Further findings of an international D&T teacher education research study: the DEPTH2 project

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Abstract
This paper reports a series of case studies from the new phase of an international project – Developing Professional Thinking for Technology Teachers (DEPTH2). The first phase of the project was a study conducted with both primary and secondary technology pre-service teacher education students in a number of different countries who were given the same teacher-knowledge graphical framework as a tool to support reflection on their professional knowledge. We discovered that, despite the different country contexts, student teachers of technology could articulate aspects of their developing teacher knowledge using the same framework for teacher professional development. The common graphical tool enabled them to set out their subject knowledge, pedagogical knowledge and ‘school’ knowledge and was useful in helping them become more self-aware (Banks et al 2004). In this second phase of the project we have developed this line of research in two ways. First, we extended the range of participants to include experienced teachers involved in in-service work connected to curriculum development. Second, we looked at the inter-relationship for pre-service teachers between their developing professional knowledge and their own personal subject construct. In this paper, the framework itself is first described, followed by examples of investigations in train across five case studies showing the way that it has been used to illuminate technology teacher knowledge in each case. Lessons are drawn for each country specific investigation, and some wider conclusions are made that have implications internationally along with some suggestions for further work.

Key words
teacher professional knowledge, personal subject construct

Introduction
Despite the widespread use of the term ‘reflective practitioner’ (Shon 1983, 1989), there is little agreement about what is meant by ‘reflective practice’. Calderhead (1989), for example, has described the notion as a slogan rather than a principle. However, in the light of our findings we would strongly argue that reflection on practice is more successful if a teacher (or any professional) is provided with a 'tool', an easily usable framework that will help them consider aspects of their professional knowledge in the widest sense, yet grounded in their subject. It was with a view to discover the impact of an enhanced awareness of teacher professional knowledge on school technology teaching and learning that a pilot project was conducted in the UK in 1998 followed by phase 1 of DEPTH in Finland, Canada and New Zealand and other institutions in the United Kingdom with student teachers (see Banks and Barlex 1999, Banks et al. 2000, O’Sullivan 2001). In phase 2 we have discovered that the graphical tool can also be used in interesting ways with experienced teachers and is able to reveal greater insights than previously investigated into the impact of a teacher’s personal subject construct.

A framework for conceptualising teacher professional knowledge
In their observation of teachers Leach and Banks (1996) noticed that success or failure of student teachers was often linked not only to their university subject knowledge and their choice of pedagogic strategies, but also to their appreciation of how the subject is transformed into a school subject. They called this ‘school knowledge’. These colleagues produced a graphical framework, a pictorial model of teacher professional knowledge (Figure 1). (See Banks, Leach
and Moon, 1999, for an explanation of the theoretical background to this work).

One might initially see ‘school knowledge’ as being intermediary between subject knowledge (knowledge of technology as practised by different types of technologists for example) and pedagogical knowledge as used by teachers. This would be to underplay the dynamic relationship between the categories of knowledge implied by the diagram. For example, a teacher’s subject knowledge is enhanced by his or her own pedagogy in practice and by the contextual expectations which form part of their school knowledge. It is the active intersection of subject knowledge, school knowledge and pedagogical knowledge that brings teacher professional knowledge into being.

Lying at the heart of this dynamic process is the ‘personal subject construct’ of the teacher, a complex amalgam of their past experiences of learning, a personal view of what constitutes ‘good’ teaching and a personal belief in the purposes of the subject.

This underpins a teacher’s professional knowledge and is important for any teacher, experienced or novice, as it is in a dynamic relationship with their attitudes to the value of professional educational experiences and the impact such events could have to change practice. Teachers judge training events, for example, in relation to their personal view of the subject as well as their professional needs but that personal subject construct, in turn, is adapted by such professional development events and in conversations with colleagues.

The following cases show the tool used in a range of contexts. The first two are in-service examples and the remainder pre-service.

Case 1 – Edith Cowan University, Western Australia

Context
The DEPTH framework was used as a structure in which to identify gaps in professional knowledge as a basis for the design of the content of the professional
development for teachers involved in the introduction of a number of new subjects for implementation at the post compulsory level in secondary schools; that is the last two years of schooling.

The Study
Sixteen teachers from the trial schools for Engineering Studies were provided with the model and explanation of the DEPTH framework. They then took the framework back to their schools, and in collaboration with the technology teachers in their departments, filled in the areas of professional knowledge in which they felt deficiencies existed. A summary of their responses follows.

School Knowledge
The teachers identified a range of school-related knowledge they perceived as being required in order to successfully implement the Engineering course.
In Australian secondary schools the subject departments tend to be isolated and work independently from each other, yet a subject such as Engineering requires a co-ordinated approach to its delivery. The need for education of all subject stakeholders was expressed as vital to ensure that Engineering was seen as something different from the traditional vocationally oriented offerings.

Pedagogical Knowledge
While all 16 teachers felt comfortable with their general pedagogical abilities to teach Engineering, a recurring concern was the ability to manage a group of up to 20 senior students who are all working on individualized engineering design projects which may be quite different from each other, and consequently all the students would have different needs and demands. The other common concern was the ability to teach and assess design at this level.

Subject Knowledge
Two overriding areas of concern for all teachers were their lack of knowledge about both the engineering industry and the prescribed curriculum content. Unlike the Technology curriculum framework for the compulsory years which has no prescribed content, the Engineering Studies course has specified content.
Case Study 3 – Massey University College of Education, New Zealand

Context
After a review of the undergraduate primary pre-service programme at Massey University it was decided that the number of courses should be reduced. Faced with this reduction, staff working in the areas of Science and Technology Education decided to offer a combined compulsory science and technology course in the third year. Based on the success of using the DEPTH framework (O’Sullivan, 2001) it was decided to incorporate a further exploration of the DEPTH model to ascertain its usefulness in identifying areas of concerns for students undertaking this new integrated curriculum course.

The Study
The previous study at Massey had identified that primary teachers who were engaged in the BEd (Tchg), degree were comfortable in the areas of school knowledge and pedagogy. Therefore it was decided to focus on Subject Knowledge and the personal subject constructs. Of course an additional focus would be on curriculum integration and whether the framework would offer the students an opportunity to self reflect on their understandings and views of Science and Technology Education as well as curriculum integration.

This integrated course has at its core a problem based learning (Ward & Lee, 2002) instructional strategy. This had been identified by the staff involved as a way to allow the students the opportunity to:

- Become authentic stakeholders in their learning.
- Identify key facets of Science, Technology and Curriculum Integration.
- Participate in a learning environment which modelled a useful classroom approach.

The DEPTH framework was used at the start of the course as a diagnostic tool to help identify the students’ current understandings and later as a self reflection tool to help identify growth or change.

Early initial findings have confirmed the importance of placing and timing of courses within teacher education programmes. Students personal subject constructs were dominated by aspects of Science rather than Technology, perhaps due to the closer proximity of courses as some students had not undertaken a technology course since their first semester at University, and this was reflected with an over dominance of Science outcomes in the problem-based learning (PBL) integrated assignment.

Case Study 4 – University of Wolverhampton, UK

Context
This research was conducted with a cohort of one-year PGCE students. It was intended to use the DEPTH framework to discover what ‘professional knowledge’ the students had at the start of the course and how this developed over the course. The course consists of five modules:

The Study
There were 11 students in the cohort, six male and five female. The research data was collected at three points at the beginning, middle and end of the course.

Subject knowledge
Students’ awareness of what constitutes subject knowledge in design & technology in schools appeared to be low at the start of the course, but there was an understanding that they would need to keep up-to-date. Subject knowledge is an aspect of professional knowledge that is easy to identify and articulate, yet it appears to be difficult for the students to separate out their own subject knowledge and what they are required to teach in schools.

Pedagogical knowledge
At the start of the course this aspect produced a limited list of what knowledge/experience the students already had. Two students mentioned specific teaching techniques and three made general statements about the ability to adapt to pupil differences, being approachable and having a good understanding of people. The list of what they needed to know was long. After their first school placement the lists of what they know and what they needed to develop were more balanced. There was, however, little commonality and what they still needed to learn was also highly personalised. However, by the end of the course most students felt that they had developed their range of teaching strategies and were better able to differentiate.
School knowledge
This was the most difficult concept for the students to grasp; they focused on knowing and understanding the school context rather than school knowledge of design and technology. Initially the students thought that they knew very little about school knowledge, but by the end of the first placement they identified a long list of knowledge and only a few areas for development. At the end of the course the students’ understanding of the school knowledge had become much more sophisticated. They identified that they had a wider understanding of schools, they appreciated that all schools have systems, procedures and policies but that these varied between schools.

Personal constructs
It is difficult to separate out how individual personal constructs have influenced professional development. The students educational experiences varied significantly, with two describing overseas’ schooling. What this research activity did do, however, was help the students to become aware of their own personal constructs and how they might impact on their learning and development, and their classroom teaching.

Case Study 5 – Roehampton University, UK
Context
This investigation was in two parts. In part 1 a cohort of 28 secondary design & technology PGCE trainee teachers were asked to give their reasons for believing that design & technology should be included in the secondary school curriculum for all pupils to provide a background for their responses in part 2. Part 2 explored trainee’s teaching experience. They reported in writing on a designing and making assignment they had taught identifying subject knowledge they thought necessary, describing the pedagogy they used to teach the assignment and the influence of the school on the nature of the assignment and how it was taught.

The Study
A preliminary analysis of the data from Part 1 has revealed that their rationale for the inclusion of design and technology can be formulated into five main groupings
• Engaging in designing and making (20%),
• Appreciating the relationship between technology and society (20%),
• Providing a cross curricular learning environment that supports pupil’s autonomy through individual and collaborative learning (20%),
• Developing creativity and thinking skills (17%),
• Learning for employment and everyday life ‘outside school’, (13%).

A preliminary analysis of the data from Part 2 has revealed that the majority of trainees were able to identify appropriate subject knowledge, taught designing strategies as well as making skills in their teaching and most were able to comment on the influence of the school on the way they taught the assignment.

Conclusion
This series of case studies illustrates a number of key implications for those involved in technology teacher education.

We would suggest:
• The context and school curriculum engaging technology teachers may vary around the world, but their professional development concerns are similar and can be brought to the surface using a common and ‘teacher-friendly’ graphic device.
• Teachers professional development changes with experience and a framework such as that used in DEPTH can help track those developments
• What teachers see as important is predicated on their professional subject construct. This belief in what constitutes ‘good’ technology teaching is very important in pre-service teacher preparation but also colours the attitude of experienced teachers to in-service course provision.

The DEPTH project team see the iterative nature of a teacher’s personal subject construct which they bring as a pre-conceived ‘given’ to teacher-development courses and which is shaped (or not!) by those development experiences as an important area for further study which will could have a profound effect on how we plan such events.
References


