Contents

Reporting to Parents – on paper and in person.

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This paper presents an overview of a session run with secondary PGCE students to raise their awareness of the issues associated with reporting to parents. The implications for record keeping and the need for clear, concise language in written reports are discussed with reference to one of the author's own school reports. Its light-hearted approach still allows students to consider this important issue in a non-threatening way.

Introduction

Before our students begin their long placement (11 weeks spanning the Easter-vacation), I run a session on reporting to parents. Many of them have the opportunity to attend a parents' evening during their placement and are often asked to produce a report on the pupils they have taught for the 'host' class teacher irrespective of whether or not there is a report due. It is also, of course, one of the current 4/98 standards.

> ***C d.*** *For all courses, those to be awarded QTS must, when assessed, demonstrate that they are familiar with the statutory assessment and reporting requirements and know how to prepare and present informative reports to parents*

Ideally, this standard is best addressed by schools but an opportunity to compare, contrast and reflect on different approaches is thought to be beneficial. The session is divided into two: reporting on paper then reporting in person.

Reporting on paper

We begin the session by considering the legal requirements for reporting to parents that is, that schools are required to produce one written report, for every pupil during each academic year. For Mathematics, English and Science this must contain the pupil's NC test score and teacher assessment, a summary of the school's results in each subject and a summary of the national results in each subject (from the previous year). We then consider the following questions:

- Who is the report written for?
- What is the purpose of the report?
- What sort of record keeping is required in order to be able to write such a report?
- How long does it take to write one report?

When students realise the number of pupils that they could teach, and consequently have to write a mathematics report for, in the course of one year some of them turn a little pale! The question of language is crucial. Students are aware of the need to avoid jargon and teacher-code but are equally aware, from their own teaching experiences to date, how easy it is to say, or do, something in stereotypical teacher language. Having largely agreed that the purpose of the report should be both summative (to inform parents of their child's achievements) and formative (to provide specific strategies as to how their child could improve) the timing, of the report is often then discussed. If the formative aspect is to be taken seriously then the issuing of reports at the end of the academic year (as is implied by the legal requirements) is not the ideal time. All the good intentions may be forgotten by the start of the academic year and, crucially, the teacher who suggested the improvement strategies may not be the pupil's teacher in the next year. The formative nature of reporting continues to a stumbling block as we re-visit Black and Wiliam (1999) and compare, once again, the theory with the practice often found in mathematics departments where pupil level record keeping often comprises a list of marks out of ten in a mark book. (This provides a useful opportunity to re-visit an earlier session on assessment).

To avoid students becoming overly depressed at this stage I usually produce an OHT of a page from my school report. This hand written report - which represents a year’s work is reproduced in table 1 in a more legible format.

Once students have got over the fact that I was generally a 'goodie-goodie' at school, there are some serious points to be made. Only one teacher (English) has made any attempt to provide a formative comment although this has been done in a positive way. It is only in English and Music that any indication of my knowledge, skills and understanding is provided. In every other subject the comments are so bland as to be almost meaningless.

Table One: Extract from Writer's School Report

Subject	Grade	Remarks
Scripture	B+	Sally has continued to work well
English	B+	Sally has worked hard and her comprehension is very good. She must endeavour to make all her written work likely and interesting.
History	B	Generally good
Geography	B+	Sally always works well
Latin	B	Good on the whole
French	B+	Good progress
Mathematics	B+	Sally continues to work well and has made good progress
Chemistry	B+	Sally has worked well
Physics	B+	Sally has worked well and has made pleasing progress
Biology	B	Sally works well
Domestic Science	B+	Sally has made pleasing progress; I hope she maintains this
Art	B-	Sally is making steady progress
Music	B+	Very good. It is a pity that Sally is not in the choir
Physical Education		Good steady work

The irony is, of course, that my parents were perfectly content to receive this report. I appeared to be trying hard and getting along OK. This observation in itself can lead to further discussion as to the role of reports. It also provides an opportunity to look at ways of phrasing comments which accentuate the positive attributes of more challenging pupils.

There are those who never stop talking and are rarely sitting in their place

John is a lively member of the group

Reeta is full of energy

There are others who don't seem to know what day of the week it is let alone which lesson they are in

Simon needs to work on his organisational skills

There are those who no matter how hard they try will achieve very little in your subject.

Iddo has made a valiant attempt to come to terms with the demands of the course

And finally there are those who are bone idle

Fiona has attended lessons. She now needs to concentrate on ...

Students are encouraged, on their next visit to their placement school, to ask for any school or departmental guidelines on writing reports and to look at examples from the previous year. The similarities and differences between various schools in this respect is an interesting area for discussion at a future seminar.

Parents' evenings

It is not unusual for reports to be discussed at a parents' evening. This section of the session is usually begun by asking students to reflect on their own experiences of parents' evenings either as a pupil, parent or teacher. They compare the organisational arrangements in terms of the physical layout of the meeting room(s) and the resources that the teacher should have with them. It is not long before one student comments that ‘it is the parents that you want to see that never show up'. Once this statement is unpacked it is soon realised to be a real indictment of the perceived purpose of parents evenings. Do we really only want to see parents whose children have been a nuisance so that this can be passed on to them? If the pupil has been a problem throughout the year then surely the parent should have been contacted already? If you were that parent would you want to be told that your child is lazy and uncooperative, semi-publicly, by perhaps eight different subject teachers? I know that I wouldn't!

There has been little research into the effectiveness of parents' evenings but I have found the work of Walker (1998) to be very helpful in providing real examples of the feelings of all those involved in the process. The quotes reproduced here are shared with the students and used as a basis for discussion.

For some parents interviewed in the Walker study, parents' evenings were clearly very daunting but they felt they had to be there

I didn't go right through the education system myself when I was at school. I didn't attend school very well at all. So for me, schools are quite a daunting place ... So I got to not knowing a clue about anything. I can't assess where Kirsty's at, or where she should be. I just feel as though I have to take on board what they're giving me because I can't challenge it. And I'm really putty in their hands. So I go in there thinking I may make a fool of myself but willing to look a fool if I can come out of there with a little bit more for my daughter. (p. 169)

Some schools encourage pupils (this can help orientate parents, I have also experienced pupils acting as a as a translator for their parents when English is not the first language although their is always a shadow of doubt about the accuracy of the translation!). However Walker's research suggests that, on the whole, pupils would prefer not to be there:

You know how you've done, don't you really? You don't need to come into school. You're here for goodness knows how many hours a day anyhow. Year 11 boy (p. 173)

Although they do report one pupil who expresses frustration at not being allowed to attend:

They're the worst evenings of my life. It's three people who're older than you and more articulate than you talking about your future when you're not there. How would you like it? (p. 173)

Conclusion

The session usually ends with an overview of the implications at classroom level in order to be able to provide a meaningful report to parents. Students' awareness of the role of reports and parents' evenings has been raised, as has their idealisation of the number of models that are in use in schools. I try to end by reading Ahlberg's (1991) poem “Parents' Evening” which comprises four short verses. Each verse provides a view of a parents' evening from the pupil, mother, father and teacher.

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The Study of the History of Mathematics and the Development of an Inclusive Mathematics: Connections Explored

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'…a historical creature is not alive if the past is not alive in…her'

(Heiede, 1992:152)

'What is mathematics?…only the realization that mathematics has not always been what it is now, and that in the future it will be something different, in other words that mathematics has a history, gives this question its real perspective.'

(Heiede, 1992:155)

In this article, we begin by sketching the dominant view of the nature of mathematics and then rehearse the arguments which suggest that the relationship between mathematics, education and equity points up the need for a reconceptualisation of the nature of the discipline. This in turn entails a re-vision of the pedagogy of mathematics classrooms and therefore has implications for the work of those engaged in teacher education. We argue that the equity demands for an inclusive mathematics require us to investigate the ways in which we can develop a mathematics education practice which respects connected knowing and person-relatedness and champions both the personal and the authority of the learner. In this context, we consider whether and how a mathematics curriculum which emphasises the historical and cultural locations of mathematics will be one which addresses such issues of social justice.

We report on a small scale empirical study of the role of a history of mathematics unit taken by undergraduate primary initial teacher education students in supporting such developments. We offer qualitative data based on students' individual reflective writing, using these to indicate and assess the impact of these approaches on these students and their conceptions of mathematics. Suggestions are made about the consequences for developing an inclusive mathematics.

The nature of mathematics: the dominant view

Mathematics as a domain of knowledge is associated with a distinct epistemological position. Although not endorsed unproblematically by philosophers of mathematics (Barrow, 1993: 112-127, 270-292) nor realistically sustainable in the light of key developments in nineteenth and twentieth century mathematics (Davis and Hersh, 1983, especially chapters 7 and 8), the dominant view of the nature of mathematical knowledge in Western cultures is that it is appropriately accorded the status of absolute truth. Mathematical knowledge comes endorsed with some sort of guarantee; its truths are certain, unchallengeable, objective, given and unchangeable. It is free of moral and human values, impersonal, external and hierarchical and the historical and cultural contexts in which it arises are irrelevant to its claims of truth (Ernest, 1991; Restivo, 1992). Prestigious mathematics is formalist and bleached of context and consequently, in this cultural context, 'structured, plan-orientated, abstract thinkers…constitute an epistemological elite' (Turkle and Papert, 1990:148).

Further, the human meaning making behind advances in mathematical knowledge is conscientiously removed from the text. We can compare, for example, two pieces of writing on quaternions both by William Hamilton with whom they originated. (We are grateful to Candia Morgan for drawing our attention to this example drawn from Solomon and O'Neill, 1998.) First we present extracts from a published letter from Hamilton which illuminates both his motivation and his thought processes, giving us an account of mathematical thinking in progress.

> *My Dear Graves*
>
> *A very curious train of mathematical speculation occurred to me yesterday, which I cannot but hope will prove of interest to you. You know that I have long wished, and I believe that you have felt the same desire, to possess a Theory of Triplets, analogous to my published Theory of Couplets, and also to Mr Warren's geometrical representation of imaginary quantities. Now I think that I discovered yesterday a theory of quaternions which includes such a theory of triplets.*
>
> *My train of thought was of this kind. Since √-1 is in a certain well-known sense a line perpendicular to the line 1, it seemed natural that there should be some other imaginary to express a line perpendicular to both the former; and because the rotation from 1 to this also being doubled conducts to -1, it also ought to be a square root of negative unity, though not to be confounded with the former. Calling the old*

root, as the Germans often do, i, and the new one j, I inquired what laws ought to be assumed for multiplying together a + ib + jc and x +iy + jz. It was natural to assume the product = ax - by - cz + i (ay + bx) + j (az + cx) + ij (bz + cy); but what are we to do with ij? Shall it be of the form $\alpha + \beta i + j\gamma$? Its square would seem to be = 1, because $i^2 = j^2 = -1$; and this might tempt us to take ij = 1, or ij = -1; but with neither assumption shall we have the sum of the squares of the coefficients of 1, i and j in the product = to the product of the corresponding sums of the squares in the factors. (1998: 215)

Next we consider the account Hamilton gave of the same work in the Philosophical Magazine.

Let an expression of the form

$$Q = w + ix + jy + = kz$$

be called a quaternion, when w, x, y, z, which we shall call the four constituents of the quaternion Q, denote any real quantities, positive or negative or null, but i, j, k are symbols of three imaginary quantities, which we call imaginary units, and shall suppose to be unconnected by an linear relation with each other. (1998: 215)

We see how the mathematics becomes authorless and independent of time and place.

Mathematics and equity

This view of mathematics as (wholly) pre-existant, stable and unrelated to human endeavour has implications for how coming to know mathematics is envisioned: coming to know the subject becomes a matter of referring to experts rather than personal reflection amongst a ‘community of validators’ (Cobb *et al*, 1992: 594) – ‘Is it an add, miss?’ (Brown and Kuchemann, 1976). The role of the teacher becomes that of

a Pythagorean educator wishing to reveal to children the eternal Divine Forms of which children’s experience must inevitably be but a confused anticipation or a pale reflection. (Winter, 1992: 91)

Who is considered knowledgeable and who is not reflects the social positioning (and therefore the power) of the knower. At the same time as the personal is expunged from the discourse, abstract, unconnected knowing is valorised.

There is evidence that the absolutist view of mathematics and the pedagogy it engenders are not neutral between different social groups. (Boaler 1996, Burton, 1995, Povey et al 1999). The stratification into hierarchies, the competitiveness, the disconnection of knowledge from the person and the personal are all found to be antithetical more to some learners than to others: those learners are over-represented in less advantaged groups (Boaler, 1997, Angier and Povey, 1999, Spender, 1989). There are other ways of interpreting the world and of thinking about and knowing mathematics, ways which celebrate 'connected knowing' (Belenky et al, 1986: 100) and relational understanding. These ways of knowing can set up different ways of associating with the objects of study. When the scientist Barbara McClintock spoke of her work with neurospora chromosomes (so small that others had been unable to find them), she said

> *when I was really working with them I wasn't outside, I was down there. I was part of the system. I actually felt as if I was right down there and these were my friends … As you look at these things, they become part of you and you forget yourself.* *(quoted in Turkle and Papert, 1990: 146)*

Here, in this unusual association with science, person-relatedness, intuition and insight are valued. If these attributes are to be nurtured within the mathematics classroom, then we need to understand mathematical knowledge as 'co-constructed' (Cobb et al, 1992: 573) by teachers and students and as a human production which consequently carries with it the imprints of its cultural and historical origins. It was our conjecture, therefore, that work with (in our case initial teacher education) students on the historical roots and cultural locations of mathematics would contribute to changes in their relationship to mathematics and their characterisations to themselves of mathematics as a discipline.

Using the history of mathematics in the teaching and learning of mathematics

Studying the history of the development of mathematical ideas opens up the possibility of seeing mathematics as a socio-cultural artefact: specific "bits" of mathematics are seen to be located in time and space and within a cultural context, helping students understand that

> *each culture defines its own mode of rationality and that, within the limits and possibilities of this rationality, a particular style of mathematical thinking arises and develops."* *(Radford, nd:1)*

Equally such studies help to give mathematics a human face (Fauvel, 1991:4). The number of students who opt out of mathematics at 16 is an increasing cause for concern. Research suggests that how the subject is conceptualised, and therefore how those engaged in its study relate that to identity, are key issues for the young people concerned (Boaler et al, 2000). They say that mathematics is about things not people: they view the subject as a series of disconnected fragments, disconnected from their lives and the lives of others, and not as part of the way in which they make meaning of their lives and the lives of those around them. Torkil Heiede suggests that mathematics is not alive without its history and that this deadness is one reason why so many people find it ‘dull, boring, uninteresting, even hateful’ (Heiede, 1996:232).

Empirical work

We carried out a small empirical study in 1999 reviewing and evaluating how far some of the above arguments appear to be supported by the perceptions of our initial teacher education students. We work with undergraduate and postgraduate students and with those training both for specialist secondary (11-18 years) and for more generalist primary (5-11 or 3-8 years) teaching. They meet the history of mathematics in designated units and/or as a requirement to investigate historical perspectives in assessed work in other parts of the course (see Philippou and Christou, 1996 and Sheath, Troy and Seltman, 1996 for other accounts of such work). We decided to review the experience of the primary mathematics specialist cohort, sixteen students of whom fifteen were women, because the work on the history of mathematics in the primary undergraduate route is concentrated into one unit of their course in the second year of a three year programme. We thought the fact that the input was concentrated would aid reflection. As the history of mathematics unit came to an end, we asked this cohort of sixteen students to write about the course and what impact, if any, they thought it had had on them. We used an unstructured format for this writing and encouraged the expression of thoughts, feelings, observations, evaluations and reflections.

We wish to draw attention to a number of themes that emerged: the novelty of the learning; its impact on their enthusiasm for the subject; the experience of new relationships with the discipline; the linking of mathematics to humanity and human endeavour; connections made or not made with themselves as prospective teachers; and, tentatively, overt links with equity issues. Rather than organise our reporting of the students’ writing closely around these themes by extracting “bites” from the text, we have included longer extracts, not least to illustrate how for many of the students those themes were both in common and interconnected. We will discuss each theme in turn and offer relevant extracts from the students’ responses; but early extracts will foreshadow later themes and early themes will be echoed in later extracts. The intention is for the reader to be more actively involved with the reported text albeit at the cost of imposing more precision. We hope this device works for the reader. Each student, thirteen out of the sixteen who took the unit, speaks once and only once.

For all the students, studying the history of mathematics seemed to be a novel experience. Because they were mathematics specialists, albeit in the context of a generalist degree, all had studied Advanced level mathematics or equivalent and at least one had also previously undertaken higher education study of mathematics. Nevertheless, the course was a revelation to them.

> *During my A-level course and 2 years of degree course I was used to just seeing names of formulas and not associating them with real people. I found it interesting to learn about where the formulas come from and to learn about the mathematicians' lives.* (Lynda)

> *I have a great deal more respect for maths and mathematicians than I ever used to have and I appreciate their abilities and how useful some discussions are…I hated calculus at school but after studying Newton and the implications of his theories I have respect for what calculus has and does accomplish.* (Judy)

Even though these were students who had chosen to specialise in the study of mathematics, many wrote of apprehension about the level of mathematics with which they were to be engaged or of an expectation of lack of engagement. Instead the unit rekindled enthusiasm and seemed to develop a more positive and more personal response.

> *The unit as a whole has brought up issues that I had never considered before such as where maths came from. I didn't realise how long ago maths problems were being considered, and didn't appreciate the extent of its progression…[it] humanised mathematics, making it more appealing.* (Carole)

> *The course is unlike anything I have previously learned about…previously I had not covered anything about mathematicians and where many of the theories originated. Therefore I discovered that mathematicians had a life – often families! This sounds strange but previously they had been merely names on a paper…Looking into the history of mathematics has broadened my understanding of many of the theories covered and encouraged me to challenge some.* (Mary)

Studying the unit seemed to have allowed most of the students to set up a new relationship to the discipline, to begin to understand the nature of mathematics differently, perhaps seeing some contingency where previously there was certainty.

> *The unit has rekindled my own enthusiasm for maths…the history of mathematics will affect my own teaching in primary school. Firstly, because it has brought back my enthusiasm for maths and this will help me to teach it effectively. Secondly, the history of mathematics means some aspects of maths cannot be taken for granted. The background knowledge puts maths into context and therefore makes it easier to teach and easier to learn.* (Zara)

Part of this new relationship to mathematics was connected to linking mathematics to humanity and with human endeavour; this is intimately linked with the developing capacity to question and to challenge. Mathematicians themselves had become visible – they were more like them, human and therefore less intimidatingly authoritative, capable of error and therefore capable of interrogation.

> *'unsolved problems in mathematics' – interesting as you tend to think that all maths is true and has been forever! ... I found it very enlightening ... also nice to see that mathematicians have a life! ... I think this would stop children growing up with the view of maths that I did!* (Hannah)

> *... making me realise that mathematics is not so clear cut. The things we take for granted took thousands of years to achieve. This should be taught also to children ... prior to this unit I was unaware of any female mathematicians or the fascinating elements to the history of mathematics – I will definitely teach this to children when I become a teacher.* (Rebecca)

More than half of the students linked their work on the unit positively with themselves as prospective teachers. They made connections, were hungry for yet more ideas and wanted their pupils to gain the benefits that they felt they had themselves obtained.

> *I now realise that the history of maths is relevant to me and to my course. I have been amazed and interested in things that I have learnt. I also realise that it is important for children to learn about the history as it gives them good equal opportunities in their education with women mathematicians and the mathematics of different civilisations such as Chinese, Egyptians etc.* (Chloe)

However, two were ambivalent about its relevance to their intended futures and two went further: they stated that, though interesting, the material they had encountered had nothing to do with their prospective careers as teachers of children in primary school.

> *Negative points. Little direct Primary school reference. I do not feel a Primary maths specialist after the teaching which was the aim…The link between different areas of maths, the way discoveries were made, makes the subject a vital piece of any higher level maths course.* (Peter)

> *The main problem with the unit is that I fail to see the relevance to primary teaching. I found it all fascinating, with the work load we already have we could have done without spending so long on something which you cannot teach to young children…The unit made me much*

more aware of how complex an area maths is. It also made me realise how far back it goes and how amazing some of the breakthroughs were when you consider when they were made etc. I now realise quite how little I know about maths!!! *(Eliza)*

What is most interesting (and, though perhaps unsurprising, most worrying) is that both these students were enthusiastic about the unit, realised that they had engaged with new and important ideas and made connections between the unit and mathematics as an area of enquiry. Yet they denied its relevance to themselves as teachers. Although this was a minority response, it draws attention to the possibility that exists within current educational discourse for perspectives on a discipline which are "vital" and "amazing" to be irrelevant to the teaching of that discipline in Primary schools. Equally, however, and more encouragingly from our perspective, some of the students made explicit couplings between what they had learned and equity issues in their intended practice.

[The unit] has given me the opportunity to 'think' about the mathematics taught in school. I think the 'history of mathematics' is a must in school. Children need to know where the ideas developed, how they developed, to understand the time and effort many people have put into work in the mathematics field ... the research I have done ... is bordering on obsession. I once watched the programme about Andrew Wiles and his passion for mathematics. I can [now] understand how these people feel ... the lesson about women mathematicians was excellent. I did not, really, know these wonderful women existed. There is also a multicultural aspect to the history of maths. We all hear about the European mathematicians and do not give a second thought to others. *(Elaine)*

[It] made me more aware of the involvement women had in the development of maths and how hard it was for them…I would now like to try out areas of the subject in school. *(Emma)*

I am surprised at how much knowledge I have gained and at how this has changed me. I am really interested in the history of maths and certain issues, in particular cultural issues ... I have learned a lot from this unit and I realise more and more how this has affected me. I am very interested in different cultural perspectives and histories and this unit has given me a wide bank of knowledge that enhances and influences my thoughts in this area… I am frequently surprised at how many areas of life the history of maths relates to …I hope that in future I will be able to pass on information like this ... to inspire future pupils. *(Helen)*

We are aware of a few texts directed specifically towards Primary teachers that will support these aims of engaging with the historical and cultural roots of mathematics (Reimer and Reimer 1992, Reimer and Reimer 1995, and Eagle 1995). Also suitable starting points for teacher reflection are to be found in Alic 1986, Joseph 1991, Lingard 1999, Nelson *et al*1993, Perl 1978 and Shan and Bailey 1991.

Conclusion

There is evidence (Lerman 1986, Povey 1998, Thompson 1984) to suggest that teachers' beliefs about the nature of mathematics as a discipline exert a significant, if unsurprising, influence on how they conceive of the pedagogical task and therefore how their lessons are planned, implemented and experienced. As Reuben Hersch notes

> *One's conception of what mathematics is affects one's conception of how it should be presented. One's manner of presenting it is an indication of what one believes to be most essential in it…The issue, then, is not, What is the best way to teach? But, What is mathematics really about?* *(Hersch, 1986:13)*

These two questions are inextricable. Taking that as a starting point, this article has been premised on three additional theses:

- that certain conceptions of mathematics and certain associated pedagogies, in simple terms those founded on an absolutist definition of the discipline, privilege some learners over others;
- that such conceptions are currently dominant;
- and that the privileged learners are over-represented in more advantaged social groups.

Taking all this together provides the engine for the search for different conceptions of mathematics. We began with the hypothesis that studying the history of mathematics can contribute to an alternative view of what the nature of mathematics is and of what it means to make and to come to know mathematics. We believe that our empirical work supports this conjecture.

Perhaps this is unsurprising. Historical perspectives, in general as much as in mathematics, have the effect of making the present something that has been achieved by human actions and, perhaps, therefore changeable now by people. Such thinking has a general emancipatory thrust as well as a particular one within mathematics education. These initial teacher education students started to develop perspectives on the nature of mathematics - human, created, challengeable, not clear cut - which make for a more inclusive mathematics.

Further research would be required to establish whether or not such conceptions were stable and, if so, to what extent they affected the practice in these students' classrooms when they became teachers.

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An Exploration into the Mathematics Subject Knowledge of Students on QTS courses.

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Currently there is much emphasis on subject competence for primary QTS students Thus within ITT courses our mathematics core provision needs to provide both subject and professional competence in accordance with government directives. We have tried to enable the students to provide evidence of their competence in different ways - a test and a re-test, completion of specific tasks, reading activities, portfolio evidence. For many students the pressure of focussing on their subject knowledge has been a difficult experience and thus we have tried to monitor the way in which this focus is affecting the way in which they both approach and operate within the classroom. Through questionnaires and interviews we have tried to elicit information about how their confidence has developed and how the focus on subject knowledge has affected their approach to planning mathematics activities. Generally the student response to subject knowledge has been positive and in this paper we explore their responses in a number of areas.

Introduction

The last few years have seen substantial changes in the way the curriculum is organised in primary schools. In particular there has been a radical restructuring of the way in which the mathematics curriculum is to be delivered. As these changes have progressed one of the recurring themes that has permeated the discussions has been that of the subject knowledge of teachers of mathematics in primary schools. The issue of teacher subject knowledge was raised in the report by Alexander et al. (1992) in relation to the delivery of the National Curriculum:

> *Teachers must possess the subject knowledge which the Statutory Orders require. Without such knowledge, planning will be restricted in scope, the teaching techniques and organisational strategies employed by the teacher will lack purpose, and there will be little progression in pupils' learning.* *(Alexander et al 1992 p.34)*

They further went on to strongly suggest that a prerequisite for the improvement of classroom practice was that teachers had a sound subject knowledge. This was especially true in Mathematics where there was a tendency in many schools to use a scheme as the mathematics curriculum rather than a resource which helped to deliver the mathematics curriculum. This meant that teachers became managers of the scheme and so required less emphasis on their own subject knowledge, since the scheme represented the required knowledge.

The link between subject knowledge and classroom practice was explored in two research projects one in UK and one in USA. In particular the UK study (Askew et al 1997) identified three types of teachers – connection focused, transmission focused, discovery focused – which represented the style which the predominately used in the classroom. This style was strongly related to their beliefs about and confidence/competence in the subject itself. In particular they found that :

> *Highly effective teachers believed that being numerate requires:*
>
> - *Having a rich network of connections between different mathematical ideas:*
> - *Being able to select and use strategies which are both efficient and effective. (Askew et al 1997)*

Thus the view of mathematics directly influenced the way in which the teachers were able to operate in the classroom. This was also true of the USA study (Thompson 1984).

The focus on teacher subject knowledge in Mathematics has been taken further in the UK in two ways. Firstly the TTA produced "Needs assessment material for KS2 teachers" which was designed to help teachers identify their own subject knowledge needs and so develop their classroom practice. Secondly a National Curriculum for ITE was produced which lays down subject knowledge requirements for Mathematics for all QTS students. This is an extensive document and specifies a large number of competencies that student teachers need to develop through the duration of their course.

It is the area of the development of student subject knowledge which this paper is intended to address. In particular the study aims to:

- Explore the development of student perception of their subject knowledge development during their QTS course;
- Identify specific areas of concern for students;
- Explore how the subject knowledge element informs the pedagogy and planning aspects of student performance;
- Identify significant episodes that influence the students' development.

Background

As the students progress through their QTS course there are three interlinking phases which need to be considered:

- What the students bring with them, in terms of their perceptions, feelings, attitudes and knowledge
- How the course addresses these elements, through school based and college based features
- How the course has changed/developed these elements.

These three phases are illustrated diagrammatically in figure 1:

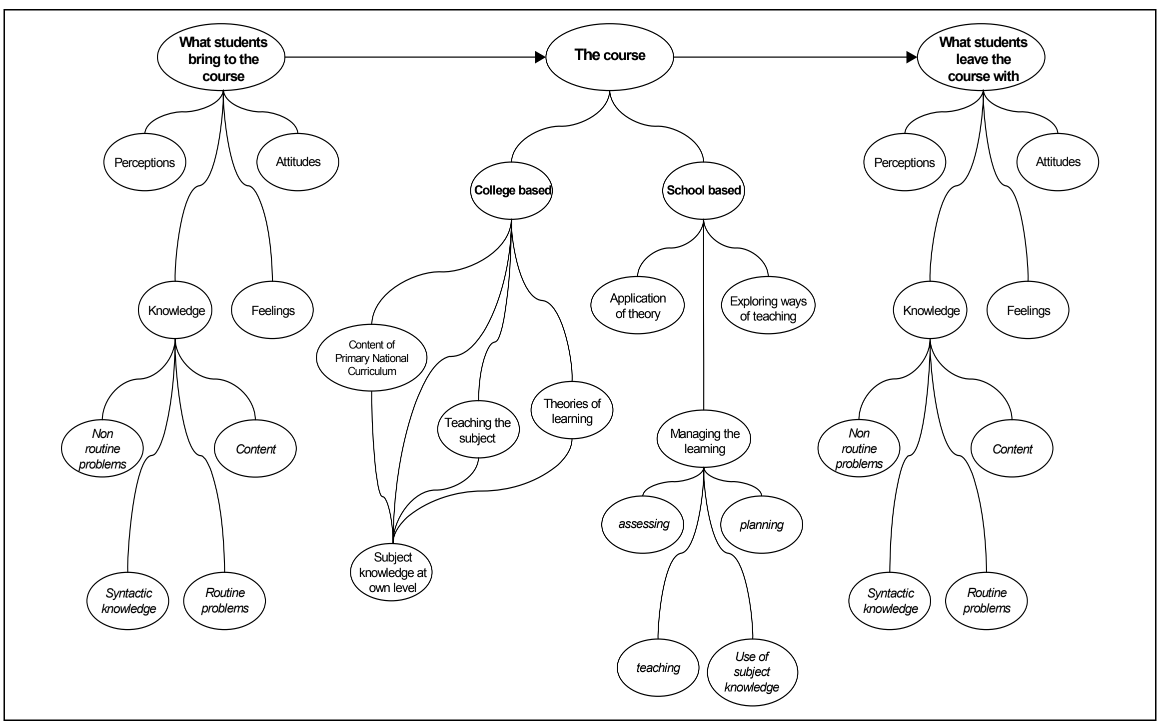


Figure 1

At the start of all our courses we encourage the students to express their feelings and perceptions about mathematics – based on the memories of their own school experience. We do this in order to ensure that their feelings about mathematics are brought into the open from the start of the course. This was a strong feature of a research project carried out in Exeter University (Bennett and Carré 1993). Their conclusions were that, as far as mathematics was concerned, what student teachers bring with them was a surface knowledge which lacked conceptual depth and an awareness of the interconnection of mathematical ideas. In particular, many students had difficulty accessing a solution route for non-routine problems which often required insight, ingenuity and working with the unfamiliar. Again similar findings are reported by Brown et al (1999).

In addressing students starting positions Bennett & Carré (1993) suggest that there were three aspects of thinking to which the students needed to be exposed:

- *Connectedness, which would enable the students to link mathematical ideas together and to move away from seeing mathematics as a disparate group of concepts*
- *Meaning, through which students gain competence in an algorithm through an understanding of the concept which underpins it*
- *Correctness, through which the students gain an understanding of the way words and symbols are used to express mathematical ideas accurately and efficiently*

A view of the knowledge needed in order to develop the quality of mathematics teaching is provided by Aubrey (1994) who quotes three aspects of knowledge identified by Grossman, Wilson & Shulman (1989)

- *content knowledge (factual information, central concepts, organizing principles and ideas make up the discipline)*
- *substantive knowledge (explanatory models or paradigms, the conceptual tools used to guide enquiry conducted in the field, or make sense of data)*
- *syntactic knowledge (knowing the relevant forms of methodology, the ways in which new knowledge is brought into the field, including the 'canons of evidence and proof and rules governing how they are applied'. (Aubrey 1994 page 3)*

These three aspects of knowledge bring together the essential features of teaching competence – knowing content, having a range of representations through which the content can be illustrated and using this to develop appropriate methods of facilitating learning.

One further theme common to the research of Thompson (1984), Ernest (1989), Lerman (1990), Brophy (1991), Askew et al (1997) is that teacher's beliefs about the nature of mathematics have a strong influence on the way in which the teacher develops mathematics in the classroom. In particular, as mentioned above, Askew (1997) was able to identify particular characteristics of teacher practice which seemed to be clearly related to teachers' beliefs.

All this research indicates that the courses which student teachers undertake need to address mathematical knowledge in its widest sense and also work with the students in developing their understanding of the nature of mathematics.

During the course

On the PGCE courses, students spend blocks of time at college and in school – 3 in school and 2 in college for lower primary (in order to facilitate a nursery experience) and 2 in school and 3 in college for upper primary. An important feature of the QTS courses which the students follow is this essential partnership between school and college. Both parts of the partnership provide the student with opportunities to develop their mathematical knowledge. In college, there is a strong emphasis on the student as a learner and in school the emphasis focuses on the student as a teacher. Both these elements should play distinct and complementary roles in facilitating student development. They also need to be seen as equally valid experiences in the students' mathematical development. Aubrey (1994) expresses the concern that if one partner becomes too dominant or is removed completely then the student experience is devalued. She suggests that teachers gain their subject knowledge from a variety of places prior to and during teacher education and that evidence suggests that students' subject knowledge is transformed through the process of moving from student as learner in college-based experiences to student as teacher in school-based experiences.

Methodology

In order to gather information that could be analysed for the purpose of exploring the aims identified earlier, a questionnaire was produced using the Database programme SNAP. The questionnaire was distributed to all students on the post-graduate programme (~100 students), to all students on the PGCE KS2/3 programme (~35 students). This gave us a representative sample of students. For a variety of reasons the return rate was low – about 50%.

The questions were generally of two types:

- Those requiring quantitative answers to questions about their subject knowledge and their perceptions of Mathematics;
- Those requiring prose responses which illustrate significant episodes/experiences during the course.

Individual questions were analysed both statistically and qualitatively to gain an understanding of student perceptions at particular times during the course. Further responses at the beginning and end of the course were analysed and compared in order to identify key issues. Again the analysis was both quantitative and qualitative. All the statistical analysis was undertaken within the SNAP environment.

Some representative results

The results attempt to look what the students bring to the course with them and then how the course helps them to develop their mathematical confidence and competence as teachers. The students bring with them both their qualifications and their own experience from school. In terms of the former the table below indicates the academic level of the students on our courses.

Analysis..: Key Stage
Break.....: q21a or q21b
Cells.......: Absolute, Analysis %, Respondents

Absolute Analysis % Respondents	Base	Missing No reply	O level A	B	C
Base	58	5 8.6%	13 22.4%	12 20.7%	28 48.3%
Missing					
No reply	-	- -	- -	- -	- -
Key Stage					
1	22	2 9.1%	6 27.3%	4 18.2%	10 45.5%
2	18	1 5.6%	4 22.2%	5 27.8%	8 44.4%
2/3	18	2 11.1%	3 16.7%	3 16.7%	10 55.6%

There is no significant difference here between students on the different PGCE courses. All that can be said is that many students have achieved at the lower end of acceptability for PGCE courses.

The second area of interest is that which gives an indication of the concerns within mathematics of the student when they start the course. As the chart below indicates the three main areas of concern were algebra shape and space and ICT:

Q1 Please rate your confidence in mathematics (at the start of the course) by ticking the appropriate box for each of the topics below - 1 least confident, 5 most confident

	1	2	3	4	5
Number	0.0%	10.3%	24.1%	46.6%	19.0%
Algebra	8.6%	20.7%	31.0%	25.9%	13.8%
Shape & space	3.4%	27.6%	25.9%	25.9%	15.5%
Measurement	0.0%	17.2%	32.8%	24.1%	22.4%
Data handling	5.2%	12.1%	31.0%	36.2%	12.1%
ICT	24.1%	17.2%	24.1%	24.1%	10.3%

The third area concerns the students feelings about mathematics. Here we first indicate some key words which the students used time and again to express their feelings about mathematics. This is a salutary experience for us as some of the key words which emerge from this process are panic, humiliation, routines, tests, specific mathematics content, anxiety, fear, mathematics as a punishment, regurgitating formulae. Of course, not all the comments were negative but none the less these words have been strong features of student responses over the last few years. The key words listed above are similar to those found in a study at Manchester Metropolitan University (Brown et al 1999). These words are often used in the context of male mathematics teachers appearing to take delight in making the mainly female students stand up and be humiliated in front of the whole class. In terms of content students appear to have a very strongly rule-based view of mathematics. Their concerns often tend to be that they can't remember the accepted algorithm for long multiplication or long division and often this is not, for them, related to the fact that meaning has been lost.

The second set of results concern the students perception of what happens during the course. In sharing these results we present some statistical results about the way student perceptions changed and then some comments form the students about what helped them. The tables below show that for most students there was a significant change in their confidence in these aspects of mathematics.

Analysis..: Key Stage
Break.....: q1b with q10b
Cells.......: Analysis %, Respondents

Analysis % Respondents		Missing	Algebra					Algebra				
	Base	No reply	1	2	3	4	5	1	2	3	4	5
Base	58	-	8.6%	20.7%	31.0%	25.9%	13.8%	1.7%	3.4%	20.7%	41.4%	32.8%
Missing												
No reply	-	-	-	-	-	-	-	-	-	-	-	-
Key Stage												
1	22	-	13.6%	27.3%	27.3%	27.3%	4.5%	-	9.1%	18.2%	45.5%	27.3%
2	18	-	5.6%	22.2%	22.2%	22.2%	27.8%	-	-	16.7%	50.0%	33.3%
2/3	18	-	5.6%	11.1%	44.4%	27.8%	11.1%	5.6%	-	27.8%	27.8%	38.9%

Analysis..: Key Stage
Break.....: q1c with q10c
Cells.......: Analysis %, Respondents

Analysis % Respondents		Missing	Shape & space					Shape & space				
	Base	No reply	1	2	3	4	5	1	2	3	4	5
Base	58	-	3.4%	27.6%	25.9%	25.9%	15.5%	-	6.9%	22.4%	32.8%	37.9%
Missing												
No reply	-	-	-	-	-	-	-	-	-	-	-	-
Key Stage												
1	22	-	4.5%	31.8%	40.9%	18.2%	4.5%	-	13.6%	22.7%	40.9%	22.7%
2	18	-	-	22.2%	16.7%	33.3%	27.8%	-	5.6%	22.2%	22.2%	50.0%
2/3	18	-	5.6%	27.8%	16.7%	27.8%	16.7%	-	-	22.2%	33.3%	44.4%

Analysis..: Key Stage
Break.....: q1f with q10f
Cells.......: Analysis %, Respondents

Analysis % Respondents		Missing	ICT					ICT				
	Base	No reply	1	2	3	4	5	1	2	3	4	5
Base	58	-	24.1%	17.2%	24.1%	24.1%	10.3%	-	6.9%	22.4%	41.4%	29.3%
Missing												
No reply	-	-	-	-	-	-	-	-	-	-	-	-
Key Stage												
1	22	-	27.3%	31.8%	18.2%	13.6%	9.1%	-	9.1%	31.8%	36.4%	22.7%
2	18	-	27.8%	5.6%	16.7%	33.3%	16.7%	-	11.1%	22.2%	33.3%	33.3%
2/3	18	-	16.7%	11.1%	38.9%	27.8%	5.6%	-	-	11.1%	55.6%	33.3%

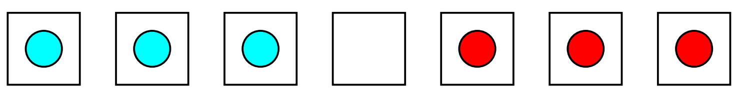
This change that the students perceived they had undergone was evident in both those students who were following KS1 courses and those who were following KS2 courses. But the change in the KS1 students was clearly more marked.

Many of the students on the PGCE course were mature students and the feelings about mathematics were deeply ingrained. Thus one of the first aspects of the course which they commented on strongly was the fact that they had someone to talk to about their mathematics and so were able to realise that "the fears they experienced were not absurd emotions but were ones which were shared with other students also. Thus for some of the students the mathematics classroom as a place of humiliation was transformed into a place of sharing and building. Thus as Brown et al (1999) indicate the college classroom is the place where the student can unlearn and discard their mathematical baggage both in terms of subject misconceptions and attitude problems.

The second aspect of the course that receives many comments is the strong link throughout the course on the link between subject knowledge and teaching (or pedagogic subject knowledge as Shulman (1986) terms it). In particular all assignments are geared towards making the students think and reflect about the tension between theory and practice – in a sense the luxury of being able to think theoretically in college with the pragmatism necessary to facilitate learning in a school situation. As one student commented – "we have become more aware of the questions we need to ask both of ourselves and of the children in order that learning can be facilitated". One of the main tensions here concerned differentiation and assessment – both of which are considered extensively in college and are difficult to manage in the classroom.

The third aspect of the course that was identified as being significant was the use of ICT. Here the feature that was clearly identified was the way in which the structure and symbolism used in such environments as Logo and Spreadsheets gave meaning to algebra, and the way in which generalisation and modelling were facilitated within the environment.

The fourth aspect of the course which received comment was that of problem solving. This is best illustrated by the example which the students themselves used. It is the problem which is often called "frogs". It is illustrated in the diagram below:

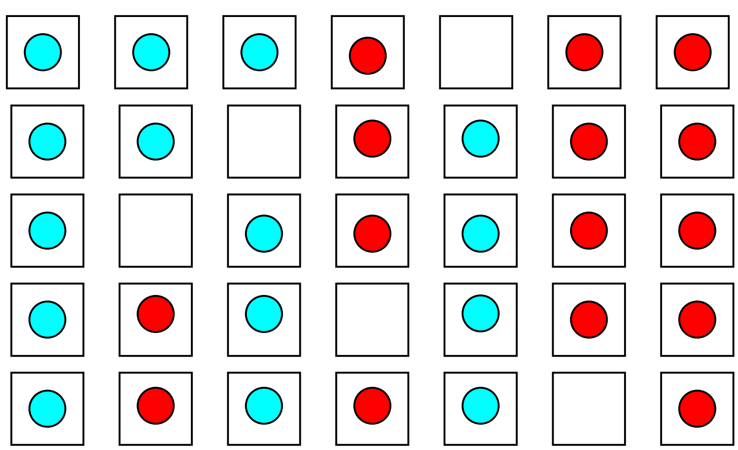


The object of the exercise is that the frogs on the right have to swap places with the frogs on the left using the following rules. They can only move in one direction – either to the left or to the right, they can slide into an adjacent place if it is vacant, or they can jump over one filled place if the next one is vacant. Two connected questions are asked – how can the task be accomplished and what is the smallest number of moves that is required. In order to simulate this exercise, we first attempt the problem physically with five students sitting on each side of a vacant chair. This proves to be too much and so we have to stop and discuss what is happening and try to identify the problems. Two ideas usually are aired – firstly the need to avoid having two persons from the same side together in the middle and secondly the suggestion that it would be easier if there were less people on each side to start with. This leads to the second phase of the exercise which is to complete the task with two persons on each side. This is accomplished with relative speed. The third phase is where the students are now sent off in groups with sets of counters to investigate the problem further and to see if they can sort out how to solve it. The fourth phase is to find some way in which they can explain, by means of appropriate representations, how the solution works. The final phase is then to use all the students – usually 10-15 on each side and to have one person direct the movements so that the required change over takes place.

So what was significant for the students in this activity? A number of issues arose in discussions with them.

- starting from a problem which was both intrinsically interesting and also complex;
- the use of a range of resources to work on the problem – human resources, iconic resources in the form of counters, and symbolic resources in the form of a written representation of the structure of the solution;
- working with a group and together focusing on ways of attacking a problem, understanding the structure of the solution, and using errors as a means of making progress through the asking of appropriate questions;
- using their understanding of the structure of the solution and the subsequent representation of that solution to solve a problem which was more difficult than the original one which they were unable to solve.

In developing a way of representing their solution there seemed to be two important considerations – a focus on one of the parameters within the problem (in the diagram above these are the colour of the counter being moved, the type of movement, and the direction of the movement), and a way of effectively representing the movement of this parameter. The first way that the students often represented the solution to the problem was as below – the movements were shown physically in a picture. Whilst this gives some visual clues as to how the problem needs to be solved it proved quite difficult to use this as a means of generalising a solution.



etc

The next representation that was often tried was as below and involves a combination of arrows and letters:

← S r → J b → S b ← J r ← J r ← S r etc.	1 slide **right** **1** jump **left** 1 slide **left** **2** jumps **right** 1 slide **right** **3** jumps **left**

Here again the representation was felt to be somewhat complex and although the patterns were starting to emerge – again all three parameters are represented in the left hand .representation but only two in the right hand one. Further colours are used to highlight what are considered to be significant aspects of the representation and which indicate the start of a pattern. Seeing the germ of a pattern starts the students to think about how they could generalise.

The next level of representation involves only one of the parameters:

- S **J** S **J J** S **J J J** S **J J** S **J** S - which just focuses on the movement

or

- B **R** R **B B** B **R R R** B **B B** R **R** B - which focuses on the colour of the counter to be moved.

In both these representations the symmetry of the movements is clear as is the structure of slides and jumps.

The final level of representation used is a shorthand version of the above and now clearly shows a generalisable pattern.

Number of counters	
2	1 R 2 B 2 R 2 B 1 R
3	1 R 2 B 3 R 3 B 3 R 2 B 1 R
4	1 R 2 B 3 R 4 B 4 R 4 B 3 R 2 B 1 R
5	1 R 2 B 3 R 4 B 5 R 5 B 5 R 4 B 3 R 2 B 1 R

A similar representation could have been used using movement as the parameter. From this generalisable pattern the students were able to articulate how the sequence of moves could be executed for any number of counters on each side - "between each slide there is an increasing number of jumps until the number of counters on each side is reached and then the number jumps decreases again" or using colours "the number of moves by a colour increases by one each time until the number of counters on each side is reached, this number of moves is repeated three times before the number of moves of each colour reduces again"

This understanding of the structure and representing it in a way such as that above then enabled the students to solve a more difficult one than the one with which they started.

Conclusions

In all the areas mentioned above a permeating theme was the way in which meaning was being developed. Within the course the prime objective was not to teach techniques but to give meaning to mathematical ideas by developing them within appropriate contexts, and showing how mathematical techniques were needed in order to solve problems. Thus the skills became sub-ordinate to the tasks (Hewitt 1996).

In working with the students one of the "big ideas" that we work with is that of structure. Mathematics does not require the learner to acquire a large number of "facts to be known" but what it does require is the knowledge of some facts plus an understanding of the structure within which those facts lie. This is what allows competence and confidence to grow. It would seem that this facts and structure model needs to underpin what could be called teacher knowledge which facilitates learner knowledge. This is particularly true in numeracy. There are certain facts that pupils need to know but they also need to realise that once they know a fact then the structure of the number system gives immediate access to other facts. If it is accepted that this is an important tenet of an ITE mathematics course then two other aspects follow immediately. Firstly we need to explore ways in which we can represent these structures – kinaesthetic, acoustic, visual, symbolic… and secondly we need to find a range of rich problems which give pupils the opportunity of exploring these structures for themselves.

In Brown et al (1999) they develop the idea of three dualities which face those working with students on Initial Teacher Education courses. These dualities are concerned with views of mathematics, and the teaching of it. In the work which we undertook there was a tension between what the appeared to need in order to build up their confidence and develop a more positive attitude towards mathematics, and what was required by the new national curriculum for ITE which is characterised by a long list of content requirements. Further this list is reminiscent for many students of that which they had grown to dislike and fear in their school mathematics. It could be argued that one of the most important aspects of an ITE course should be about helping students to gain an understanding of some of the "big ideas" in mathematics. This is difficult to achieve if monitoring the acquisition of a large amount of mathematical content becomes the dominant feature of all courses.

We would agree with Askew et al(1997) that a high level of subject content knowledge is not a pre-requisite for becoming a successful mathematics teacher. But having a holistic view of the nature of the subject and being able to see the connections between its constituent parts is. This necessitates the building up of student confidence which in turn suggests that working with students in appropriate contexts is a way of both developing a holistic view and seeing the connections across the subject.

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On becoming a 'Professional Development Teacher': A Case from Pakistan

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In 1994, the Aga Khan University, Institute for Educational Development (AKU-IED) started a new master's programme for mid-career teachers. The graduates of the programme went out to become 'Professional Development Teachers (PDTs)'. In this paper one PDT describes her work in the school that sponsored her, and in the AKU-IED. The discussion draws upon examples from her work with a mathematics teacher. Findings indicate that the model of teacher development proposed by the AKU-IED has potential for teacher growth because it incorporates features of some robust forms of teacher development such as mentoring and coaching including cycles of supported planning, demonstration and feedback.

The Professional Development Teacher (PDT) is a new species in the world of education in Pakistan and came into existence when the first cohort of twenty one M.Ed. graduates including myself from the Aga Khan University, Institute for Educational Development (AKU-IED) went out in the field. I was one of these twenty-one graduates. In this paper, I have described the activities, which I undertook in the course of my work as a PDT. The paper focuses on certain key aspects of the PDTs work such as the elements of coaching and mentoring in the work with the teachers, and the close school university links that were forged by the programme.

Background

Students' learning in the classroom setting in Pakistan is characterised by a concept of learning that sees teacher as the repository of knowledge whose role it is to transmit this knowledge to the students (see also, Halai 1998,1999). In a comprehensive overview of teacher education in Pakistan, Khalid (1996), identifies a number of issues that plague the education in Pakistan. However, she points out that certain initiatives taken by non government organisations have been successful in improving teachers' instructional practice and bringing about a positive change in their attitudes towards teaching. According to her, these initiatives are sensitive to the peculiar needs and contextual realities of the community it serves. Ali (1994), cites the example of one such successful initiative in teacher development. However, she points out certain issues that need to be addressed, among them being teachers' belief that knowledge resides with the experts (teachers) and its implication for classroom practice.

Jaworski (1996) says,

> *Pakistani culture, for example, encourages a deference to older, wiser and more eminent members of the society. Education is situated in an hierarchical power structure where curricula are defined externally to schools and success is measured by examination performance (pg.69).*

It is in this backdrop of traditional educational practices with emphasis on teacher directed learning that the AKU-IED initiated an innovative in-service education programme for teachers. It was expected by the AKU-IED and by the sponsoring institutions that the graduates would work as change agents in the schools and work towards establishing school based professional development programmes. The arrangements for PDTs sponsored by schools in Karachi entailed working for three years on a time sharing basis with the AKU-IED and the sponsoring school. The details of the work involved and time-sharing to be worked out by mutual consent of the institutions involved.

At the AKU-IED the PDTs were primarily responsible for planning, teaching, and evaluating, certificate level programmes for the teachers of the co-operating schools. The programmes were called 'Visiting Teacher (VT) programme' and were offered in various curriculum areas such as mathematics, language, science, and social studies. The co-operating schools were institutions from the private sector and the government sector who had entered into contractual agreement with the AKU-IED to second teachers for the various programmes at AKU-IED and work together in mutually beneficial ways towards school improvement, among other things.

How I worked as a PDT

After getting my degree I worked part time in the university i.e. half the academic year where I helped run the VT programme for mathematics teachers. The remaining half of the academic year I worked in school. The school that I worked in was a private school for girls in Karachi. It had a teaching staff of nearly a hundred. The number of students was 1300. There were three sections in the school, pre-school or nursery, primary school and secondary school. A head mistress was responsible for the academic and administrative affairs of each section. The overall administration was in the hands of the principal.

In the school I taught mathematics to one class which was one third of the total teaching load that teachers in school had. This was a class VI, with thirty-six girls (10-11 yr.). According to the principal a large majority come from middle to lower middle class families.

In order to ensure continuity to the pupils when I left for the AKU-IED, one other teacher (Zarina) was assigned to work with me in the same class. Zarina had been teaching mathematics and general science in the secondary section of the school for four years. Her previous teaching experience elsewhere was 11 years. She had a first degree in biology but no professional qualification. I got to know Zarina better when she came to the university to attend the VT programme, which I was conducting along with a group of other colleagues. The principal wanted Zarina to take on more mathematics teaching than she was doing at that stage. To prepare her for that she asked Zarina to work closely with me.

To address their individual needs, the teachers whom I worked with were divided into year groups in the primary school and subject groups in the secondary school. I met each group once a week every week. The purpose of the meetings was to plan lessons, share ideas, critique lessons taught and observed earlier, do mathematics (in the case of mathematics teachers) and raise issues and questions if any.

Zarina was part of the group responsible for teaching mathematics to class six. My work with Zarina had the added component of shared responsibility of a class. This led to Zarina and myself co-teaching. This meant that we planned the lessons together, one of us taught and the other observed the lesson. There were occasions that I taught the lesson and Zarina observed me and vice versa. The lessons were critiqued in the post lesson meetings. The one who taught the lesson was responsible for marking any written work that the students produced as a result of the teaching. Other responsibilities such as setting the examination paper and marking the exam were shared through mutual negotiation.

In the case of other teachers there were cycles of planning, observation and feedback but the teaching was largely done by the teachers. I observed their classes and they were invited to observe me teach.

Throughout my three years of work as a PDT I maintained a reflective journal. The journal entries were made regularly on a daily basis. I would start out by describing my day in school or at AKU-IED, sometimes I would also write remembered bits of conversation that I found significant for some reason. The descriptions were usually followed by or entwined with analytical thinking about the issues, questions or concerns arising. I shared aspects of my journal entries with the teachers at school and with other PDTs at AKU-IED. Zarina also maintained a reflective journal. However, an issue in sharing journals is that if entries might be coloured by the awareness of another person reading them. To deal with this issue we would share with each other portions of our writings. This provided the freedom to write freely without feeling constrained and yet be able to share thoughts with the reader as when one felt ready to do so.

Lessons learnt as a PDT

As a PDT, during the course of my work with in-service teachers, I took up different roles and responsibilities, including those of a change agent, a teacher, curriculum planner and researcher. In what follows I have discussed the lessons I learnt as I took up the various roles and responsibilities as a PDT. The issues, questions and concerns that arose have also been discussed. Although, in school I worked with a group of about fifteen teachers, my discussions are with specific reference to the mathematics teacher Zarina.

Mentor and mentoring

Initially, when I started work in the school there was considerable ambiguity surrounding my role as a PDT. As noted in Halai (1998), the role was interpreted variously as a problem solver, evaluator and supervisor. All these labels have connotations that could possibly have proved problematic in my effort to promote teacher growth and learning. For example, perception of a PDT as a problem solver could have inculcated dependence on outside sources to solve own problems. Evaluator and supervisor could have been interpreted on the basis of teachers' past experiences of being supervised by and evaluated by a more experienced senior teacher. The result of the supervision and evaluation fed into the teacher's annual reports that were in turn used for decisions regarding promotions and rewards. Ali (2000), confirms that the current supervisory system in Pakistan does not contribute to teachers' professional development. Therefore, during the course of my work I had to work towards establishing clarity regarding my role as a teacher educator who was there to promote teacher learning in a safe non judgmental environment. I illustrate the issues regarding establishing of relationship with the teachers with reference to my work with Zarina. As Zarina and I co-taught, observed each other teach and critiqued the lessons taught, immense opportunities arose for me to see how she learnt. These opportunities allowed me to deepen my own understanding of the skills, attitudes and strategies required to be an effective teacher educator. I realised that working as PDT meant among other things being a mentor to the teachers I worked with. In a comprehensive overview of the dominant narrative of mentoring, Semenuik & Worral (2000), claim that there is almost unanimous enthusiasm among researchers on the value of mentoring initiatives for promoting teacher development in experienced teachers and in supporting the induction of newly qualified teachers. Earlier in a review of research extant on mentoring Gray & Gray (1985), and McIntyre, Hagger &

Wilkin (1994), also concur that mentoring programmes (to induct beginning teachers) can effectively meet the needs of the protégé. Like, Semenuik & Worral (2000), I believe that mentoring is a deeply personal and is a nurturing relationship between myself and my mentee who was an experienced teacher. I believed that for the relationship to promote the mentee's growth, I needed to maintain an environment, which was supportive, non-evaluative and encouraging. Only then would the mentee be motivated or challenged enough to take risks.

To establish mutual trust I did a number of things. First was to establish myself as a learner and expose my practice (thereby my vulnerabilities) to the teacher. For example, when teaching class six I was also trying out new ideas learnt during the MEd. programme. One of the things I tried out in my teaching was setting students to work in small groups at problem solving tasks with possibility of multiple solutions and encourage them to represent their solutions in a variety of ways using words, pictures, or symbols. In my effort to set up collaborative learning settings in small groups I faced immense issues. An extract from my journal reads:

I must do something about the issues which are coming out of teaching. First, pupils are not used to working with each other. It is obvious from the way they work, the individualistic approach to group tasks, the squabbles and so. This means that for meaningful learning to take place, I have to focus more on strategies specific to co-operative learning. I also feel that in a whole school day, just thirty-five minutes of working with each other is not going to help. I have to convince other teachers also to use co-operative learning in class.
My journal

Sharing these reflections with Zarina and discussing its implications for our work made me feel comfortable in the knowledge that I had a critical friend whom I could share my concerns with. A consequence was that I was a learner alongside Zarina. Second, inviting Zarina to observe me teach and give me feedback implied and reinforced a relationship of mutual support. Indeed, there were occasions when Zarina provided me with critically constructive feedback on my practice.

I realised that there was no fixed method to being a mentor, there were certain strategies such as being flexible, open to negotiation of ideas and reflection on questions and issues arising which facilitated and enhanced critical dialogue between the teacher and myself. I also found that being a classroom teacher myself, and working alongside the teachers with all the nitty gritties of lesson planning, teaching, marking work and so on created immense opportunities for the teachers and for me to reflect on own instructional practice. In the section that follows I elaborate with the help of examples from my classroom work with

Zarina how the professional development opportunities were created by identifying questions and concerns close to the teachers' heart.

Curriculum development & implementation

An important component of my work with Zarina was our planning meeting with other mathematics teachers. These meetings were a new initiative in the school and had started as a result of my professional development responsibilities. I found that the curriculum development element of these meetings was a crucial aspect of our work because it led to teacher development in a variety of ways. For example as we planned units on fractions and decimals we laid out our aims. Planning activities and tasks that were appropriate to our aims meant extending work laid out in the textbook. It also required a discussion of critical issues like 'how children learn'. For example, the textbook introduced a concept by its definition whereas, Skemp (1986), suggests that a psychologically more appropriate approach would be to start from examples and activities from which concepts could be abstracted. Similarly, the implications of asking students to work on problems that were closed, leading to one right answer or asking students' to follow teacher's procedures to solve the problems were discussed. These curriculum development initiatives identified issues such as the teacher's need to extend and enhance own understanding of mathematics. I provide below three examples from my classroom work with Zarina.

<u>The Fractions lesson:</u> When planning work on fractions we wanted students to have varied experiences with fractions. This would involve use of paper strips, drawings and stories to talk about fractions. The aim was that when students were exposed through these multiple strategies to the rules of adding, multiplying and dividing fractions they would be able to see the reasons behind the rules. This emphasis on reasons led to a discussion of the rule ''when dividing fractions invert and multiply''. The emphasis on rules with reasons was also due to the fact that Skemp (1986), was a required reading in the various mathematics courses at AKU-IED and so all the teachers in the group were familiar with it. Thus, we worked together at pattern seeking using paper strips and drawings on the blackboard to see the emergence of this rule of division of fractions. Subsequently, I was teaching class six mathematics. Zarina observed while I taught. The lesson had been planned together. We had agreed to focus on allowing pupils to explore their own strategies of problem solving to reduce pupils' dependence on teachers. I asked the pupils to work in pairs on the problem given below and left them to choose their own ways of interpreting the problem and recording its solution.

> *Saima wants to divide three fourths of a cake into fifths so that she may send it to five of her friends who could not attend her birthday party. How much will each friend get?*

The students had had considerable experience of working with fractions mainly through manipulation of symbols and rules. In their previous lesson they had explored some ways of using language to read questions regarding division of fractions. For example, reading 5 ÷ 1/2 as how many halves in five, rather than five shared by half. Pupils are usually encouraged to think of division as sharing but this approach makes no sense when working with fractions i.e. ‘shared by half a person?’ In class I saw that one pair of students had done the work by using symbols i.e., 1/5 of 3/4 = 3/20. The pair next to them Naima and her companion had approached the problem differently. They had also done the algorithm symbolically : 3/4 ÷ 1/5 = 3/4 x 5/1 = 15/4 However, when asked they could not tell what those fifteen fourths were and why was their numerical answer a number greater than a whole. They had focused on the word ‘divide’ in the phrase *divide three fourths of the cake into fifths* and decided on the rule of division as their solution strategy. The subsequent discussion in class was about the problem statement, what did the problem require the students to find and the appropriate solution procedure to find it. This discussion necessarily focused on the difference between the two procedures used by the students above.

In a later conversation talking about her instructional practice Zarina referred to this lesson and said that like Naima she also had similar confusions about the rules of fractions. It was when we had done mathematics in the planning meetings that she had realised the rationale of these rules. She went on to say that she saw it her moral obligation to help the child come to grip with questions and confusions arising in the course of their work. As a result she said she wanted to plan so thoroughly that she would be able to cope with these emerging questions in class. I found like Buchmann, (1987) and Ball & Mcdiarmid (1990) that teachers’ subject matter understanding plays a significant role in teaching mathematics. I was also convinced like Feiman Nemeser & Parker (1990) that doing mathematics with the mentee was a way of making subject matter a part of the conversation in learning to teach. Although Zarina’s instrumental learning (Skemp, 1976) of the rules of fractions, and her declaration of her moral obligations towards her students raise a number of questions and issues, pertinent to my discussion here is the manner in which these issues were raised and highlighted. I believe that it was the localised and close nature of our work that created the possibility of exploring such intensely personal yet professionally critical concerns such as moral obligations towards the students and the role of subject matter knowledge in it.

<u>The moving decimal point.</u> Zarina invited me to observe a class on decimals. During the group planning meeting there had been a good discussion on multiplying a decimal number with ten or other powers of ten and what happens as result of. A number strip was used. It comprised of two interwoven

cardboard strips in different colours say yellow and pink. The pink one had slits through which the yellow one was woven. On the pink strip there was a decimal point. The yellow one had numerals written on it. When the yellow strip was pulled to the right or left the numerals changed their position in relation to the decimal point thereby changing the value of the number. I had assumed that this activity made it amply clear to Zarina that when a decimal number is multiplied by 10 or powers of 10 the digits move and not the decimal point as suggested in the textbook.

As I observed I saw that Zarina had showed on the black board one example selected from the textbook of how to multiply a decimal number with a decimal number. She then gave them (pupils) the rule i.e. add up the number of places on the right hand side of the decimal point in each factor and use it to place the decimal point in the product. The class was then told to work in their notebooks through some questions from the exercise given in the textbook. The class ended with pupils being asked to finish off their work at home. In the post lesson discussion she (Zarina) said that as there had been no planning meeting the week before she had taught multiplication and division by powers of ten using the old method. The old method was described as telling children when you multiply any decimal fraction by powers of ten the decimal moves right hand side.

This lesson and the post lesson conference raised a number of questions for me. At different stages in our work together Zarina had expressed her wish to plan lessons that would encourage pupil thinking. In her journal Zarina stated that she wanted to plan and teach lessons which were not based on exposition alone but encouraged pupils to think by using a variety of ways. Given the above reflections and our extensive work on decimals using the number strip I wondered she reverted to telling. Her comment that in the absence of a planning meeting she had reverted to the old way of teaching, suggests that she depended heavily on these meetings but required more structured and specific support for lesson planning. Perhaps, in the absence of the level of support that she required Zarina did not feel capable of trying out anything other than exposition. As a PDT, I always had to weigh my actions in terms of its impact on the teacher. For example, a constant question in my mind was whether I would create dependency if I provided new ideas, support, and resources. Little (1985, 1990) and Pedretti (1996) also indicate that issues of dependence and autonomy are central to the role of the facilitator or critical friend in teacher development. It would thwart teacher growth if new forms of dependency were created by the facilitators in their concern for directing rather than facilitating action and reflection. The lesson also indicated that subject matter knowledge is indispensable in teaching (Feiman Nemser & Parker, 1990) it is the pedagogical content knowledge (Shulman, 1986) that gives ideas about how to represent content to students.

The issue for me as a PDT was to encourage Zarina to be more critical in her reflections and identify ways in which she could have modified her current plan to suit pupils need. Perhaps I had assumed that Zarina had learnt something when she had not so was surprised by what she said about the decimal point moving. Perhaps a more direct reference to our work related to the number strip would have brought out the issues regarding content and pedagogy more clearly into focus.

<u>The decimals lesson continues:</u> When I went in the lesson had already started Zarina was teaching division of decimal fractions. The class was sitting in rows and columns pupils are working individually. They were working on division of decimals. The blackboard work shows that the teacher must have explained the use of equivalent fractions in getting rid of the decimal point in the divisor. I saw a positive sign, the bulletin board where sample of pupils work had been put when I was teaching fractions was now covered with fresh samples of pupils work showing pictorially 0.3×0.4. Suddenly one child raised her hand.

Pupil 1: Miss, 12 ÷2. 4, I don't understand.
The teacher asked if any one else knew. Three pupils responded.
Pupil 2: multiply denominator by 10.
Pupil 3: 120 upon twenty-four point zero (120/24.0)
Pupil 4: change to equivalent (fractions).

My journal entry

The teacher accepted all three responses and wrote them on the black board. She then asked P1 what happens if we multiply only denominator by 10 and goes on to explain the need to multiply both numerator and the denominator by 10 (12/2.4 x 10/10 =120/24) and referred to the answer given by P4. She then drew a place value chart on the black board to demonstrate the changing place value of the digits in the number. But three or four pupils shouted that they knew about changing place value, and not to draw the chart on the black board. However, she went ahead and showed when 12 and 2.4 would be on the place value chart both before and after multiplying by ten.

I was encouraged by this observation because it showed Zarina's movement from dependency to independence. That she had internalised change became evident from her classroom teaching which reflected the decisions taken in the planning meetings such as allowing pupils to make meaning of their mathematical work by using words, pictures or mathematical symbols to express their ideas. An indication of change was also an incident, which occurred towards the end of the academic session. She approached the principal with the request that she be given a science class to teach in the next term. This she claimed would allow her to capitalise on her science education and provide her opportunities to make use of new approaches to teaching in science as well.

Zarina, who had been a classroom teacher for eleven years and was known for her shy retiring nature volunteered to co-ordinate the planning meetings during the time when I was away at AKU-IED. She successfully co-ordinated the planning meetings with the other mathematics teachers of class six. The result was that once I left after completion of my three year contract with the school Zarina, was given the responsibility by the principal of co-ordinating the planning meetings of teachers of classes six and seven.

School-University Link

The three years after graduation that I worked both, with my school and AKU-IED, the nature of my responsibilities and the manner in which it had been set out necessitated a close link between the school and the university. When I went to school it was fresh after my experiences of the MEd programme. I was enthusiastic about trying out my learning in the real messy world of the school. However, as I worked at setting up the school based professional development programme, set up mentoring relationships with the teachers and taught mathematics to students, I learnt lessons that were of immense use to me when I returned to the AKU-IED where my prime responsibility was planning, teaching and evaluating the VT programme in mathematics education.

These lessons were shared with the academic community through a variety of mechanisms, both, formal and informal. For example, formal presentations at conferences locally and outside Pakistan for example, (Halai, 1996; 1999) and publications, for example, (Halai, 1997, 1998, 1999).

As a PDT, I was acutely aware of issues that had arisen in my efforts at initiating change in the classroom; issues such as lack of trust, and mutually supportive working norms among the colleagues. When the group of PDTs met to plan and conduct the VT programmes, this learning was fed into the planning of the VT programmes. For example, extra care was taken to ensure that a relationship of trust and collegiality was established. The instructional team in the VT programme modelled collaboration by team teaching. The participating teachers were expected to work in groups and reflect on the experiences, challenges and possibilities of working with peers. Observing each other teach and provide constructive yet critical feedback was also a significant aspect of experiences offered to the participants of a VT programme. These collaborative work experiences had implications for teachers' work on return to their respective schools. Indeed, many of the re-entry action plans that the teachers prepared reflected the significance that teachers attached to creating possibilities of working with other teachers on their return.

Similarly, work in schools brought out with great clarity the significance of teachers' subject matter knowledge, particularly if innovative approaches to teaching were to be used. Hence, a significant strand running through mathematics education programmes offered at certificate and advanced diploma level at the AKU-IED was on teachers doing mathematics. This element of direct feedback of school learning into planning of university based programme was of great significance in a context where there is no indigenous research worth the name so that research conducted in contexts very different from the developing world contexts is used to inform planning of programmes.

The physical mobility of the various groups of PDTs now being stationed at the AKU-IED and now at school created an interaction that had the implication of reducing the gap between the institution of higher education and the schools.

The PDTs, including myself, were instrumental in setting up support mechanism for the teachers that would empower them. For example, professional association of mathematics teachers known as "Mathematics Association of Pakistan" was established. The AKU-IED supports the association, which boasts a strong membership of above 300 teachers all of whom work on a voluntary basis.

Concluding Reflections:

The model of teacher development proposed by AKU-IED combines the features of some of the powerful ways of providing teachers the opportunity to change their practice. For example, Semenuik & Worral (2000), Feiman Nemeser and Parker, (1990) and Gray & Gray (1985) acknowledge mentoring programmes as robust forms of professional development while, coaching by experts and peers including cycles of supported planning, demonstration, observation and feedback have been acknowledged by Joyce & Showers (1982) as effective forms of professional development. As was evident from my work with Zarina, that element of coaching including cycles of planning observation and feedback were incorporated in a safe and nurturing environment that is a halmark of effective mentoring initiatives. Being school based the teacher and the PDT worked within the framework of the contextual realities. The one to one nature of interactions of the PDT and the teacher created the possibility to negotiate goals, and activities within their own contextual framework so that the change initiative had a greater likelihood of success than those mandated by above.

Traditionally in Pakistan schools have looked towards outside sources to fulfil the professional development needs of their teachers. The result was often an 'outside in approach' where teachers were sent for workshops or training with little or no follow-up support. These initiatives did not lead to a change in instructional practice as teachers' beliefs and attitudes regarding their instructional practice were not addressed (Khalid, 1996). The concept of school being the site of professional development is liberating and empowering for institutions that have traditionally looked outside, towards institutions of higher education and teacher centres to provide teacher development for the teachers. Besides, the close and intense relationship between the teachers and the PDT ensured that needs were identified from within and structures were in place for follow-up and support in the classroom.

Semunuik and Wollar (2000), state that an issue with setting up mentoring programmes for teachers is the lack of collaborative structures in the schools. While I agree that schools are characterised by teacher isolation and lack of collaborative structure, I believe that programmes such as the one described above have the power of breaking teacher isolation.

Institutions of higher education such as the AKU-IED are concerned with creation of knowledge that would inform practice. Today a major criticism levelled at educational research is that it is not regarded useful by teachers (Hargreaves, 1996; Schifter, 1998). Perhaps, this is due to the gap between the experiential and practical nature of the teacher's world and the academic world of a university based teacher educator. The knowledge created by collaborative efforts of the kind described here could provide valuable insights regarding the practical world of the teacher and its links to theory because the structure of the programme is such that a close interaction between the school and the university is facilitated.

Finally, in the developing world context such as that of Karachi, Pakistan there is absence of base line data regarding the ground realities in the classroom. However, there are indicators to suggest that the picture of education in Pakistan is not promising (Warick, 1995). Initiatives like these proposed by the AKU-IED could generate valuable and much needed qualitative insights into the issues and concerns regarding teacher development and school improvement.

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One Cycle, Two Frameworks: Right Direction for Inspection?

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The inspection by Ofsted of courses of initial teacher education is high-stakes. This paper presents further analysis of the complete cohort of published inspection reports of providers of secondary mathematics initial teacher education Postgraduate Certificate of Education (PGCE) courses carried out by Ofsted in the period 1996/8. The analysis demonstrates that there is considerable variation in the reports, in terms of word length, how particular criteria seem to be applied, and how judgements are expressed. Attention to the transparency of the inspection process and to matters of validity and reliability is crucial if there is to be confidence in the inspection system.

The quality of courses on initial teacher education (ITE) in England is judged through a process of external inspection. Such inspection is carried out by the Office for Standards in Education (Ofsted) Initial teacher Education and training (ITET) team. The reliability and validity of such inspections has been the subject of much inquiry already. For example, in a survey of providers of ITE courses, Graham and Nabb (1999) found that less than one in ten of 152 providers were confident that the inspection of ITE courses was a valid, reliable and consistent process. The survey also pointed to the use by Ofsted of 'additional inspectors' (AIs), people recruited and trained quickly alongside the process of inspection using HMI exemplification material, as being particularly problematic because they were judged to be even more inconsistent than the permanent inspectorial staff of Ofsted. Campbell and Husbands (2000) raise similar concerns and conclude, from their case study of the inspection of one particular institution, that 'the methodology of inspection is .... insufficiently reliable for the consequences which flow from it'. The comprehensive review of Ofsted recently completed by the Education Sub-committee of the House of Commons Select Committee on Education and Employment (House of Commons Select Committee on Education and Employment, 1999) also commented on the need to establish the level of reliability and validity of the basic elements of inspection. The committee expressed the wish to see research into this issue extended. It is important, they say, to help ensure 'public acceptance of inspection, that such work is open to scrutiny by the academic community' (*ibid.* para 129).

Access to original inspection data is not possible, hence analyses must be confined to the published inspection reports for each provider. Building on previous work in this area (Jones and Sinkinson 2000, Sinkinson and Jones 2001), this report also focuses on inspection reports for providers of Secondary Mathematics Postgraduate Certificate of Education (PGCE) courses in existence during the round of inspections conducted during the 1996-1998 cycle.

The Inspection Framework for Courses of Initial Teacher Education

Since 1996, the inspection of courses of initial teacher education in England has been determined by a Framework for the Assessment of Quality and Standards in ITT produced by Ofsted, in consultation with the (UK) Teacher Training Agency. The first version, published in 1996 (Ofsted/TTA, 1996), was used for the inspections carried out in 1996/7. This framework was then revised (Ofsted/TTA, 1997) and this new version used for the remaining inspections carried out during 1997/8. The framework (in both versions) requires the Ofsted inspectors to organise their judgements about the quality of ITE courses around a series of ‘cells’, each cell being graded on a 1–4 scale and each cell underpinned by a series of criteria. Grade 1 signifies 'very good, with several outstanding features', grade 2 'good, with no significant weaknesses', grade 3 'adequate, but requires significant improvement', and grade 4 is 'poor quality'.

For provision to be judged compliant with the requirements of the Secretary of State for Education, each cell must be judged by the inspection process to be at least adequate (a grade 3). Without compliance in *each* of the cells, in *all* of the ITE courses that the institution provides, accreditation of the institution by the TTA is withdrawn. Unsatisfactory inspection reports have already led to the closure of courses and, in some cases, whole institutions (see, for example, Ghouri and Barnard 1998).

As the evidence of the Open University to the Education Sub-committee of the House of Commons Select Committee on Education and Employment (House of Commons Select Committee on Education and Employment, 1999, appendix 76) makes clear, in their view the inspection framework is based on a limited conception of quality. First, they say, a narrowly defined orthodoxy of what is appropriate in ITE is developing. Second, continual re-inspection, in which providers are required to focus resources on narrowly defined issues of compliance, threatens development and innovation. Third, the omission of an analysis of value-added by ITE courses from the inspection framework means that no acknowledgement is made of the effectiveness of providers who take applicants from threshold entry level through to competent outcome levels. The above points to some concerns about the validity of the inspection framework. In addition, that the framework has been changed puts some question on its validity.

Validity and reliability are central concerns for any process of educational measurement. Definitions used within this research are given extensively in earlier publications, see for example, Sinkinson and Jones (2001).

Methodology

The main methodological approach adopted is one of critical document analysis. As Jupp (1996 p.311) explains, this involves 'a critical reading of texts aimed at uncovering how problems are defined, what explanations are put forward and what is seen as the preferred solution. It also seeks to bring to the surface that which is rejected in the text and that which does not even appear: what is *not* seen as problematic, what explanations are not considered, and what are not preferred solutions'.

The 'criteria for assessing the quality and standard of inspections and the work of (school) inspectors' as published by Ofsted (Ofsted 2000), were also used. The specific criteria involved were:

- evidence is sufficient in quantity and range to be representative
- there is careful analysis and interpretation of all inspection information
- judgements are fully consistent with the inspection evidence, reflect reliable use of the criteria in the Framework
- the judgements made cover the relevant requirements in the Framework

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Results

A total of 64 Ofsted reports on secondary mathematics ITE courses have been analysed. Of the inspections carried out in 1996/7, 20 of the providers inspected were partnership schemes run by HEIs; one was a school-based scheme or

SCITT. Of the 1997/8 inspections, 38 providers were HEI partnerships, with 5 being SCITTs. It is believed that all the inspections carried out in the 1996/7 round were carried out by HMI – inspectors employed and trained by Ofsted. In 1997/8 when a different Framework for Inspection was in use, the majority of inspections were done by 'additional inspectors' selected by Ofsted as being suitable for the job and given a modicum of training amounting to two or three days (see evidence provided to the inquiry of the Education Sub-committee of the House of Commons Select Committee on Education and Employment (House of Commons Select Committee on Education and Employment, 1999)).

Analysis of the published ITE inspection reports

Table 1, below, shows the distribution of grades given in the 1996/7 and 1997/8 secondary mathematics inspections.

Cell	Grade	1		2		3		4	
		96-97	97-98	96-97	97-98	96-97	97-98	96-97	97-98
S1	selection procedures	33%	19%	52%	63%	14%	19%	0	0
T2	quality of training	24%	21%	43%	60%	33%	19%	0	0
T4	assessment of trainee teachers	19%	23%	57%	51%	19%	21%	5%	5%
ST1	trainee teachers' subject knowledge	33%	12%	57%	77%	10%	7%	0	5%
ST2	trainee teachers' planning and teaching	24%	5%	48%	72%	29%	23%	0	0
ST3	trainee teachers' assessment of pupils	14%	5%	62%	74%	24%	16%	0	5%

Table 1: Grade profile of secondary mathematics PGCE courses,

1996-97 inspections (n=21, 20 HEIs, 1 SCITT) 1997-98 inspections (n=43, 38 HEIs, 5 SCITTs)
(Rounding errors account for the fact that not all totals are 100%)

A cursory examination of the distribution of grades appears to suggest that was more difficult to be awarded a grade 1 in the 1997/98 inspections compared to the 1996/7 inspections. It is worth noting that all the grade 4s in 1997/98 were awarded to SCITTs. Some possible reasons for such a difference may be:

- simply coincidence that there were more outstanding aspects seen in 1996/97
- the fact that the framework for inspection changed between the two years may have had an effect
- there was a marked difference in the personnel carrying out the inspections in the two years. In 1996/97 it is understood that all inspections were conducted

by HMI, in 1997/98 approximately two-thirds of the inspections were conducted by Additional Inspectors (AIs)

Previous published analyses of these outcomes (Jones and Sinkinson 1999, 2000), focused on cells T2 (quality of training) and C2/ST2 (trainee teachers' planning, teaching and classroom management). This report centres on cells T4 (assessment of trainee teachers) and C3/ST3 (trainee teachers' assessment of pupils).

The criteria for cell T4 have changed little between the two versions. Criterion (a) in the 1996/97 framework has been subdivided into criteria (a) and (b) in the 1997/98 version, as follows:

1996/97 T4(a) 'assessment objectives are clearly linked to the Secretary of State's criteria and to course provision; and assessment criteria are clear and relevant and are consistently applied' (Ofsted/TTA, 1996)

1997/98 T4(a) 'assessment objectives are clearly linked to the standards for the award of QTS and to course provision'

T4(b) 'assessment criteria are clear and relevant and are accurately and consistently applied in relation to the standards for the award of QTS' (Ofsted/TTA, 1997)

In the 1997/98 framework cell T4 has an additional criterion relating to providing trainees with a Career Entry profile, this cell is not graded within the inspection process. Thus, we might expect that the outcomes of inspection for cell T4 should be consistent between the two years of the cycle of inspection and indeed, initial perusal of the grade distributions for the two years confirms that expectation, see Table 2.

Cell	Grade	1	2	3	4
T4	1996/97	19%	57%	19%	5%
T4	1997/98	23%	51%	21%	5%

Table 2: T4 Grade profile of secondary mathematics PGCE courses,

1996-97 inspections (n=21, 20 HEIs, 1 SCITT) 1997-98 inspections (n=43, 38 HEIs, 5 SCITTs)

Providers could perhaps feel confident therefore, that judgements made by the different 'types' of inspector using the two frameworks appear to be consistent. Delving more deeply into the content of the inspection reports, accuracy and consistency appear to be more variable.

Once each criterion has been graded by the inspector, the inspection guidance indicates how the overall cell grading is to be made. For example, to receive a grade 1 for any cell, 'most criteria will be judged to be very good and none less than good. There will be only a few of the criteria judged to be good (indicative range 20%-30% depending on significance)'(Ofsted 1996, 1997).

In 1996/7 four providers were awarded a grade 1 in cell T4, in 1997/8 the number awarded grade 1 was 10. As detailed above, any cell awarded a grade 1 is judged to be 'very good, with several outstanding features' (Ofsted and TTA, 1997, p7). It would thus be reasonable to expect that inspection reports for T4 would reveal a large number of statements in which 'very good' or 'outstanding' or their equivalents appeared. The actual distribution is given in Table 3.

Provider number	Number of statements expressing very good or equivalent	Number of features listed as outstanding, excellent, or exemplary
1	5	1
2	1	0
3	2	1
4	1	0

Table 3: Analysis of reports awarding a Grade 1 in cell T4, 1996/97
(Grade 1 means 'very good with several outstanding features')

In contrast, in several reports where providers were awarded a grade 2 for cell T4, there were instances where 'very good' and even in one case, 'outstanding' occurred more frequently than in those providers' reports which had been awarded a grade 1. Clearly there were issues of consistency and reliability.

For courses inspected in 1997/98, the distribution is shown in Table 4.

Provider number	Number of statements expressing very good or equivalent	Number of features listed as outstanding, excellent, or exemplary
1	1	0
2	4	0
3	1	1
4	2	3
5	0	0
6	4	0
7	1	1
8	0	1
9	3	1
10	3	1

Table 4: Analysis of reports awarding a Grade 1 in cell T4 , 1997/98
(Grade 1 means 'very good with several outstanding features')

It seems that similar issues of inconsistency and unreliability occurred here; there appears to be evidence that the boundaries between grades awarded are not as clear-cut as perhaps they need to be to convince providers that judgements at these boundaries are accurate. Nevertheless, it seems that the difference between a 'solid' grade 1 and grade 2 is clear from reading the complete report on cell T4.

As stated earlier, the Framework for Inspection was changed in between the 1996/97 inspections and those conducted in 1997/98, even though they were all part of the same 'round' of inspection. The Secretary of State's requirements and criteria for courses in initial teacher training are given in DfEE Circular 10/97, in which the changes between the two frameworks are summarised thus:

> *A major change within this Framework is the replacement of what were previously described as competences (in the C cells) with the new QTS standards (now in ST cells)...In other respects, partly in response to informal feedback from providers, this version remains very similar to the version developed for 1996/97.* *(Ofsted and TTA, 1997, p1)*

Cell ST3 (trainees' monitoring, assessment, recording, and accountability) in the 1997/98 framework has 9 criteria, one of which is sub-divided into four parts, each of which is graded during the inspection, making a total of 12 subgrades which contribute to the final grade for ST3. In the 1996/97 framework the equivalent cell C3, contained six criteria, each of which were graded. Due to the introduction of 4/98 Standards for the Award of Qualified Teacher Status which necessitated the production of the new framework of inspection in 1997/98, the whole tenet of the cell appears quite different from its predecessor C3, so it is likely that there would be discrepancies in the outcomes. The profile of grades awarded in each of the phases of the inspection cycle is given in Table 5.

Cell	Grade	1	2	3	4
ST3	1996/97	14%	62%	24%	0%
ST3	1997/98	5%	74%	16%	5%

Table 5: ST3 Grade profile of secondary mathematics PGCE courses,

1996-97 inspections (n=21, 20 HEIs, 1 SCITT) 1997-98 inspections (n=43, 38 HEIs, 5 SCITTs)

It is immediately apparent that there is a disparity between, in particular, the spread of grades 1 and 2 in the two phases. It seems as if it was easier to achieve a grade 1 in the 1996/97 part of the inspection cycle. Is there a connection between a) the difference in inspection personnel between the two phases and/or b) the difference in the number and descriptors of criteria upon which the cell was graded?

Smaller numbers of providers were awarded grade 1s interesting outcome. It is, however, an outcome common to all inspected subjects and one which Ofsted judges that 'trainees' weaknesses (in ST 3) often reflect practice in the schools where they are placed, The Ofsted *Review of Secondary Education* 1993 - 1997 indicates that assessment remains the weakest aspect of teaching in most schools (Ofsted, 1999).

Looking in detail at the wording of the reports where providers were awarded grade 1, the evidence given in Table 6 is found relating to the descriptors 'very good' and 'outstanding', which are indicators of provision judged to be of grade 1 standard in the 1996/97 round of inspection.in this cell than in any of the other cells inspected during the cycle; which is, in itself, an

Provider number	Number of statements expressing very good or equivalent	Number of features listed as outstanding, excellent, or exemplary
1	0	0
2	1	0
3	2	0

Table 6: Analysis of reports awarding a Grade 1 in cell ST 3, 1996/97
(Grade 1 means 'very good with several outstanding features')

The equivalent data for the 1997/98 round is found in Table 7

Provider number	Number of statements expressing very good or equivalent	Number of features listed as outstanding, excellent, or exemplary
1	3	1
2	1	0

Table 7: Analysis of reports awarding a Grade 1 in cell ST 3, 1997/99
(Grade 1 means 'very good with several outstanding features')

There appear to be similar inconsistencies within the data in these tables too, from which it is difficult to make any assertions about whether the change in framework is likely to have an effect on grading outcomes.

ST 3 is one of three cells inspected where judgements are made on the basis of inspectors observing a fixed-size sample of trainees teaching in the classroom. Although the data collected in schools is supplemented by further information gathered from, for example, assignments and teaching files of other trainees within the cohort. The size of the sample observed teaching is determined by the number of trainees on the course at this stage of the inspection process. For example, for a cohort of 19 trainees, four will be observed teaching in schools, less than 20%. Statements made in resultant reports, such as 'the majority of trainees are able to recognise the level at which pupils are achieving...' and 'trainees are very good at monitoring pupils' progress in their classes... '(Ofsted, 1998/1999), appear to be rather sweeping generalisations of outcomes which may have been observed by less than one-fifth of a cohort and perhaps do little to fill providers with confidence in the accuracy and reliability of the inspection process. The overall cell grade for each trainee observed teaching 'for approximately one hour', (Ofsted 1996, 1997), is determined by the inspector. Neither the two Frameworks for Inspection nor the guidance materials (*ibid.*) specify what strategies were employed to arrive at the final cell grading.

The variation in the lengths of reports written on different cells has been reported elsewhere (Sinkinson and Jones 2001). Differences in the ways in which the cell reports are constructed present problems of inconsistency, particularly within what is designed as a criterion based evidence base. As Campbell and Husbands (2000, p46) suggest, there appears to be a disparity between the model of inspection, in which the criteria are, according to Ofsted, set out in clear and unambiguously accountable terms, and the content of the actual, published reports of each inspection. It seems reasonable to suggest that, since not all criteria within cells are mentioned specifically in every report, at least some of the judgements for some providers were arrived at through what Campbell and Husbands (*ibid.*) describe as 'a rather more traditional HMI model.' Such a model relies less on a formal checklist of criteria and more on inspectors making a judgement of individual cell quality which fits in with their evidence-based judgement about the overall coherence and quality of the inspected course. It is likely that most HMIs are able to do this effectively and reliably, but AIs, given the length of training they receive prior to inspecting, are unlikely to have the 'tacit HMI expertise' described by Campbell and Husbands (*ibid.*). Indeed, Graham and Nabb (1999, p24) report that 59% of the respondents to their questionnaire felt that judgements made by AIs were less valid and reliable than those made by HMIs. However, if reporting from inspections based on a criterion-referenced framework were to be explicitly referenced to every criterion within it, then there may be more opportunity for confidence in the outcomes of inspection, so perhaps the newer framework could lead to such increased confidence.

Discussion

Education, at all levels, is now rooted firmly within what Norris (1998) calls an 'evaluation culture.' The procedures involved in such evaluations have been shown, in this research and in that conducted by others, for example Campbell and Husbands (2000), to be lacking in terms of reliability. Issues concerning funding allocations, trainee numbers and institutional reputations, not to mention lecturers' jobs, are a direct consequence of the outcomes of inspection. Hence it is vitally important that all involved in the inspection of PGCE courses have confidence in both the methodology adopted and the judgements made. It is certainly a step forward for providers to know the criteria upon which their courses are judged, although the wisdom of changing those criteria midway through an inspection cycle is questionable, but there seems to be some way to go yet before complete confidence in reliability and validity is achieved by providers.

Campbell and Husbands (*ibid.*) argue that it is difficult to establish how far Ofsted has succeeded in addressing problems of reliability such as 'inter-observer agreement, representativeness of classroom behaviour sampled and the influence of observers upon the observed', since Ofsted has not, to date, allowed its policy and practice in these areas to become part of the public domain. Gilroy and Wilcox (1997) have shown the virtual inevitability of inspection criteria being specified imprecisely.

Ofsted argue that national moderation meetings and exemplification details of criteria provided during training for inspectors deal adequately with potential difficulties of inconsistency. This may indeed be true, but the procedures adopted by Ofsted are kept behind Ofsted's walls. The rules governing the moderation remain similarly secret, as do the grades awarded to individual trainees and to individual criteria within each cell. Thus, it is virtually impossible for any provider to monitor consistency. It would be a huge step forward in terms of providers striving to constantly improve the training that they offer, for the exemplification details to be placed within the public domain. This might give substantial credibility to Ofsted's stated aim of 'stimulating and informing discussion and contributing to the development of policy and practice in secondary initial teacher training'. (Ofsted, 1999, p6).

At present there appear to be little confidence amongst providers that the feedback provided by Ofsted does indeed contribute to the development of practice. Graham and Nabb (1999, p20) report that 75% of ITT respondents disagreed or strongly disagreed with the statement: 'The ITT system receives sufficient overall feedback about good practice based upon inspection evidence'. This seems to indicate that providers would welcome more statements, within their inspection reports, which provide examples of good practice seen during the inspection.

This research indicates that there is room for much development in order that all participants in the process of inspecting secondary mathematics PGCE courses are confident that it is reliable, valid and robust. Perhaps there is a need for a discussion between Ofsted and providers about the merits of the 'traditional HMI approach to inspection' which existed prior to 1996, in which there appeared to be much more confidence, and the criterion-based approach in place now, which is the source of so much disquiet. The current round of ITE inspections to be completed in August 2002, is being conducted with one framework throughout the cycle; research into outcomes for that cycle may determine whether some of the inconsistencies identified above have been eradicated.

Inspections of ITE courses last a complete academic year. The stress generated for all involved is immense. Bassey (2001) has suggested, in his response on the Annual Report of HMCI of Schools for 1999-200 to the Select Committee, that the said committee should be concerned about 'the emotional costs to teachers of inspections'. That concern should extend to inspection of ITE courses.

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