medium for developing student work (figure 2).

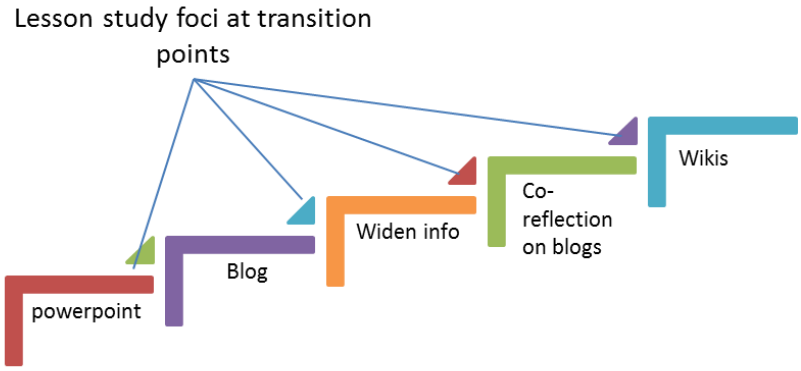

Figure 2 Initial outline medium term plan for technology integration into the curriculum

The initial design in helping to develop students' ability to find and handle information, with subsequent issues of relating current affairs information to political theory, focused on the use of Web 2.0 technologies to encourage the students to search for information and write about it in relation to political theory. 20 students were split into 4 groups. Initially, two groups analysed one newspaper each week, whilst the other two groups analysed an alternative newspaper with a different political outlook. Each week students were then asked to create a PowerPoint presentation focusing on an issue of their choice taken from their newspaper and relating it to political theory. After three weeks, students were introduced to the production of blogs (only 3 of the 20 had experience of writing their own blog at the start of the process). Each student was asked to complete at least two individual blog posts each week using their newspaper as a base for information. Again, after three weeks, the students were introduced to 'policy unit' websites e.g. IPPR, Policy exchange. Those using a 'socialist' newspaper were asked to use the Policy Exchange website (a neoliberal policy unit), and those reading the neoliberal newspaper were asked to use the IPPR website (a generally social-democratic policy unit) so that information from different political bases was considered, the two sources together acting as the basis for the blog posts. After a further three weeks, students were then paired up with a student who had been looking at the newspaper/policy unit opposite to themselves. They were asked to comment online to each other using the comment facility. Finally, after a further three weeks, the students were asked, in pairs, to choose a current issue from those they had blogged about and create a final wiki page which considered and explained an issue of their choosing, relating it to the political theory they had considered.

Having designed the curriculum approach with associated discussion of the types of technology that might support student learning, we then decided at which points within the curriculum plan the use of lesson study would help to develop a deeper understanding of how the technology would be embedded pedagogically in supporting the learning of the students and the work of the teacher. Initially, this led to the planning for four research lessons, each one the transition from the use of one technology to the next so as to support the teacher through explicit discussion concerning how the technology would be embedded within the learning of students (figure 2).

Method

This project is a small scale pilot case study, and as such the evidence collected over the course of the project consists of three main sources of data:

1. the recording of planning and evaluation meetings using an electronic recorder;
2. the completion of an interview at the end of the process to gain an understanding from the classroom teacher as to what they believe they have gained from participation in the project;
3. observation notes completed by the University partner during the research lessons.

Initially, the intention was to carry out four research lessons but due to an evolving focus within the work which led to an amendment and simplification of the technologies used only two lessons were eventually plan, observed and evaluated.

The recordings from meetings and the interview were transcribed and analysed through thematic coding to understand the foci of the discussions involved and in the case of the final interview the opinions of the teacher relating to the development of their own pedagogic practice.

Results

The project began with an initial planning meeting in November 2012 where the basic approaches of both Design-Based Research and Lesson Study were outlined, before moving on to consider the learning challenge which the students faced. This led to the identification of an issue relating to the work of the politics group,

'…the problem of the changing nature of politics is an issue because they want something that is static and they don't realise how it's always changing and bringing in the latest events and news… Current affairs is an issue.' (teacher researcher)

'…and marrying that up with basic political science theory… There is no way they can get a higher grade without applying it contemporary society. They want to talk about whatever is in the textbook… But it's trying to bring in whatever is the latest.' (teacher researcher)

The resultant learning challenge was identified as how students approach and critique current news stories through the lens of political theory. This also involves understanding how to find and handle information. The classroom teacher also highlighted that to do this the students would need to develop their understanding of how to find and handle information,

'so there are issues around information handling…. Information mining, and applying it to the political theory.' (teacher researcher)

It was through this initial discussion that the medium-term curriculum design shown in figure 2 was developed as it was agreed by the two researchers that the use of a technological intervention would be an efficient sensible way of encouraging information mining and handling. Subsequent to the initial meeting, the University partner took the initial learning challenge insights from this discussion to create this framework, including the pattern of research lessons.

As will be discussed below, the initial designed curriculum format was altered as the research unfolded in reaction to the emerging results from the early research lesson results and due to external pressures at an organisational level. The results below are considered in relation to the three original research questions.

Lesson Design Research as a vehicle for integrating technologies and pedagogy in classrooms

In the early phase of the project, the concern was with designing an overall structure for the curriculum and this was completed by firstly identifying the learning challenge and then using past research completed by one of the participants as a basis for creating a model in this particular context. By focusing on curriculum and pedagogy as overarching principles within which technology would be embedded it was very clear to the teacher researcher at an early stage what the overarching principles and approach of the research would be.

'it's an iterative process where the pedagogy is driving the process…but at the same time you can keep dipping into an evaluation of the technology itself in helping you deliver that level of effective teaching, pedagogy, I get it.'

This was confirmed during the end of project interview with the teacher researcher, when she highlighted a secure understanding of the notion of the project being centred on planning execution and evaluation, together with the embedding of lesson study to act as a medium for understanding student learning and emergent issues.

'The conversations that we had was planning, the planning process of how they are going to be learning how we are going to measure it. What the purpose of each stage…. The planning process between both of us, rejigging everything that was of great value…'

Much of the DBR literature implicitly approaches the process from a standpoint of design and testing. The initial design of the medium-term curriculum plan was based upon the embedding of technology as a way of handling information, but the addition of lesson study gave a level of flexibility and constant detailed iterative feedback in a more holistic way. As a consequence, both researchers understood Lesson Design Research (LDR) as a vehicle for holistic consideration of the learning challenge which allowed for a level of both coherence and freedom, the result of medium term planning followed by constant updating and detailed consideration of the emerging issues and change. This was particularly the case in the opinion of the teacher researcher who found the approach both useful and professionally liberating.

'In schools everything is set in a very set action plan way almost like doing a scientific experiment. We've evolved with the needs of the learners and when you observe and when we reflect on what we were doing all of these other issues were coming to our attention and we were addressing them as we go along. So rather than stick on track for a final product when you get one result or a result in line with that we've address so many issues. Having the opportunity to do that as a full-time teacher you don't have much time to reflect on all of these issues, embedding technology in your teaching. It is very holistic and very wide reaching and we ended up having conversations about learners in terms of their way of accessing information about how hard it is to measure learning, about assessment for learning. We've had all of these different types of conversation during our lesson study even though we had a primary goal which was using the technology. It has allowed us to have very constructive conversations about other elements pedagogical issues that are always going to improve the experience for them and you so I found it very useful.'

Both researchers believe that by integrating an explicit medium-term design concerning the use of technology and pedagogy through consideration of curriculum with the detailed planning, execution and evaluation of chosen lessons which Lesson Study offers, LDR may have the potential to integrate technologies and pedagogies together within the classroom.

LDR and the development of student learning

Before the project started the teacher researcher identified issues relating to students not being able to make the link between current affairs and political theory, the insight which led to the chosen learning challenge. This included little discussion, and the tendency for students to show little interest. However, once students started to use the blogs on a regular basis there appeared to be a change in their engagement with their learning, and a far greater degree of synthesis of current affairs issues and political theory. This appears to have had the additional impact of students feeling more confident and knowledgeable about the use of theory leading to changes within classroom sessions, for example the teacher researcher commented:

'For the first time we had discussions. You always say to students don't just copy and paste in news review. It almost changed the nature of what they were doing, the key terms things you always are emphasising to them when you were doing another activity. But it changed the nature of the conversation and their learning.'

The use of PowerPoint at the start of the project served the purpose as a stepping stone from general discussion within the lessons which had been unsatisfactory in bringing a level of critical engagement and understanding, but the introduction of the use of blogs appears to have had the most positive impact on student engagement and learning not only impacting upon the level of understanding by students, but also apparently on their writing skills.

'One student said that having to do it individually meant that he was improving his writing skills. I don't know why, but in general discussion they said that they are more likely to copy and paste into a PowerPoint slide than they are into blogger. There was a class consensus about this.' (Teacher researcher)

In the latter part of the project, the development of peer assessment and the use of the wiki were abandoned, as a focus on exam preparation became more important. As part of this new focus, greater consideration was given to the role of feedback to students and how blogs might be utilised to support this process. A simple process of 'double hand in dates' was established where students were given feedback on their first response, and given a second date by which amendments needed to be resubmitted so that improvement in learning could be measured. This was adopted but through the medium of handwritten responses rather than through the use of the blog. Students were very positive about this development, and resubmission data demonstrated a greater level of learning through active engagement with teacher comments. A framework for using blogs and comment boxes was developed for use in the next academic year.

The role of LDR as a method for creating sustainable development and utilisation of technologies in classrooms

in the end of project interview, the teacher researcher reflected on how her perception of technology, in this case blogging, and its relation to her teaching has changed,

'I wasn't particularly confident with managing all of the blogs, how I was going to do that. I didn't get exactly what I wanted. Now I know what I want, for example, I wanted it to be all of those web addresses on my moodle site. We've got all the students who are enrolled on my course, all of their assignments, their submissions, and I wanted their blogs so I could literally do both.'

At the start of the process she was not particularly confident having done a small amount of blogging herself but lacking any real knowledge other than how to create a simple post. As a consequence, as the quote above suggests she was not sure as to how blogs could help her pedagogy and the learning of the students. Through the process of discussing a curriculum framework and then by detailed discussions in planning, execution and evaluation she now has a much clearer understanding of how the technology can be used pedagogically and has a better knowledge of some of the core functions of the technology itself having learned these through the context of her activity as a teacher. Having come from a position where she saw technology and pedagogy as two separate entities (as in the quote below) she now has a clearer understanding of the pedagogic worth of blogging and how it might be further integrated into her practice in the future,

'I'm going to deliver it so much better and I've got ideas of so many other things that I can do like the exam questions, giving them feedback and having a bank of questions and maybe then correcting their work. It's what you said, I first had a conversation with you about using ICT and to me they were very separate things but now they are very much embedded and it's a tool that is helping me.'

Perhaps one of the important reasons for the success of the adoption of technology in this case, and its alignment with classroom pedagogy was the fact that from the beginning technology was seen as an embedded tool useful in its worth as an additional approach to solving a pedagogic problem rather than being seen as the central element in the development of the project. This is apparent in a strand of discussion which developed over the course of the project on the use of blog tagging which initially started as a way of indicating the underlying political theory which was related to a current news issue, but which ultimately led to a potential way of differentiating the learning by allowing some students to create their own tags whilst suggesting tags to other, less able students as a way of supporting their thinking. This integration of a technological solution to a pedagogic problem is illustrated in the quote below.

'but the technology wasn't taking over, it wasn't about you've got to do this. The mechanisms of the technology, technology was enabling us to think about well how are we going to learn this better or reworked the learning. For example about tagging, tagging wasn't about how you are going to tell me how to tag it was about which tags, it was about them realising what keywords and these key articles, examples you can bring out in an exam constantly. And it was that conversation that was valuable. And it's actually been valuable to the students.'

The Lesson Study element of LDR was emphasised in this respect by the teacher researcher who talked about the fact that much in-service teacher training tended to focus on technology as a separate issue which tended to concentrate on the technical aspects involved. The planning and evaluation discussions inherent to Lesson Study allowed the technology to be seen as an embedded tool,

'Yes, and also its lesson study allows you from the very first minute you plan the first minute to start considering it as an embedded tool. You go to a lot of technology in the curriculum meetings that very separate things, this is what technology does and this is what it could do you and this is how you do it. This was a simultaneous process which is super valuable.'

This meant that by the end of the project, the teacher felt confident about the use of blogs and how they might be utilised in the future to aid student learning further. The quote below illustrates this clearly with blogs being conceptualised as a tool which will allow students to engage to a greater degree with writing, understanding and ultimately with exam preparation.

'so we've got the idea of blogs, they've started writing on the blogs. By what you're saying they're getting a far more focused way of writing about examples. We are now using the blogs as a vehicle for getting those examples into some form of longer answer, with hyperlinks they're drawing in information and beginning to think about 5, 10 and 25 mark questions and then what we can do is meet early next term to think about the utility of using the blogs as a jump off point for beginning to prepare for exams.'

By focusing on a pedagogic and curricular problem, LDR, and particularly the lesson study component, allowed for a number of continuing discussions to be developed focusing on student learning and enabling pedagogies. Given her success in including an aspect of technology as an emerging solution to the learning challenge, there is strong evidence that this led the teacher to have the basis for sustainable and confident us of blogs to address other pedagogic challenges. Indeed, as some of the comments above suggest this has also led to initial consideration of how the use of other technologies can be incorporated within future pedagogic approaches.

Discussion

Design-based research and lesson study have both been demonstrated as acting as useful approaches pedagogic change and innovation (for example, Lewis et al, 2006; Chang, 2011). DBR achieves this through the use of theoretical frameworks and an approach which centres on design. However, where technology is concerned there can still be a tendency for the technologist to develop the detail of the pedagogic approach, with the teacher acting as an implementer. Lesson study is more concerned with the detail of understanding the action of learning and using pedagogic insights to discuss the creation of detailed plans, leading to observation and evaluation to test and understand the dynamics of the learning, and to a lesser extent teaching, which result. We argue that by bringing these two perspectives together, the resultant approach emphasises the strength of each. This leads to a relatively simple approach which consists of three elements:

1. **Identifying the learning challenge:** the first stage of the process is taken from lesson study and requires the researchers to consider the pedagogic context in which they are working, and through this decide on a particular learning challenge they believe students to have. This then gives the focus for any subsequent developments within a project.
2. **Developing the medium-term framework:** having established the learning challenge, members can decide on the theoretical basis for their work relating to that challenge. From this, design-based research approaches can be used to create a medium-term curriculum plan, and where necessary some form of technological development. This gives the project initial form and direction and allows participants to identify points which they believe will be critical to the development of learning which can then become the foci for the use of lesson study.

3. **Engaging with pedagogic change:** the use of lesson study to consider new pedagogic approaches, including the embedding of technology, flows directly from understanding the wider curriculum form and change. Importantly, it is in this element that critical, sustained and deep discussion can be fostered and the personal expertise of different members of the group exposed in a collaborative and developmental way. In addition, the observation of learning and the use of evaluation link to learning processes and outcomes allows for iterative development, and ensures the freedom to change the direction of the initial plan where this is desirable. As such it ensures that the quality of learning remains the centre of development as opposed to being secondary to the development of an artefact or resource, the utility of which may lessen if initial objectives are not flexible.

TPACK as a conceptual framework rests on the interplay of subject knowledge, pedagogy and technology. Mishra and Koehler (2006) emphasise that a consideration of technology which is divorced from either of the other two aspects of their model will most likely be inappropriate. The results from this small-scale case study suggests a practical method for realising the interplay of these ideas and may serve as an approach to the successful embedding of technology within wider pedagogic systems in classrooms. However, we would go further in arguing that TPACK is only a subset of the wider concept of 'pedagogic literacy'.

Cajkler and Wood (2013) define pedagogic literacy as the broad-spectrum of skills and understanding that are required to be a successful teacher. They suggest that,

'Pedagogic literacy includes teacher skills that are general in nature, for example understanding of learning and learners; context-related skills such as knowledge of the school and departmental cultures and its working practices, team work and collaboration, as well as the specific but interdependent professional skills such as lesson-planning, use of questions and understanding of various teaching approaches. The concept also includes teacher beliefs and values, philosophies of teaching, including attributes such as commitment to professional development, reflection on practice (Schön 1983) and respect for learners and colleagues. Growth in pedagogic literacy represents a continuum of teacher development composed of learning from a very long and wide range of experiences, including critical reflection on one's own learning experiences in instructed settings, through to the acquisition of theoretical understanding in teacher education programmes and reflective practical teaching skills from school placements early in one's career. The process continues throughout a teaching life leading to ever greater understanding of teaching as a social phenomenon, of the recursive uneven nature of learning and the wide diversity of learners.'

(Cajkler and Wood, 2013, 16)

This comment ranges from contextual factors which are important within any particular learning environment, the work achieved through interaction with others, understanding of approaches to teaching and learning together with personal belief systems. It also suggests that continued interaction and personal development of vital to the development of that literacy. Augmenting subject knowledge, developing critical approaches to pedagogy and understanding of technologies and their role within teaching, the central tenets of TPACK are part of this, but do not cover the full breath of the notion of pedagogic literacy.

Kopcha (2012) in referring to the barriers to the use of technology highlighted issues around confidence, beliefs and professional development. The evidence from this preliminary small-scale case study suggests that through collaborative discussion and development of pedagogic literacy these barriers can be overcome. However, it has to be understood that to achieve such a positive response requires an open-mindedness on part of the participants, and a willingness to dedicate time as insight and personal understanding comes from sustained discussion and participation; the use of lesson design research is not a 'quick fix' solution.

Initial conclusions

This small-scale case study demonstrates some very positive results, but due to its size cannot offer any claim to generalisation. However, it does suggest some important principles which could be usefully considered and pursued in greater depth and at a larger scale. The teacher researcher in this particular case study was committed to developing her practice; how would the approach translate to larger groups of teachers where a greater variation in the level of motivation and engagement as well as a greater variation in prior technological understanding would be a given?

We believe that the basic model outlined in this paper would be a good starting point for further consideration and development and we believe that it should be seen as one element of a wider movement towards professionals considering, developing and extending their pedagogic literacy. Consideration of theoretical frameworks such as TPACK would be essential element to such work but should be seen as only a partial conceptualisation of pedagogic activity, development and innovation.

Finally, we argue that one of the additional benefits of an approach such as lesson design research is that it begins to break down the practitioner researcher divide. Both groups bring expertise to discussion, leading to all participants having the opportunity to extend their pedagogic literacy. University researchers may have a greater understanding of theoretical frameworks and possible approaches for evidencing the impact of the developments undertaken, whilst the classroom practitioners bring their innate understanding of the classroom environment and the specific contexts within which they work to inform a deeper level of discussion and evaluation of their learning and pedagogic developments undertaken. Such an approach can only be of benefit to both parties.

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