DEPTH2: Developing professional knowledge in D&T secondary initial teacher education

Journal Item

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DEPTH2 - Further findings of a D&T teacher education research study

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Abstract

There are various aspects to teachers' professional knowledge, some such as subject knowledge are more easy to articulate than others, for example knowing how to construct a scheme of work. Student teachers need to be able to understand the various aspects of teachers' professional knowledge in order to be able to help themselves reflect on and develop these various aspects.

This research builds on earlier work conducted with design & technology colleagues in a number of different countries and teacher training institutions (see Banks et.al 2004). The original study grew out of the work of Leach and Banks (1996) at The Open University, who noticed that the successful development of student teachers depended not only on their subject knowledge and their choice of pedagogy but also 'their appreciation of how the subject is transformed into a school subject' (Banks et.al. 2004).

Leach and Banks, together with other colleagues, developed a visual tool for discussing the aspects of professional knowledge that student teachers are required to develop and this formed the basis of this research.

The research was carried out with a cohort of one-year PGCE students on a conventional face-to-face programme. There were 11 in the group with six male and five female and the majority were aged under 25; this is atypical of this course both for gender and age, but this constituted the 2004-05 intake. There were three data collection points: September 2004, on their first day of their course; January 2005 following their first school placement and June 2005 at the end of the course.

The findings indicate the students' development across the PGCE course in each of the areas relating to knowledge of subject, pedagogy and school. In each area there is a growth in their knowledge and a development in the complexity of their understanding. The students' knowledge developed from a generalised understanding to a more specific and sophisticated one. It is

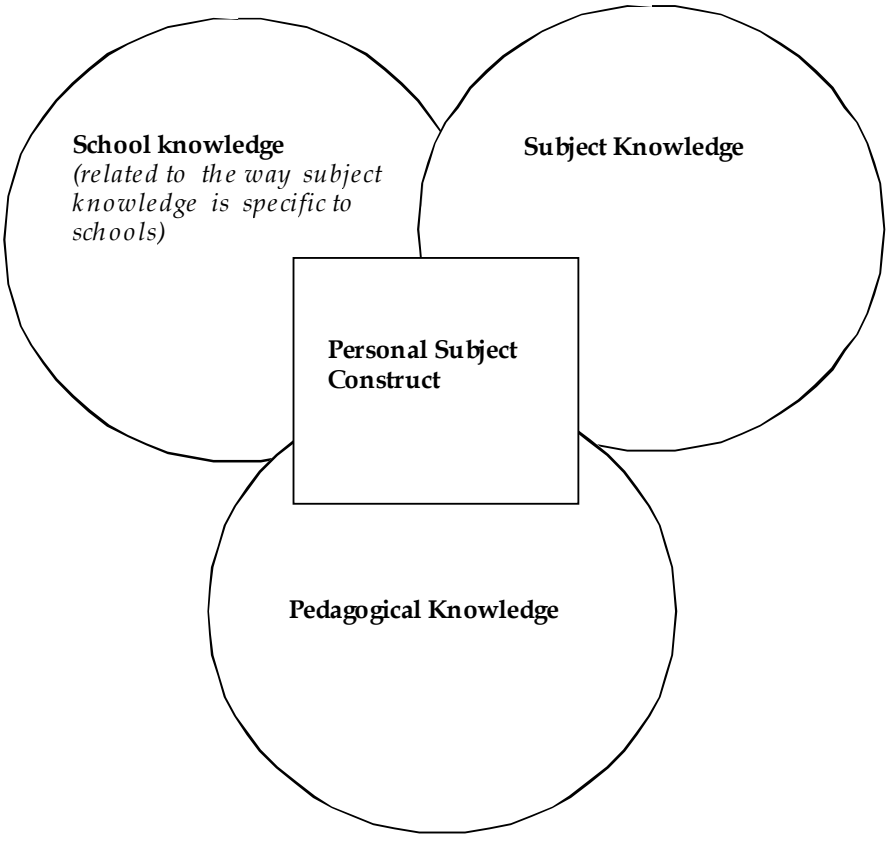
hoped to be able to continue this research during the induction year of each successful student.

Introduction

The term 'reflective practitioner' (Schon 1983, 1987) has become common parlance in teacher education, although there has been discussion about what it actually means (Calderhead 1989). It has also been claimed (McIntyre 1993) that 'reflection' on practice is difficult for student teachers because of their limited experience and limited time. However, this study grew out of earlier work with colleagues (Banks and Barlex 1999, Banks et. al. 2000, Banks et.al. 2004) which was designed to support design and technology student teachers in developing their reflective practice. The study also provided some insight into the effectiveness of the teacher education programme provided by the institution.

In the earlier work a visual tool was developed by Leach and Banks (1996) based on ideas from Shulman (1986), Gardner (1991), Verret (1975) and Chevellard (1991). It was also influenced by the work on situated learning by Lave and Wenger (1991). The model, shown in figure 1, classifies teachers' knowledge using the headings of: subject knowledge, pedagogical knowledge and school knowledge, all of which are under-pinned by the teacher's own personal constructs.

Figure 1 – a visual tool for describing teachers' professional knowledge (Leach and Banks 1996)



This model attempts to describe the various aspects of teachers' professional knowledge. Subject knowledge refers to knowledge of the discipline, its key questions, ideas and debates, for example in design and technology the practices of technologists in different fields. Pedagogical knowledge in this model refers to how the subject is presented to pupils, the illustrations, explanations and analogies used to help them understand the concepts and knowledge. School knowledge is the way in which the subject discipline is represented in schools, for example in design and technology the way in which 'designing' is taught as a series of sub-skills. This has been simplified by Banks et.al. (2000) as:

- knowing their subject
- knowing how to teach their subject
- knowing how to teach their subject in their school.

Personal constructs – the experiences, beliefs and values of each student which informs their view of education and teaching – are important aspects of developing professional knowledge as it has been shown that these play an important role in what student teachers learn (Massengill et. al. 2005, Poulou 2005).

It is acknowledged that models deconstruct and simplify the complexity of social realities but they do this in order to help us understand the situation. Here it was intended to help student teachers understand the various aspects of their own developing professional knowledge, with the understanding that – like learning to drive – the separate aspects are inter-related and have to work together in the classroom for effective teaching to take place.

Other researchers have formulated models (Silberstein and Tamir 1991, Marks 1995) focusing on qualified teachers' professional development and the development of the 'expert knowledge' of primary student teachers (Turner-Bissett 1999). Even government officials (Evans 2005) have produced a model to present 'a theorised view of pedagogy'! The models vary in detail but all present a deconstructed view of teaching whilst asserting that this is only in order to describe the complex nature of teaching.

Design and technology as a discrete subject first appeared in the English National Curriculum in 1989. It was developed from the subjects previously taught as woodwork, metalwork, home economics and textiles (early versions also included art, business studies and information technology). What united these subjects was the process of designing and making, where subject knowledge was brought to bear to solve problems or design improved solutions. Despite a shaky start, the subject is now firmly embedded in the school curriculum and is a popular subject with pupils (Datanews 2003, 2006). Student teachers of design and technology are required to focus on two specialist areas, selected from electronics and communications technology (ECT), food technology, materials technology and textiles technology.

Design and technology as practiced in schools is different from 'technology' studied in university or practiced in industry. This means that not only is a

student teacher's own subject knowledge important, but also his/her ability to transform this into 'school knowledge' in order to meet the requirements of the National Curriculum and examination specifications.

The research study

The study was qualitative, using an interpretative framework to discover how the student teachers perceived their own understanding of their professional knowledge, and how their perceptions developed over the period of their training. After each data collection point, initial analysis was undertaken and fed back to the students to verify or amend.

The research was conducted at a conventional face-to-face University in the West Midlands with a cohort of one-year PGCE design & technology students. It was intended to discover what 'professional knowledge' the students had at the start of the course and how this developed over the course.

The course consisted of five modules:

Module	Description
1	University-based. After three weeks full-time in the University the students begin to split their weeks, first spending one day a week in school, then two days, building up to four days. The time in school is spent on University-planned activities and observation of classroom teaching.
2	School-based. The students spend seven weeks in school on a 33% timetable, the remainder of their time is spent on completing University-planned activities, observation of classroom practice, lesson planning, preparation and evaluation and assignment preparation.
3	University-based. The students return to the University for a week, then spend one week in a primary school. After two weeks back at the University they begin to split their time between the University and school (a different school from their first experience).
4	School-based. This is a ten week school placement with students teaching a 66% timetable, with additional time spent as before.
5	ICT module. This is a year-long module which combines University work on ICT in their subject and a small action-research project in school.

There were 11 students in the cohort, six male and five female. The majority (eight) were under 25 years of age, two students were aged 26-35 and one was over 36 – this was atypical for this course, both in terms of gender and age profile, but constituted the cohort for 2004-05. All the students were specialising in materials technology and electronics and communications technology, but came from a variety of backgrounds, including design.

The research data was collected at three points:

- September 2004 – on the students' first day on the course;
- January 2005 – on their first day back in the University after their first block school placement of seven weeks;
- June 2005 – at the end of the course after a second block placement of ten weeks in a different school.

At each data collection point the model was discussed to ensure that the students' understood the terms. They were then asked to outline their personal constructs and respond to three questions:

- What subject knowledge do I have/need to acquire for teaching?
- What pedagogic knowledge do I have/need to acquire for teaching?
- What school knowledge do I have/need to acquire for teaching?

Findings and Analysis

Analysis was undertaken using interpretation and inductive analysis, looking at the relationship between the data and emerging findings (Ritchie and Hampson 1996, O'Leary 2004). It is acknowledged that a small sample such as this cannot be generalised but it is hoped that the findings contribute to the growing literature on student teacher development.

Responses from the students were analysed under each of the headings presented in the visual tool: personal constructs; subject knowledge; pedagogical knowledge and school knowledge.

Personal constructs - Values and beliefs inform not only what student teachers learn (Massengill et. al 2005) but also influence their classroom practice. Personal constructs may also be open to influence from the social context of the schools in which student teachers are placed (Lave and Wenger 1991).

The meaning of personal constructs and how these might have been developed were discussed and students were asked to note their age, gender and give a brief outline of their own educational experiences. Age and gender details are given above. The students educational experiences varied, with two describing overseas' schooling.

One female student (S3) wrote that she had been taught by all-male staff and that this 'sometimes proved difficult'. She went on to say that 'it could have been delivered differently by mixed teaching staff', indicating that she felt that as a female teacher she would teach differently to her male counterparts. Most other students simply noted their own educational experiences without reflecting on how these may impact on their own learning and teaching, except to say that their enjoyment of the subject had led them to want to teach it.

At the second data collection point the same student (S3) noted that she felt she had been 'influenced' by other teachers at her placement school through

observing how they taught. Others began to see the influence of some of their earlier experiences (S2, S6, S9), one commenting that 'my industrial placement influenced me in a number of different ways'.

It is difficult to know how individual personal constructs have influenced professional development, partly due to the students' limited ability to reflect on and articulate this. However, the research activity did 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.

Subject knowledge

Within design & technology, subject knowledge takes on a slightly different meaning from that given it by Shulman (1986), who implied that it consisted of a fixed set of material. In the National Curriculum in England, design & technology is characterised by its 'process' which uses subject knowledge to inform judgements made, where there are often no strictly right and wrong answers. There is, of course, a body of knowledge to be learned in design & technology – for example, characteristics and properties of materials – but the subject is more concerned with how that knowledge is used, or applied, than knowing just for its own sake. In the process of designing and making pupils may go beyond the teachers' existing subject knowledge, particularly at post-16 level when pupils are engaged on projects of their own choosing and following their own interests. However, underlying all this there are key concepts within design & technology and the visual model here was concerned with how well the students felt that they had an understanding of these.

It was found, though, that the students, despite the prior discussion, interpreted subject knowledge as referring to the four fields of design & technology and the content of these, rather than the overall key concepts and questions. This is understandable given the focus of their University training and the need to ensure that they have sufficient knowledge of an area to teach it during the school placement, but does indicate that it may be necessary to make students aware of the 'bigger picture' ideas within the subject.

Many responses indicated that the students felt they had a 'good' or 'sound' grasp of subject knowledge with several making reference to their A-level or degree qualifications. Only one, who was a foreign-qualified teacher, made reference to aspects of design & technology knowledge: metals, basic engineering, engineering drawing. Almost all (10) acknowledged that there were gaps in their knowledge or practical skills, some of these were specific, e.g. woodworking (S2), metals and manufacturing (S6), electronics (S7, S11). This was expected as the breadth of school-based design and technology means that the first degrees that allow students to begin the PGCE course cannot cover all the required subject knowledge. Several (3) also referred to the need to keep subject knowledge up-to-date, an important aspect of design and technology. However, despite a general understanding that subject

knowledge needed to develop/improve there appeared to be little understanding of what this might mean.

After the first school placement descriptions of their subject knowledge became more detailed; they referred to gaining knowledge, or identifying gaps, in specific aspects, such as electronics (8 mentions) and graphics (5 mentions). One student related the subject knowledge to key stages in school, e.g. KS3 woods, metals, plastics; KS4 product design. There were also references to knowledge of specific software used in the subject, such as ArtCam and ProDesktop. At this point, only two students referred to 'general subject knowledge', indicating that most of them had become much more aware of the specific subject knowledge required.

This trend continued after the second school placement. All students reported improvement in their subject knowledge, citing specific improvements, in electronics (S4, S5, S7, S11). In particular they felt that their knowledge had broadened and become more varied. Two students said that their knowledge of 'school projects' had improved. Seven also acknowledged the need to 'keep building on knowledge learnt' (S5).

Development of subject knowledge occurred through University training and school placements. Students' awareness of what constitutes subject knowledge in design & technology appeared to be low at the start of the course, but there was an understanding that they would need to keep up-to-date. Halfway through the course they had become much more aware of the specific knowledge needed to teach design & technology and consequently much more aware of their own strengths and areas for development. These latter were targeted during their second, final, school placement so that by the end of the course, whilst several still identified specific areas for development, most felt that they had grasped the basics and needed to continue to develop and improve their knowledge.

Subject knowledge is an aspect of professional knowledge that is easy to identify and articulate. Most design & technology courses begin with a subject knowledge audit so students quickly become aware of what they do, and don't, know. During school placements subject knowledge becomes a central issue, irrespective of what they may know about lesson planning, classroom management and the rest, if they don't know the subject knowledge to be covered then they feel vulnerable. However, the nature of the subject means that students will experience different aspects of subject knowledge according to the schools they are placed in. For example, some schools place a high priority on integrating electronics into pupils' work whilst others barely cover it. Some schools have plenty of ICT resources within design and technology, whilst others are poorly-resourced. The school placements, and what students were required to teach, will have had an impact both of what subject knowledge they developed and where they felt they still had gaps.

It was noticeable that, after the school placements, students' responses were directly linked to their school experience. This seems to indicate that development of subject knowledge is based on a 'need to know' basis rather

than any attempt to broaden general conceptual knowledge and understanding. Whilst this may be understandable for student teachers, given the time constraint and the imperative of assessment, it is hoped that this instrumental view of developing subject knowledge does not continue into their teaching careers. Design and technology thrives on teachers who are innovative and creative, not those only driven by curriculum or examination needs.

Pedagogical knowledge

At the start of the course their limited experience of teaching meant that the students were unable to fully grasp the intended meaning, in this model, of 'pedagogical knowledge'. They were concerned with 'teaching methods' or techniques and needed to become confident in these before they could begin to consider how they presented different elements of content. Initially, the students relied heavily on 'stories' from their University tutor and observations of their mentor when developing their pedagogical knowledge. Later they were able to share experiences, both mentor observations and their own teaching experiences, to be able to begin to build up their own repertoire of pedagogical knowledge.

In September, this aspect produced a limited list of what knowledge/experience the students already had. Two students mentioned specific teaching techniques, such as using the board (S2) and demonstrations (S2, S3, S11) and three made general statements about needing to adapt to pupil differences (S8), being approachable (S7) and having a good understanding of people (S9). The list of what they needed to know was long. The two main areas mentioned (6 mentions each) were learning a variety of teaching methods and the ability to differentiate – this second is laudable and it is interesting to note an awareness of differentiation at the start of the training course. Four students identified the need to know about assessment (S4, S5, S9, S11) . Interestingly, given the media attention to pupil behaviour, only two students identified the need to know about 'discipline'.

After their first school placement the lists of what they know and what they needed to develop were more balanced. One student (S1) commented that his 'eyes have been opened'. There was little commonality, however, in students' lists. What they felt they had learnt included: planning lessons (four mentions, two linked planning to what pupils already knew and to set targets); awareness of pupils' learning styles (two mentions); different teaching strategies – not identified (two mentions). Other, single, responses ranged from understanding the importance of 'relevance' to pupils; the need for a purposeful environment to the use of teaching aids. Only one student (S11) articulated specific techniques, learning how to do demonstrations and explanations 'so that pupils understand' and using different activities within a lesson 'to keep pupils motivated and on task'.

What they still needed to learn was also highly personalised. Five students identified the need to differentiate their teaching (S1, S4, S5, S11 , three identified the need to develop further their teaching strategies (S5, S6, S11) and two the need to improve classroom management (S6, S11). Other, single, needs included to improve time-keeping; to be more organised; to make lessons interesting and a deeper understanding of how pupils learn. Only one (S3) mentioned the need to 'chunk' lessons into starter, learning episode and plenary – this referred to the Key Stage 3 Strategy materials which had been taught in University sessions, but at this stage (2003) seemed not to be apparent in many design and technology departments.

By the end of the course most students felt that they had developed their range of teaching strategies and were better able to differentiate, one (S5) commented that this was due to 'observing good practice and given advice (sic)'. What they felt they still needed referred to *improving* pedagogy, for example improve demonstrations (S1, S7), differentiation (S3, S6, S8, S10, S11), including three references to teaching SEN pupils, classroom management (S10), assessment (S4). This indicates that they felt that they had acquired the basics but were aware that their practice needed to be refined and developed. A few students were becoming more sophisticated and identified the need to develop their ability to make better use of pupil data (S6); to develop their recording of pupil information (S4) and to develop their knowledge of pupils within a specific school context (S11).

For students the term 'pedagogy' meant teaching methods and strategies, and they did show a developmental process in their developing knowledge of this. There was also a growing understand of the knowledge that underpins practice. It is hoped that this could be used as a basis for students to fully develop their pedagogical knowledge, that is their knowledge of how to best present the concepts within the subject to allow for pupil learning. This will only be known through following the students into their early years of teaching and tracking their continuing development.

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 & technology.

Initially students felt that they knew very little about school knowledge, one student identified knowledge of health and safety and the National Curriculum for design & technology (S11). Others stated that they knew only their own school/educational experience. There was a long list of what they thought they needed to know, ranging from knowledge of local schools (from a foreign student (S2) and a Scottish student (S4)); knowledge of the National Curriculum (S5, S9): knowledge of the design & technology department (S6) to knowledge of the school ethos and rules (S6, S8), disciplinary procedures (S5, S8) and the local context (S1, S7, S10, S11).

By the end of the first placement there had been a complete reversal, the students identified a long list of knowledge and only a few areas for development. Areas of knowledge included: knowledge of school policies (six mentions); how the school runs (four mentions); knowledge of the design & technology department (four mentions) and pastoral care systems (two mentions). There were some comments that reflected individual experiences – the importance of teacher communication 'across the whole school and within the department' S4); the 'school requirements of the teacher, e.g. appropriate clothing and time management' (S7)! Only four students identified further knowledge that was needed, this related to more knowledge of the UK curriculum (foreign student); information about other religions (S2); understanding the hierarchy within the department (S5) and the ability to adapt if resources are lacking (S5).

At the end of the course the students' understanding of the school knowledge had become 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 (five mentions). One or two related to gaining knowledge of the 'vocabulary' used in schools (S4), an awareness of the 'under-funding' of schools (S5) and the 'rigidity' of the school structure (S5). Areas that needed further development also indicated the greater sophistication, students felt that they needed to know more about 'politics of the school' (S3); where design & technology sits within the school curriculum' (S3); working as part of a team (S9); pshe/citizenship and 'specific knowledge within the specific school' (S11).

Again, this shows an emerging understanding of 'school knowledge' as in the visual model used in this study. It is clear that students' concerns during school placements are within their own classroom and department and that it is only when they feel comfortable with these that they are able to explore further.

Conclusion

Despite the students' re-interpretation of the meanings of the various aspects of teachers' professional knowledge, the study did reveal developments in their professional understanding as they proceeded through the PGCE course. As would be expected they had a non-specific understanding of subject knowledge at the start of the course which became more specific as their training, in University and school, made them aware of what they needed to know.

In terms of pedagogical knowledge the students' development appeared to be highly individualised, suggesting that the school context is very influential. By the end of the course the students' responses indicated that they felt that they had acquired a basic pedagogical knowledge which they needed to further improve.

The students felt that they had very little school knowledge at the start of the course but this changed drastically after one school placement. The

knowledge they gained in school was derived from a combination of directed activities, school-based training and from finding out because they needed to know. The second school placement developed this knowledge, with the awareness of the similarities and differences between schools. During the period of University-based training between the two school placements there was a lot of sharing of information about school contexts, particularly when second school placements were announced and students could 'quiz' those who had been at the school for the first placement.

The University and school-based training both served to increase students' knowledge about schools, but the findings illustrate the importance of the school context in determining the nature of the individual student's development. For University tutors this means that the selection of schools, allocation of placements and training of school mentors is an important aspect of their work. The findings could further information PGCE course developments, for example in helping to make clear to students that pedagogical knowledge is more than knowing/using a range of teaching methods.

It is hoped that this research can now be further developed to follow these student teachers into their induction year, and possibly beyond, to discover how their professional knowledge and understanding continues to develop.

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