TOWARDS A PEDAGOGY OF TEACHER EDUCATION: FROM A MODEL FOR TEACHER TRANSFORMATION

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This paper describes a model to describe the development of teachers' subject knowledge for the teaching of mathematics, a model that can be extended to all aspects of teacher transformation. The model is then developed to offer a framework for a pedagogy of teacher education.

Introduction

Teaching requires a myriad of knowledge and skills, knowledge about students, systems and structures, knowledge about styles of teaching and learning, knowledge about management, resources and assessment as well as knowledge about the subject. Existing research in the area of teachers' knowledge, offers definitions of professional knowledge as well as explanations for the different forms of knowledge that a teacher holds (Shulman 1986; Wilson et al. 1987; Brown and McIntyre 1993; Aubrey 1997; Banks et al 1999). So, if we accept that teaching is a complex activity, teaching about teaching is, in that sense, doubly complex!

We view learning to become a teacher in terms of a growth model. As teacher-educators we acknowledge some aspects of acting as 'change merchants' (Pimm, 1993), but we hope to avoid the 'sales pitch' (Breen 1999) as we too do not wish to witness imitation of our sessions:

> *The passing on of methodology does not happen by osmosis ...though the very explicitness is likely to lead to the form being taken on without the security offered by the substance of the accompanying understanding .... There is a temptation for imitators to take in the more visible aspects of our presentation ..What is often left behind are the crucial invisible and complex features underpinning the activity* *p. 117*

We are also not trying to 'fix' anything, despite current government agendas for defining best and right practices and strategies.

> *This culture is based upon judging what is right and wrong, paying little attention to what mathematics teachers are actually doing (since it is wrong anyway) in their classrooms, and looking outside themselves for the 'right' way to newest 'fix'.* *Dawson 1999, p.148*

Dawson continues to suggest that we move from a 'culture based on judgement to a culture based on possibility' (p. 148). Krainer (2002), in discussing an Austrian curriculum project, also discusses teacher education emerging from the belief that there is no 'best' practice but different approaches to 'good practice'. Reflection, he says, is vital to this process: 'through innovations and reflections teachers construct their own professional growth' (p. 5).

Reflection and generality: an awareness of possibilities

Generality is crucial in mathematics and to the practice of all educators. Only generalisation allows transferability of knowledge from a particular situation in which something is practised to the many other situations in which similar practice may occur. Much mathematics is taught through the demonstration of special cases. As mathematics educators, we use specific examples of teaching in the hope that these are seen as generic by our students.

> *A generic example is an actual example, but one presented in such a way as to bring out its intended role as the carrier of the general. This is done by means of stressing and ignoring various key features, of attempting to structure one's perception of it. Different ways of seeing lead to different ways of knowing.* Mason & Pimm (1984) p.287

In mathematics teaching, there is the prevalence of the 'worked example', (often with the assumption that it is generic and carries the key features). In relation to the learning of mathematics, Mason and Pimm offer the reminder that:

> *Unfortunately it is almost impossible to tell whether someone is stressing and ignoring in the same way you are. ...*

In initial teacher education (ITE), watching others teach often provides the 'worked' example. In the UK there are many shortened routes into teaching (e.g. graduate entry schemes) in which students may spend more time in the 'doing' mode than the 'reflecting' mode. There is often the expectation that they are observing practice to copy that practice, like the mathematics teacher and learner.

> *... A teacher having written an example of a technique on the board, is seeing the generality embodied in the example, and may well never think of indicating the scope of the example, nor of stressing the parts that need to be stressed in order to appreciate the exampleness. However, the pupils have far less experience, even with the particular instance of the discussion (and may well be unaware that there are others) which as a consequence absorbs all their attention. The pupils may only see the particular (which is possibly for them quite general, i.e. not mastered) As a result they often try to 'learn the example'.* Mason & Pimm (1984) p.286

This quote offers parallels for the teacher educator and the ITE students. The teacher educator also needs to think about the possibility for generality when working with ITE students. An idea, an example, a lesson style may not indicate the 'scope of the example'. Like the pupils described in the quote, how often we have found ourselves with students who have enjoyed the session but not always seen the generality intended (cf. Paddington (Prestage & Perks, 1992) and Square roots (Perks & Prestage,1999)). Mathematics ITE students face a range of materials to use for teaching. The mathematics textbook, for example, is often given to our students as a basis for lesson planning. The teacher who offers this to the students may see the generality embodied in the text and be able to adapt the content to their own pedagogy and pupils' needs. Our ITE students however can only read the particular example that appears to represent a generality to be followed (the mathematics inherent in these texts may also be problematic, cf. Haggerty & Pepin, 2002). The mathematics National Strategy (DFEE, 2001) offers a descriptor of a three-part lesson (mental starter, main section, plenary), often used by ITE students and some teachers as the only model to follow. We need our ITE students to observe practice and reflect upon the set of particulars to 'see' the generality in order to develop their own practice, to develop an awareness of the possibilities. It is only by reflections, we would argue, that our students are likely to develop all the necessary attributes of the mathematics teacher. But we too need to reflect upon and, perhaps, adapt our own practice to allow this to happen.

Along with many teacher-educators, the sense of helping others to grow and to become reflective informs our pedagogy. As we work with teachers, how do we make explicit, at least to ourselves, other aspects of our pedagogy for teacher education? How do we find the generality that informs the practice of teacher education?

A model for teacher transformation

Elsewhere we have defined a model for considering the development of subject matter knowledge necessary for teaching mathematics (Prestage and Perks, 1999a, 2001) and have begun to extend this to teacher education (Prestage and Perks, 1999b). Personal subject matter knowledge and professional content knowledge of teachers are mediated by deliberate reflection in order to create a more fluid and connected personal understanding of mathematics needed for the classroom. The description of the model for teachers' subject knowledge for the teaching of mathematics is offered first, in order to consider its development for thinking about aspects of pedagogy for teacher education.

The initial construction of the model began from an awareness of working on subject knowledge with our ITE students who work on our one and two year post- graduate course. ITE students arrive with a certain amount of personal subject knowledge (*learner-knowledge*) that enables them to answer mathematical questions. Their subject knowledge is ill-connected and they have to work on developing connections when planning for teaching (Perks and Prestage, 1994). They also bring with them their personal beliefs and certain characteristics of 'being a teacher'. Throughout the professional ITE year they gain different knowledge and understandings of other *professional traditions.* Some are national, like the National Curriculum, the Numeracy Strategy and the examination system with all their attendant exemplar materials. Some are local traditions gained from particular school settings such as schemes and textbooks - the ways in which national policies are translated in different settings. Learner-knowledge and professional traditions are related together in these first stages to create classroom events for others to engage with learning mathematics, figure 1. These classroom events, and the lesson plans which precede them, offer the first evidence for pedagogical content knowledge (Shulman, 1986).

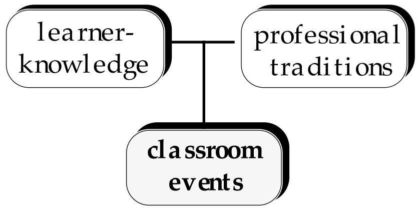

figure 1

Reflection upon these events (reflection-upon-remembered-action) leads to the beginnings of practical wisdom as the students discover that ‘telling doesn’t work’, ‘all learners are different’, ‘certain misconceptions affect learning’, ‘efficient algorithms are not easy to remember’, etc. Students’ lesson evaluations can reveal this practical wisdom (e.g. Perks, 1997). It is most in evidence when it is used to reconstruct lessons, explanations, and demonstrations and enables the students to adapt activities from the professional traditions to suit their particular circumstances, figure 2.

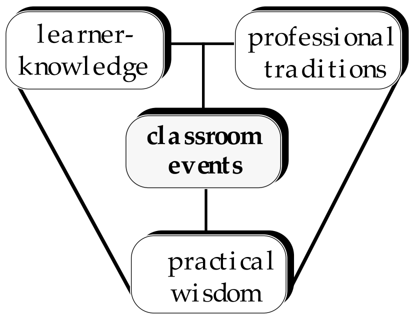

figure 2

As the pre-service teacher develops, classroom mathematics is now based on the interaction between these three aspects and the reflections upon them.

Our beliefs about content knowledge for teaching match those of Buchmann (1984), that teachers need a rich and deep understanding of their subject in order to respond to all aspects of pupils’ needs.

> *Content knowledge of this kind encourages the mobility of teacher conceptions and yields knowledge in the form of multiple and fluid conceptions.* *(p.46)*

We believe therefore that ‘good’ teachers reflect upon the classroom events at a further level than is shown in figure 2. They reconsider their own personal understandings of mathematics to reflect upon the ‘why’, not only of teaching but also of mathematics.

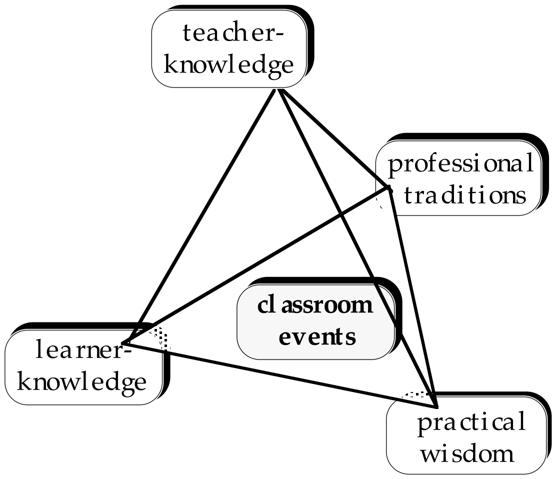

figure 3

They come to own a better personal knowledge of mathematics (*teacher-knowledge*) (figure 3) that allows them not only to answer the questions correctly but that also helps to build a variety of connections and routes through that knowledge, and that provides answers to 'why' something is so (Prestage, 1999). It is our contention that only when such subject knowledge is informing classroom practice that the real needs of learners and the challenge of mathematics are addressed.

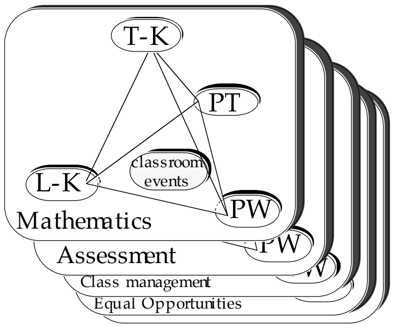

figure 4: Learner-knowledge for the teacher-educator

Teacher-knowledge is developmental, it depends upon reflection upon the interactions between learner-knowledge, professional traditions and practical wisdom, to create multiple and fluid conceptions in the subject. Good pedagogy relies on a depth of teacher knowledge.

Transposing the model for teacher education

The model for teacher development originally focussed on subject knowledge, but the model also works for other aspects such as assessment, classroom management etc. The learner-knowledge for a teacher-educator, figure 4, is subject knowledge plus all other aspects of general professional craft knowledge.

What then are the implications of this for thinking about a pedagogy for teacher education? Is there an equivalent *teacher-knowledge* that informs our practice?

Much of our practice as teacher-educators lies with our practice as mathematics teachers.

> *I arrived to my current job as a teacher-educator with aspects of the above in place. This was my learner-knowledge for being a teacher-educator. I had both learner-knowledge and some teacher-knowledge for mathematics subject matter, I understood the professional traditions and held a certain amount of practical wisdom. I also held a variety of other professional knowledge about general teaching matters. These then formed the basis for me to reflect upon and analyse and synthesise for others to come to know about teaching mathematics. (S.P. research diary, 1997)*

What then are the professional traditions of the teacher-educator? What is the practical wisdom? Can we identify these and so make explicit the teacher-knowledge? The professional traditions of our current profession (in England) emerge from personal experiences, education and training, the current government and government agencies' policies, as well as inspection criteria against which judgements are made and educational research. Practical wisdom can be defined as considering what the students need to know and how sessions might be constructed for them so that they engage in the ideas.

Initially our mathematics education sessions were based on how we had taught (our learner-knowledge). As our experience developed so did our practical wisdom and knowledge of the professional traditions. As we develop the multiple and fluid conceptions, by making our practices explicit and reflecting upon and sharing these with others, perhaps we are developing 'teacher-educator-knowledge'. That is our aim, and hence our transposed model emerges (figure 5).

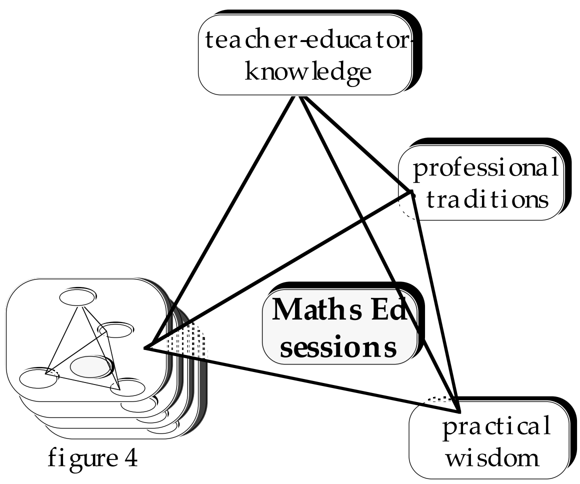

figure 5: the development of the teacher-educator

The model offers a framework to describe practice, to recognise different demands and to highlight the reflective processes needed to develop teacher-educator-knowledge. The teacher-educator needs to find the generality of the connections between the learner-knowledge, professional traditions and practical wisdom, to be able to offer generic examples and ways of working that allow teachers to work on their own professional development.

Conclusion

Shulman (1986) has articulated a variety of ways in which case studies can contribute to our knowledge about teaching, the case study allows for a detailed picture of the particular which may allow for more general principles to emerge. We would argue that teacher-educators need to articulate more of their practice to provide case studies. These enable research to be based within an interpretative research paradigm, carried out to understand what is happening, "striving to investigate without disturbing" (Bassey 1995, p.6). With a progressive focusing on the data (ibid. p.7) we hope a theory will emerge which will be grounded in case study data investigating the nature of pedagogical content knowledge in teacher education. Practically, each of the case studies could provide an illustration of a specific instance. By reflecting upon these with reference to a synthesis of learner knowledge, professional traditions and practical wisdom of other mathematics teacher-educators, the equivalent of a teacher-educators teacher-knowledge might emerge. The aim of this process is to make explicit the multiple and fluid conceptions of the art of teaching mathematics education.

Once we have a shared understanding from the 'wisdom of practice' (Shulman, 1986) we may be better prepared to move towards an articulation of a pedagogy for mathematics teacher education.

> *[We} need to investigate our own practice … which allows the focus to be put on those areas we have kept in the shadows. And this includes research that questions the value of the activity rather than just research which measures its degree of success.* *Breen, 1999, p.120*

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