Contents

	Page
Editorial.	1
A Framework for the Observation and Review of Mathematics Teaching	3
Tim Rowland and Fay Turner	
Lesson Observation: What do we record? Anne Haworth	18
Twenty Years of Observing Mathematics Lessons Maria Goulding	23
Observing Mathematics Lessons with Blank Record Sheets. Pat Perks	31

.

.

42

49

53

**

Observing Trainee Teachers Paul Weeden

Admissions to secondary mathematics PGCE courses: are we getting it right? Geoff Tennant

.

Two Books used on the Keele University Two Year Conversion PGCE: Mathematics Doug Averis

i

A Framework for the Observation and Review of Mathematics Teaching

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This paper describes a framework for mathematics lesson observation and the ways that this framework is being used in practice, for mathematics teaching development. The research which led to the development of the framework drew on videotapes of mathematics lessons prepared and conducted by primary PGCE students towards the end of their initial training. A grounded theory approach to data analysis led to the emergence of the framework - a 'knowledge quartet', with four broad dimensions, through which the mathematics-related knowledge of these teachers could be observed in practice. We term the four units: foundation, transformation, connection and contingency. This paper describes how each of these units is characterised, and analyses a fragment of one of the videotaped lessons, showing how each dimension of the quartet can be identified in the lesson.

Introduction

In a recent issue of *Mathematics Education Review*, Doug French discussed the subtle blend of mathematics and pedagogy that underpins the work of the mathematics teacher (French, 2005). There is more, of course, as those involved in Initial Teacher Education (ITE), students and tutors are only too aware. Indeed, in his seminal work in the 1980s, Lee Shulman identified seven categories of teacher knowledge. Four of these are not subject specific (an example is 'knowledge of learners') but three of them focus explicitly on subject 'content' knowledge.

Subject matter knowledge (SMK) is knowledge of the content of the discipline *per se* (Shulman, 1986, p. 9), consisting both of substantive knowledge (the key facts, concepts, principles and explanatory frameworks in a discipline) and syntactic knowledge (the nature of enquiry in the field, and how new knowledge is introduced and accepted in that community). Pedagogical content knowledge (PCK) is particularly difficult to define and characterise, conceptualising both the link and the distinction between knowing something for oneself and being able to enable others to know it. PCK consists of "the ways of representing the subject which makes it comprehensible to others...[it] also includes an

understanding of what makes the learning of specific topics easy or difficult ..." (Shulman, 1986, p. 9). Curricular knowledge encompasses the scope and sequence of teaching programmes and the materials used in them.

How are these different kinds of 'content' knowledge acquired by teachers of mathematics? This question is addressed throughout this paper, but it is important to acknowledge that the acquisition of knowledge for teaching neither begins nor ends during initial training, although the training institution and the placement schools are key environments for raising and refining the pedagogical awareness of beginning teachers. In particular, it is expected that trainees will develop detailed 'curricular knowledge' in their work in schools, so that they come to know the scope and sequence of the National Curriculum and of the Numeracy Strategy. The means by which they develop a more detached, strategy-independent rationale for what they do and how they do it is more complex, but no less important.

Our research is located in a collaborative project involving researchers at three UK universities, under the acronym *SKIMA¹* (subject knowledge in mathematics). The work in the early stages of our collaboration focused on investigations into trainees' subject matter knowledge and its relation to teaching. This has been reported elsewhere (e.g. Goulding, Rowland and Barber, 2002; many other references can be found on the *SKIMA* website). The research reported in this paper, which began three years ago, was undertaken in collaboration with two *SKIMA* colleagues, Peter Huckstep and Anne Thwaites.

Purpose of the research

All primary (elementary) trainees are trained to be generalist teachers of the whole primary curriculum. Over half of the Postgraduate Certificate in Education PGCE year is spent working in schools under the guidance of a school-based mentor. Placement lesson observation is normally followed by a review meeting between a school-based teacher-mentor and the student-teacher. On occasion, a university-based tutor will participate in the observation and the review. Research shows that such meetings typically focus heavily on organisational features of the lesson, with very little attention to mathematical aspects of mathematics lessons (Brown, McNamara, Jones and Hanley, 1999; Strong and Baron, 2004).

The purpose of the research reported in this paper was to develop an empirically-based conceptual framework for lesson reviews with a focus on the mathematics content of the lesson and the role of the trainee's mathematics SMK and PCK. Such a framework would need to capture a number of important ideas and factors about content knowledge within a small number of conceptual

¹ <u>http://www.skima.maths-ed.org.uk</u>

categories, with a set of easily-remembered labels for those categories.

The focus of this particular research was therefore on the ways that teacher trainees' mathematics content knowledge - both SMK and PCK - can be observed to 'play out' in practical teaching during school-based placements. We wish to clarify at the outset that whilst we see certain kinds of knowledge to be *desirable* for elementary mathematics teaching, we are convinced of the futility of asserting what a beginning teacher, or a more experienced one for that matter, *ought* to know. Our interest is in what a teacher *does* know and believe, and how opportunities to enhance knowledge can be identified. We believe that the framework that arose from this research – we call it the 'knowledge quartet' – provides a means of reflecting on teaching and teacher knowledge, with a view to developing both.

Method

This study took place in the context of a one-year PGCE course, in which 149 trainees followed a route focusing either on the 'lower primary' years (LP, pupil ages 3-8) or the 'upper primary' (UP, ages 7-11)². Six trainees from each of these groups were chosen for observation during their final school placement. Two mathematics lessons taught by each of these trainees were observed and videotaped, i.e. 24 lessons in total. We took a grounded theory approach to the data for the purpose of generating theory (Glaser and Strauss, 1967). In particular, we identified aspects of trainees' actions in the classroom that seemed to be significant in the limited sense that it could be construed to be informed by their mathematics SMK or PCK. These were grounded in particular moments or episodes in the tapes. This inductive process generated a set of 18 codes. This was valuable from the research perspective, but presented us with a practical problem. We intended to offer our findings to colleagues for their use, as a framework for reviewing trainees' mathematics content knowledge from evidence gained from classroom observations of teaching. We anticipate, however, that 18 codes is too many to be useful for a one-off observation. Our resolution of this dilemma was to group them into four broad, super-ordinate categories, or 'units', which we term 'the knowledge quartet'.

Findings

We have named the four units of the knowledge quartet as follows: foundation; transformation; connection; contingency. Each unit is composed of a small number of cognate subcategories. For example, the third of these, *connection*, is a synthesis of four of the original 18 codes, namely: *making connections; decisions about sequencing; anticipation of complexity*, and *recognition of*

 $^{^{2}}$ LP and UP have subsequently been renamed 'Early Years' and 'Primary', and are referred to as such in the final section of this paper.

conceptual appropriateness. Our scrutiny of the data suggests that the quartet is comprehensive as a tool for thinking about the ways that subject knowledge comes into play in the classroom. However, it will become apparent that many moments or episodes within a lesson can be understood in terms of two or more of the four units; for example, a **contingent** response to a pupil's suggestion might helpfully **connect** with ideas considered earlier. Furthermore, it could be argued that the application of subject knowledge in the classroom *always* rests on **foundational** knowledge. Drawing on the extensive range of data from the 24 lessons, we offer here a brief conceptualisation of each unit of the knowledge quartet.

Foundation

The first member of the quartet is rooted in the foundation of the trainees' theoretical background and beliefs. It concerns trainees' knowledge, understanding and ready recourse to their learning *in the academy*, in preparation (intentionally or otherwise) for their role in the classroom. It differs from the other three units in the sense that it is about knowledge possessed, irrespective of whether it is being put to purposeful use. This distinction relates directly to Aristotle's account of 'potential' and 'actual' knowledge. "A man is a scientist ... even when he is not engaged in theorising, provided that he is capable of theorising. In the case when he is, we say that he is a scientist in actuality." (Lawson-Tancred, 1998, p. 267). Both empirical and theoretical considerations have led us to the view that the other three units flow from a foundational underpinning.

A key feature of this category is its *propositional* form (Shulman, 1986). It is what teachers learn in their 'personal' education and in their 'training' (preservice in this instance). We take the view that the possession of such knowledge has the potential to inform pedagogical choices and strategies in a fundamental way. By 'fundamental' we have in mind a rational, reasoned approach to decision-making that rests on something other than imitation or habit. The key components of this theoretical background are: knowledge and understanding of mathematics *per se*; knowledge of significant tracts of the literature and thinking which has resulted from systematic enquiry into the teaching and learning of mathematics; and espoused beliefs about mathematics, including beliefs about why and how it is learnt.

In summary, this category that we call 'foundation' coincides to a significant degree with what Shulman (1987) calls 'comprehension', being the first stage of his six-point cycle of pedagogical reasoning.

Transformation

The remaining three categories, unlike the first, refer to ways and contexts in which knowledge is brought to bear on the preparation and conduct of teaching.

They focus on knowledge-in-action as *demonstrated* both in planning to teach and in the act of teaching itself. At the heart of the second member of the quartet, and acknowledged in the particular way that we name it, is Shulman's observation that the knowledge base for teaching is distinguished by "... the capacity of a teacher to *transform* the content knowledge he or she possesses into forms that are pedagogically powerful" (1987, p. 15, emphasis added). This characterisation has been echoed in the writing of Ball (1988), for example, who distinguishes between knowing some mathematics 'for yourself' and knowing in order to be able to help someone else learn it. As Shulman indicates, the presentation of ideas to learners entails their re-presentation (our hyphen) in the form of analogies, illustrations, examples, explanations and demonstrations (Shulman, 1986, p. 9). Our second category, unlike the first, picks out behaviour that is directed towards a pupil (or a group of pupils), and which follows from deliberation and judgement informed by foundation knowledge. This category, as well as the first, is informed by particular kinds of literature, such as the teachers' handbooks of textbook series or in the articles and 'resources' pages of professional journals. Increasingly, in the UK, teachers look to the internet for bright ideas and even for ready-made lesson plans. The trainees' choice and use of examples has emerged as a rich vein for reflection and critique. This includes the use of examples to assist concept formation, to demonstrate procedures, and the selection of exercise examples for student activity.

Connection

The next category binds together certain choices and decisions that are made for the more or less discrete parts of mathematical content – the learning, perhaps, of a concept or procedure. It concerns the *coherence* of the planning or teaching displayed across an episode, lesson or series of lessons. Mathematics is notable for its coherence as a body of knowledge and as a field of enquiry, and the cement that holds it together is reason. The pursuit of coherence and mathematical connections in mathematics pedagogy has been stimulated recently by the work of Askew, Brown, Rhodes, Wiliam and Johnson (1997); of six case study teachers found to be highly effective, all but one gave evidence of a 'connectionist' orientation. The association between teaching effectiveness and a set of articulated beliefs of this kind lends a different perspective to the work of Ball (1990b) who also strenuously argued for the importance of connected knowledge for teaching.

In addition to the integrity of mathematical content in the mind of the teacher and his/her management of mathematical discourse in the classroom, our conception of coherence includes the *sequencing* of topics of instruction within and between lessons, including the ordering of tasks and exercises. To a significant extent, these reflect deliberations and choices entailing not only knowledge of structural connections within mathematics itself, but also awareness of the relative cognitive demands of different topics and tasks.

Contingency

Our final category concerns the teacher's response to classroom events that were not anticipated in the planning. In some cases it is difficult to see how they could have been planned for, although that is a matter for debate. In commonplace language this dimension of the quartet is about the ability to 'think on one's feet': it is about *contingent action*. The two constituent components of this category that arise from the data are the readiness to *respond to children's ideas* and a consequent preparedness, when appropriate, to *deviate from an agenda* set out when the lesson was prepared. Shulman (1987) proposes that most teaching begins from some form of 'text' - a textbook, a syllabus, ultimately a sequence of planned, intended actions to be carried out by the teacher and/or the students within a lesson or unit of some kind. Whilst the stimulus - the teacher's intended actions - can be planned, the students' responses can not.

Brown and Wragg (1993) group listening and responding together in a taxonomy of 'tactics' of effective questioning. They suggest that 'responding' moves are the lynch pins of a lesson, important in the sequencing and structuring of a lesson, and observe that such interventions are some of the most difficult tactics for newly qualified teachers to master. The quality of such responses is undoubtedly determined, at least in part, by the knowledge resource available to the teacher. For example, Bishop (2001, pp. 95-96) recounts a nice anecdote about a class of 9- and 10-year-olds who were asked to give a fraction between $\frac{1}{2}$ and $\frac{3}{4}$. One girl answered $\frac{2}{3}$, "because 2 is between the 1 and the 3, and on the bottom the 3 lies between the 2 and the 4". Bishop asks his readers how they might respond to the pupil. It is relevant here to suggest that such a response might be conditioned by whether they were aware of Farey sequences and mediants, or what heuristics were available to them to explore the generalisation inherent in the pupil's justification.

Chloë's lesson

We now proceed to show how the knowledge quartet might be applied in the observation and review of placement lessons. We shall do this by homing in on a short (14 minutes) portion of one of the 24 videotaped lessons. The trainee in question, Chloë, was teaching a Year 1/2 (pupil age 5-7) class a particular strategy for mental subtraction. By focusing on this vignette we aim to maximise the possibility of the reader's achieving some familiarity with the scenario, with Chloë and a few of the children in her class. What is lost, of course, is any sense of how the quartet might inform reflection on the rest of her lesson. On the other hand, the passage we have selected would be, in itself, a valuable focus for some useful reflection in the post-lesson mentoring discussion.

Conforming to the English National Numeracy Strategy (NNS) guidance (DfEE,

1999), Chloë segments the lesson into three distinctive and readily-identifiable phases: the mental and oral starter; the main activity (an introduction by the teacher, followed by group work, with tasks differentiated by pupil ability); and the concluding *plenary*. The learning objective stated in Chloë's lesson plan is: "Children should be able to subtract 9, 11, 19 and 21 using the appropriate strategies". The lesson begins with a three-minute mental and oral starter, in which Chloë asks a number of questions such as 'How many must I add to 17 to make 20?', 'How many more than 7 is 10?', designed to test recall of complements of 10 and 20. There follows a 14-minute introduction to the main activity. Chloë reminds the class that in their previous lesson (which was taught by her mentor) they added 9, 11, 19 and 21 to various 1-digit and 2-digit whole numbers. Chloë demonstrates how to subtract these same numbers by subtracting 10 or 20 first, then adding or subtracting 1. She has a large, vertically-mounted 1-100 square, and models the procedure, moving a counter vertically and horizontally on the hundred square. She calls on children to assist her as 'teachers' in the demonstration. At the end of the demonstration, Chloë lists an example of each of the four subtractions on a whiteboard. The class then proceeds to 23 minutes' seatwork on differentiated worksheet exercises that Chloë has prepared. The 'more able' children subtract 19 and 21, the others subtract 9 and 11. Finally, she calls them together for a four-minute *plenary*, in which they consider 30 - 19 and 43 - 21 together.

Chloë's Lesson and the Knowledge Quartet

We now home in on the introduction to the main activity, to see how it might be perceived through the lens of 'the knowledge quartet'. This is typical of the way that the quartet can be used to identify for discussion various matters that arise from the lesson observation, and to structure reflection on the lesson. Some possibilities for discussion with the trainee, and for subsequent reflection, are flagged below thus: **Discussion point**. We emphasise that the process of *selection* in the commentary which follows has been extreme. Nevertheless, it offers a realistic agenda for a typical, time-constrained post-lesson review meeting.

Foundation: Chloë's lesson plan refers to "appropriate strategies" for subtracting four near-multiples of 10, without recording what strategies she has in mind. It becomes clear that she will emphasise mental, sequential strategies, perhaps with some use of informal jottings (DfEE, 1999, p. 2/4). This is very much in keeping with the *National Numeracy Strategy*, which, following the Dutch RME (Realistic Mathematics Education) approach, emphasises mental calculation methods in the early grades. Sequential (or cumulative) strategies for two-digit addition and subtraction begin with one number (for subtraction, the minuend) and typically move up or down the sequence of integers in tens or ones. Split-tens methods, by contrast, partition both numbers into tens and units

and operate on the two parts separately, before re-combining (e.g. Anghileri, 2000, pp. 62-65). The objective of the previous lesson (on adding near-tens) and the current one is taken directly from the NNS *Framework* (DfEE, 1999) teaching programme for Year 2:

Add/subtract 9 or 11: add/subtract 10 and adjust by 1. Begin to add/subtract 19 and 21: add/subtract 20 and adjust by 1. (p. 3/10)

These objectives are clarified by examples later in the *Framework*; such as

58+21=79 because it is the same as 58+20+1; 70-11=59 because it is the same as 70-10-1

24-9=15 because it is the same as 24-10+1; 35+19=54 because it is the same as 35+20-1 (p. 4/35)

The superficial similarity in these examples; captured in the NNS objective immediately above, is, we would suggest, deceptive. The differences between them can be articulated in terms of what Marton and Booth (1997) call 'dimensions of variation'. The dimensions in this case bring with them different kinds and levels of complexity, as follows.

Dimension 1: Addition or subtraction. In general terms, it might be thought that subtraction is the more demanding. Indeed, the first lesson of the two had dealt exclusively with addition, the second with subtraction.

Dimension 2: Near multiples of 10 or 20. Again, it seems reasonable to anticipate that adding/subtracting 20 is the more demanding. Indeed, Chloë has explicitly planned for the lower-attaining groups of pupils to work exclusively with 9 and 11.

Dimension 3: One more or one less than 10/20. Addition and subtraction of 11/21 entail a sequence of actions in the *same* direction i.e. aggregation or reduction; whereas 9/19 require a *change* of direction for the final unit i.e. compensation. Research confirms what might be expected, that the latter is less spontaneous and more demanding (e.g. Heirdsfield, 2001). Indeed, the compensation strategy for adding/subtracting 9 is, in lay terms, a 'trick'.

Discussion point: what considerations determined Chloë's choice of worksheet problems for the two 'ability' groups in the class?

Transformation. We pick out two factors for consideration relating to this dimension of the quartet (as usual, bearing in mind that they are underpinned by foundational knowledge). First, Chloë's use of the 100 square as a model or representation of the sequence of two-digit positive integers. The 100 square is useful for representing ordinal aspects of the sequence, though with some discontinuities at the 'ends' of the rows, and particularly for representing the place-value aspects, although a 0-99 square arguably does this better (Pasternack, 2003). Chloë makes full use of the 100 square in her exposition, but is frequently dismissive of children's use of the spatial language that it invites.

For example, subtracting 9 from 70, she places the counter on 70:

Chloë:	Right, there's 70. [] From 70 I want to take away nine. What will I do? Rebecca?
Rachel:	Go up one.
Chloë:	No, don't tell me what I'm gonna go up or move, tell me what I actually do.
Rachel:	Take away one.
Chloë:	Take away one to take away nine? No. Remember when we added nine we added ten first of all, so what do you think we might take away here? Sam.
Simon:	Ten.

This would seem to relate to the format of the NNS examples (above), which she follows in four 'model' solutions that she writes for reference on the board, e.g.

70 - 9 = ?, 70 - 10 + 1 = 61

Somewhat surprisingly, the children are forbidden to use 100 squares when they do the worksheet exercises. Chloë refuses a request from one child for a "number square", saying, "I want you to work them out all by yourselves". In fact, there is nothing in Chloë's lesson plan to indicate that she had intended to use the 100 square in her demonstration.

Discussion point: What led Chloë to use the 100 square? What are its potential affordances - and constraints - for calculation relative to the symbolic recording in the NNS examples? Had she considered using an empty number line (e.g. Rousham, 2003) as an alternative way of representing the numbers and their difference, of clarifying when compensation is necessary, and why?

The other aspect of transformation that we select here concerns Chloë's choice of examples. As we have observed, this has emerged as a rich vein for reflection and critique in every one of the 24 videotaped lessons. Space considerations restrict us to mentioning just one, in fact the first chosen to demonstrate subtraction, following the initial review of addition. Chloë chooses to subtract 19 from 70. We have already argued that subtracting 11 and 21 would be a more straightforward starting point. Moreover, 70 is on the extreme right boundary of the 1 to 100 square. After moving up two squares to 50, there is no 'right one' square: it is then necessary to move down and to the extreme left of the next row, so the neat 'knights move' is obscured, and the procedure unnecessarily complicated. We note that one of the NNS *Framework* examples (above) is 70 - 11, and that all four of Chloë's whiteboard template examples were of the form 70 - n.

Discussion point: Was Chloë aware in-the-moment of the complication mentioned above, or did she anticipate it in her planning? Did the symbolic form in her written plan (70 - 20 + 1) perhaps obscure the consequences of her using the 100 square for this calculation?

Connection. Chloë makes explicit links with the previous lesson on adding near-multiples of 10, and reviews the relevant strategies at the start of this one. Her oral and mental starter, on complements to 10 and 20, essentially focuses on the concept of subtraction as comparison, whereas the strategy taught in the main activity is on change-separate, or 'take away', subtraction (Carpenter and Moser, 1983). Procedures associated with the two concepts tend to be based on strategies for counting on and counting back respectively (*ibid*.). Arguably Chloë could have encouraged some flexibility in the choice of such procedures, whereas she chose to prescribe exclusively forms of counting back in the main activity. The effect of her approach to differentiation for the different groups was to emphasise the similarity between 9 and 11 (needing an initial subtract-10) and between 19 and 21 (subtract-20), when the pairing of 11 and 21 (consistent reduction) and 9 and 19 (needing compensation) was an alternative form of connection.

Given her use of the 100 square to demonstrate the strategies, there was scope for some discussion of the links between vertical and horizontal spatial movements on the board and the tens-ones structure of the numbers under consideration. As we have remarked, she actively discouraged children's reference to the spatial analogue. It seemed that her attention was on conformity at the expense of flexibility and meaning-making.

Discussion point: discussion could usefully focus on the two subtraction concepts, how they relate to the first two phases of the lesson, and whether comparison strategies might offer useful alternatives to 'take-way with compensation', in the case of subtracting 9/19.

Contingency. A key component of our conceptualisation of this dimension of the quartet relates to how the teacher responds to unexpected or deviant ideas and suggestions from children in the lesson. There are no compelling distractions from Chloë's planned agenda for the lesson in this episode, although the child's question about using the number squares for the exercises might be a case in point. Various children's use of up/down language on the 100 square, to which we have already referred, might have been usefully explored rather than dismissed. A similar opportunity presented itself when, in the review of adding 9 at the beginning of the lesson, Chloë invites one of the pupils to demonstrate:

Chloë:	Show the class how you add ten and take away one on a number square. What's the easy way to add ten on a number square? Cameron.
Cameron:	Go diagonally.
Chloë:	Not diagonally. To add ten you just go

Cameron: Down.

No further reference is made to Cameron's diagonal proposal, although his elegant use of vocabulary alone is surely worth a moment's pause. It is true that his initial suggestion is not, strictly, a correct answer to her "add ten" question. It does, however, offer a nice spatial way of thinking about adding 9 - and adding 11 too - and suggests that Chloë's mentor may have stressed it in the previous lesson. Indeed, the fact that adding 9 corresponds to a diagonal southwest move might usefully connect to the insight that subtracting 9 would necessitate a north-east move, and the consequent need to *add* one after subtracting 10. It would seem that Chloë is too set on her own course to explore the possibilities offered by remarks such as Cameron's.

Discussion point: Did Chloë recall Cameron's suggestion? If so, how did she feel about it at the time, and how might she have responded differently?

It is important to add that the second question in this proposed discussion point is not intended as a thinly-veiled rebuke or correction: there are often very good reasons for teachers sticking to their chosen path. The purpose of the question is to raise awareness of the fact that an opportunity was presented, and that a different choice could have been made. We also reiterate that a single event or episode can frequently be considered from the perspective of two or more dimensions of the quartet, as demonstrated in our commentary.

Further Developments

In this paper, we have introduced 'the knowledge quartet' and shown its relevance and usefulness in our analysis of part of Chloë's lesson with a Year 1/2 class. We have a manageable framework within which to discuss actual, observed teaching sessions with trainees and their mentors. These groups of participants in initial teacher preparation, as well as our university-based colleagues, need to be acquainted with (and convinced of the value of) the quartet, and to be familiar with some details of its conceptualisation, as described in this paper. Within the last year we have taken steps towards this familiarisation in the context of our own university's pre-service elementary and middle school teacher education programmes. The four dimensions of the knowledge quartet have been used as a framework for lesson observation and reflection. Initial indications are that this development has been well received by mentors, who appreciate the specific focus on mathematics content and pedagogy. They observe that it compares favourably with guidance on mathematics lesson observation from the NNS itself, which focuses on more generic issues such as "a crisp start, a well-planned middle and a rounded end. Time is used well. The teacher keeps up a suitable pace and spends very little time on class organisation, administration and control." (DfEE, 2000, p.11).

It is all too easy for analysis of a lesson taught by a novice teacher to be (or be perceived to be) gratuitously critical, and we therefore emphasise that the quartet is intended as a tool to *support* teacher development, with a sharp and structured focus on the impact of their SMK and PCK on teaching. Indications of how this might work are explicit in our analysis of Chloë's lesson. We have emphasised that our analysis has been *selective*: we raised for attention some issues, but there were others which, not least out of space considerations, we chose not to mention. The same would be likely to be true of the review meeting - in that case due to *time* constraints, but also to avoid overloading the trainee with action points. Such a meeting might well focus on a lesson fragment, and on only one or two dimensions of the knowledge quartet for similar reasons. At our university, mentor training on the knowledge quartet and its use has emphasised the need to be specific and selective in the use of feedback. Mentors took part in workshops in which several groups observed the same videotaped lesson with a focus on one of the four dimensions of the quartet. Useful discussions followed concerning the quantity and type of feedback that would be appropriate.

Any tendency to descend into deficit discourse is also tempered by consideration of the wider context of the student teacher's experience in school. In the novice teacher we see the very beginnings of a process of reconciliation of pre-existing beliefs, new 'theoretical' knowledge, 'practical' advice received from various quarters, in the context of highly-pressured, high-stakes school-based placements. There is also good evidence (e.g. Hollingsworth, 1988; Brown, Mcnamara, Jones, and Hanley, 1999) that trainees' concern for pupil learning is often eclipsed by their anxieties about timing, class management and pupil behaviour. In an attempt to recognise and address this, the knowledge quartet is being introduced to trainees on both the Early Years and Primary PGCE and the Key stage 2/3 PGCE at our university, in order to direct attention to the subject content dimension of their classroom practice, and the ways that content knowledge might inform their planning, preparation and teaching. These sessions have also been well-received, with the trainees welcoming the quartet as a way of framing their thinking about their teaching. Many have expressed interest in participating in quartet-related research in their first teaching appointment (see below). By introducing mentors, mathematics co-ordinators and trainees to the knowledge quartet, we are provide all relevant 'stakeholders' with a framework for the discussion of mathematics planning and teaching that will encourage a focus on the subject content as well as the management of lessons. In addition, we have recently been analysing lessons taught by secondary mathematics PGCE students, through the lens of the knowledge quartet. We could add that colleagues working in English and in science education see potential in the quartet for their own lesson observations and review meetings: it would be interesting to see what the conceptualisations of the dimensions of the quartet look like in these and other subject disciplines.

Our research on the application of the knowledge quartet as a tool to support teacher development is now being extended within a project working with beginning teachers over the first three years of their teaching. This project grows out of a recognition that the mathematical knowledge and understandings of teachers, their beliefs about the nature of mathematics and the teaching and learning of mathematics, cannot be radically changed within the one year PGCE. In this project the participants will be helped to become increasingly familiar with the quartet in order to use it as a shared language for discussion of, and reflection on, their mathematics teaching. To date, eleven trainees from one cohort of the Early Years and Primary PGCE course have worked with a researcher and discussed video-tapes of their lessons with specific reference to the four dimensions of the knowledge quartet. This is the beginning of a four year longitudinal study looking at how the quartet may be used with beginning teachers and their mentors to develop mathematics teaching. It is also expected that findings from this study will also inform the development of the conceptualisation of the quartet and our understandings of how to facilitate its use by others.

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Lesson Observation: What do we record?

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I was attracted to write about this topic partly because I am relatively new to the world of teacher education and the call for papers encouraged people in that situation to do so, but more because I feel happy with the processes that I use to provide records of lessons that I observe. I realise as I write that rather smug statement that I am setting myself up for criticism and I look forward to reading what others have to say!

At the University of Manchester, as, I imagine, at many other institutions, we have an agreed form (based the QTS standards) on which to record our observation of lessons, and we are strongly encouraged (and supported by the provision of laptop computers) to record such observations electronically. This accords well with what I would wish to do in any case and suits my style well; I have developed my own electronic version of the form that works better for me than the original.

In reflecting our current practice, I have been reminded of the records I received on my own lessons on teaching practice at the Institute of Education many years ago – a few comments from my tutor written on a page torn out of an exercise book! And, at that time, very few of my lessons were observed by teaching staff at the school and none were formally recorded by them. These days, many formal observations are required, pieces of paper for people's filing cabinets seem to be necessary and records can be called for in (rare) cases of warning, student appeals, etc. These are not, however, the main reasons why I wish to record my observations of and reflections on the lessons I observe; my reports are addressed to the trainee and I see their purpose as being to provide supportive developmental feedback in a form that the trainee can reflect on, perhaps discuss with others, and learn from.

It is an enormous privilege and great delight to be permitted to sit at the back of other people's lessons and write about what I see (though it is rare for me to contain myself sufficiently to sit still at the back and not get out of my seat and talk to the pupils about what they are doing!) and I always encourage our trainees to observe and criticise me when I am teaching them at the university – I have learnt so much from observing others and hope that they will do so too!

My practice is to record as much as I can on my laptop during the lesson as it happens, but not to attempt to produce a final document at the time. I know that some people do this and I have worked with such a system myself, but I

welcome the opportunity to discuss to what I see with the trainee and (usually) with the mentor after the lesson and, later, to reflect on it before finalising my writing. In particular, discussing the lesson with the trainee can provide a different perspective on what occurred and, sometimes, encourage me to soften a harsh judgement that I may have made or persuade the trainee to be more self-critical. I think of and then write about what else could have been done in the lesson, focussing in particular on different aspects of the mathematics, on questions that could have been asked and responses that could have been given, and on links that could have been made with other mathematical topics, other subjects and real life. I often present my reflections in the form of questions to the trainee with the aim of encouraging a reflective approach.

My time target is to complete my report and e-mail it to the trainee on the same day as the lesson, before our memories of the lesson fade and the writing loses its value. I encourage the trainees to discuss the reports with their mentors in their weekly meetings, and I offer them the opportunity to correct any errors I have made and to let me know if they feel I have misrepresented them. I rarely get such feedback, most trainees apparently finding the feedback fair and helpful, but I occasionally have corrections of fact ("I did set homework", etc) and, on one occasion, some comments indicating that my judgement of the trainee's success in managing the lesson effectively was not a fair reflection of the situation. This related to a lesson after which, unusually, I had had to rush away and had not been able to discuss what happened in any detail with the trainee. A painful reminder that I should, have course, have spoken to him before sending him my comments.

Writing reports on trainees' lessons is time-consuming and there are times when I wish I didn't have to do it – but the feedback that I get from trainees about the reports they receive indicates that this is one of the most important aspects of my work.

On the next pages there is a reduced sized copy of the pro-forma Anne uses. Ed.

Lesson Observation Report

s for users:
reginning teachers show twen written feedback week during continuous wractice as part of the p monitoring and assessive use the separate areas main achievements and
he lesson and to assist n the targeted developi eaching skills.
 Area 1 (eg High expect Respect and pupils Setting a go
Area 2 KU Knowledge levels Knowledge specification Subject knowled Accuracy Prior knowled Subject rela Common m addressed

- 3 TEACHING
- 3.1 Planning, Expectations and Targets

- uld be observed and at least once per school/college process of ng their work
- to summarise the issues arising from beginning teachers ment of their

g)

- ations of all pupils
- consideration for
- od example

(eg)

- of NC PoS and
- of subject
- wledge base
- edge accounted for
- ted questions
- isconceptions
- appropriate contexts
- Links with other subjects

Area 3 PET (eg)

- Appropriate objectives
- Preparation and use of resources, including ICT
- Use of support staff
- ٠ Plan builds on prior learning
- Plan is pitched at an . appropriate level

University of Manchester PGCE

Area 3.2 MA (eg) 3.2 Monitoring and Assessment • Giving sound feedback • Self-evaluation Effective questioning Differentiation Monitoring pupils' progress Assessing achievement of objectives • Marking 3.3 Teaching and Class Management Area 3.3 TCM (eg) ٠ Relationships with pupils ٠ ICT . Purposeful learning environment Health and safety Literacy and numeracy (key skills) Whole class, group and individual teaching Pace . Classroom presence . Management of . pupils/resources Homework ٠ Key Strengths of Lesson (include at least THREE)

Targets arising out of this lesson (at least ONE, no more than THREE)

Twenty Years of Observing Mathematics Lessons

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Over the years of working in teacher education, much has changed and this is reflected in how I record my observations. I offer three examples of these records one of an earlier style, these were often completed with the student, and two written after the lesson and discussion with the student, one for a strong student and one for a weaker student, to account for the standards.

In the many years I have been observing student teachers on teaching practice, two significant changes have taken place. The first, the introduction of school based training in 1994 (DfE, 1992) meant working in partnership with schools, fewer visits to schools and a greater emphasis on moderation and monitoring during those visits. The second big shift happened as a result of the same circular. This was the move to assessing students against competencies, and later assessing trainees against standards (DfES, 2002).

In responding to these changes, my own practice in lesson observation has become much more formal. Before 1992, I would write continuous lesson notes (carbon copied so the student and the school could keep a copy), often very descriptive but punctuated with starred comments highlighting significant incidents or making judgments or offering advice. These would be shared with the student after the lesson in a one to one discussion.

This practice was adapted to address competence based assessment, retaining the free notes but filling in a form structured in sections corresponding largely to the individual competences (subject knowledge, subject application, class management, assessment and recording of pupils' progress, relationships with pupils) either during the lesson or afterwards. I always tried to fill this form in with the student, using the free notes, and inviting their contribution. Wherever possible, the mentor or class teacher did a joint observation and joined in the post lesson discussion. This was an improvement on the previous practice as it gave the student and mentor more involvement. Moreover, the process of analysing the whole lesson against the competence categories, using the running notes as raw data, was a useful evaluative exercise and helped me to focus on aspects of the lesson which I might otherwise ignore. The general pattern here would tend to be that many teachers would comment very little on subject knowledge, assuming that all students were strong in this area, but write a great deal in the class management category. I would tend to comment on the ways a student's breadth and depth of subject knowledge was revealed in the lesson, including how they were using the framework of the National Curriculum, how they presented the mathematics to pupils and on assessment for learning seen in the lesson rather than the recorded assessment over a period of time. An example of one of these feedback sheets is given in figure 1.

Figure 1.

A Subject knowledge

This was an investigational activity which involved elements of AT1 (communication, reasoning) and AT3 (making and testing generalisations).

B Application of subject knowledge

The investigation was presented clearly and pupils were given several examples to familiarise themselves with the problem and direction to be followed. It was accessible, and provided opportunities for differentiation by outcome. Excellent opportunities given for pupils to explain things in their own words and develop their communication skills. Some very good work produced. Alternative ways of recording encouraged.

C Classroom management/organisation

Pupils were working either in pairs or in groups, but did their write-ups individually. A lively group, handled firmly, without losing their interest. Motivation increased noticeably as pupils became more involved in the work and achieved success.

D Asessment/recording of pupils' progress

The assessment criteria for the work were shared with the pupils at the beginning and referred to as you circulated and monitored progress. 'Write that down etc.'You listen to the pupils and try to move them on without being overdirective.

E Relationships with pupils

Good working relationships with the pupils. You are firm, open and reasonable with them. You encourage them and praise them for good work. You are obviously sharing in and enjoying their learning and progress.

F Competences requiring further development

This was a very good lesson. With work like this you will need to develop the hard part – encouraging pupils to explain why their pattern/generalisation works.

In my present institution the second of three visits focuses strongly on a lesson

observation with oral feedback after the lesson and written feedback sent to the trainee subsequently. The argument for this is that the detail and number of the present standards make it too difficult to fill in one of the official forms there and then. This has advantages and disadvantages - the written feedback is delayed and may have lost its impact but it may be more considered. It also feels much less collaborative than the second model described above. The written feedback for a strong student using this model is given in figure 2.

Figure 2.

Focus: General observation and/or in relation to previously identified targets. General

Knowledge and Understanding: NC/National requirements, progression, ICT, SEN, own subject knowledge.

The work for both lessons was set at an appropriate NC level for each class. Your own subject knowledge was good, and in the statistics lesson enabled you to emphasis key ideas. With yr 7s the pupils were using the ILP 'Successmaker'. You were able to support the pupils and overcome any technical hitches.

Planning, Expectations and Targets: Objectives, assessment opportunities, gender/ethnicity, resources, safety, support staff, out-of-school contexts.

The planning was good. The Yr 8 lesson was a three part lesson, with the starter sensibly used to recap previous learning, the development to consolidate understanding of the mean, median and mode, including the types of distribution where they can be deployed, and the plenary designed to sum up the key ideas. You are also clearly planning for what comes ahead.

Teaching and Class Management: Expectations, relationships, structure and sequence, differentiation, motivation and pupils' interests, manage time, discipline, use ICT, homework, independent and collaborative learning, equal opportunities.

There were high expectations in evidence, the lessons were well structured, examples were well chosen, the text exercise and the worksheet were both appropriate. Your explanations were good. There was good use of question and answer. The pupils discussed definitions in the whole class and then wrote their own in their books. This was helpful for their mathematics and their literacy skills. The later exercise where pupils had to decide which measures could be used in different situations used pairs collaborating. This was good – you could have extended the whole class discussion here a little as the pupils were making interesting points in response to this more challenging activity.

You have picked up one of the big weaknesses of Successmaker - the rigid

adherence to standard algorithmic procedures when pupils are almost certainly doing mental methods. This may be worth discussing with the class.

Monitoring and Assessment: Range of strategies, constructive feedback, involve pupils, NC and other criteria, support and SEN, language demands, records, communicate to others.

You picked up and built upon pupils' understanding in the q/a sessions. You also circulated well in both lessons. When you are circulating you tend to do it quite rapidly and are scanning the whole class to make sure everyone is on task. This is good but don't lose the opportunity to dwell with some pupils for a bit longer, or to be proactive (e.g. Can you talk me through how you are going to do this?) rather than reactive, or to look over their shoulder as they are working to find out what they are thinking. You have good command of the classes and so you can afford to do this.

Professional Values and Practice: Pupils' backgrounds, consistency, positive values and behaviour, recognise rights and responsibilities, contribute to school life, roles of professionals, evaluation, statutory frameworks and regulations.

Your professionalism and enthusiasm is clear in your planning and teaching.

TARGETS (up to 4 derived from the standards)

- * Voice you are tending to speak at the same level and this sounds a bit strained at times. Try to think consciously about modulating the tone of your voice.
- * Your subject knowledge is good but you could stress that the 'fair shares' idea behind the mean and that the median splits the distribution in two (50% below, 50% above). You could give particular examples to show how changing the highest value can alter the mean dramatically but leave the median and mode unchanged. You referred to this briefly – it may have been good to find each value for a particular distribution to stress this point.

Other Comments

(e.g. progress on previous targets, comments on teaching file, noteworthy achievements, opportunities and suggestions)

You seem to be doing very well in this supportive school and will be able to develop your expertise further in the next phase. Keep up the good work!

The last example in figure 3 was for a trainee judged to be weak in the same school as the second student.

Figure 3.

Focus: General observation and/or in relation to previously identified targets.

You are focused in general on class management issues. I watched this lesson with particular attention to some of the previously identified targets of lesson planning, matching, and differentiation.

Professional Values and Practice: Pupils' backgrounds, consistency, positive values and behaviour, recognise rights and responsibilities, contribute to school life, roles of professionals, evaluation, statutory frameworks and regulations. You were ready for the lesson and taught it in a professional way with respect for the pupils.

However, you did not have all the necessary documentation which I had asked for - in particular the standards profile. I would have expected you to have made some headway with this given our conversation before Christmas. Jo can help but it is your responsibility.

Related to this, none of the lessons in the TP file have been evaluated. There is no evidence therefore for Standard S1.7.

Knowledge and Understanding: NC/National requirements, progression, ICT, SEN, own subject knowledge.

You know the relationship for angles at a point on a straight line (talking about angles on a straight line may lead pupils into misconceptions), the angle in a complete turn and the angle sums in triangles and other polygons. Your own knowledge is not yet sufficiently flexible to respond to pupils' unexpected questions "Sir does this always work? " See the visual 'proof' I sent to you which may be appropriate at this level. The material for the lesson built on previous work on angles. Had you thought of making links with the algebra topic by making explicit the way algebra was being used in the angle chasing exercise (why have they put a letter next to this angle? We have to work it out. It's unknown to us at the moment but we may have enough clues to help us. Why have they used a different letter here and the same letter here etc.)

There were no pupils with SEN in this class.

Planning, Expectations and Targets: Objectives, assessment opportunities, gender/ethnicity, resources, safety, support staff, out-of-school contexts.

The lesson was planned and had objectives which you had written up on the board but not referred to. What are objectives for?

Two pieces of card joined by a paper fastener is a nice way to demonstrate the dynamic properties of angles – pupils can estimate as you turn and the relationship between value and type of angle can be established. It is also nice for opposite angles. The resource of paper triangles with torn out angles to

produce a conjecture about the value of the triangle angle sum is a nice idea. Next time you could use the OHP to illustrate how to assemble the cut out angles but more importantly to put several examples up where the angles were demonstrably different in size. When planning, highlight the punchline:

The angle sum seems to be about 180°

so that you can emphasise this in your teaching. When planning you need to think of different ways of solving the same problem so that you can build on pupils' different ways of seeing things.

Have you thought of ways you can use out of school contexts in this topic (using bearings and back bearings, setting up an orienteering course are great ways of making this come to life).

You need to learn how to use the school's dynamic geometry software before trying it out with pupils – it opens up all sorts of possibilities for conjecture.

Teaching and Class Management: Expectations, relationships, structure and sequence, differentiation, motivation and pupils' interests, manage time, discipline, use ICT, homework, independent and collaborative learning, equal opportunities.

The lesson was structured appropriately with a short starter establishing previous knowledge, a practical activity and a nice textbook exercise which was varied and challenging. The work seemed to be appropriately matched for most pupils. Differentiation seems to be by rate of progress.

The pupils did seem motivated by the work – when they were working on the exercise there were some lovely examples of peer teaching going on. This happened by default – you could set up collaborative groups deliberately and ask them to report back

With three people in the classroom, discipline did not seem to be a problem. You have an authoritative voice and can call the pupils to attention when you need to. Don't forget that praise and reward, whilst valuable in their own right, are also a means of gaining mutual respect

Monitoring and Assessment: Range of strategies, constructive feedback, involve pupils, NC and other criteria, support and SEN, language demands, records, communicate to others.

Assessment for learning was the weakest part of this lesson. You asked 'what' questions throughout the lesson and only asked one 'how' question at the very end when you asked them how they could find the angle sum for a quadrilateral. This elicited some wonderful responses (it's 360° because it's got 4 right angles) which you could have probed and developed but you were intent on moving towards what was in your head. You also need to ask 'why' questions and give

the pupils time to answer.

Asking such questions can be part of differentiation since it will help you identify those who are not 'getting it' and those who need extra stimulation. I would have liked you to leave the angle sum of the quad etc as something for them to chew on until next time.

Even when you went round the class you did not draw out from the pupils what they were thinking but rather you told them how to solve the problems.

TARGETS (up to 4 derived from the standards)

- * More detailed planning including the use of a wider range of resources and more thought given to differentiation. Lesson evaluation is part of ongoing planning and must be done.
- * Assessment for learning in the classroom (no evidence of S3.2.2). As you gain confidence you really have to try to find out what is going on in the children's heads and build upon it.
- * Evaluation and reflection related to the standards must be done. You would not go into a maths exam without knowing what you were to be tested on! If you were more familiar with the standards you would have been able to respond better to the question about adaptations for EAL learners in terms of greater use of visual aids and more discussion of pupils' thinking.

Other Comments

(e.g. progress on previous targets, comments on teaching file, noteworthy achievements, opportunities and suggestions)

The school identified targets are very appropriate and you will only get to grips with them by explicitly evaluating your practice. This may seem to be a paper chasing exercise but it is meant to help you reflect, monitor your own progress and make decisions about future actions.

Doing this would almost certainly help you with your own identified priority of class management. Behaviour is often closely tied up with the work and the relationships developed through showing an interest in children's progress. Good luck with the next few weeks of the development phase.

The school had identified difficulties with this trainee before I went in to see the lesson. In particular they doubted his commitment and interest in the pupils. Before the lesson, he confessed his doubts about teaching and confessed that he was not particularly interested if pupils could not understand mathematics which he found obvious. He eventually left the course. In looking back at the above feedback I cannot help but feel that it was fair but it must have felt excessively

damming - the final straw for a trainee who was already on the brink of leaving.

Reflections

I have always regretted the reduction in the number of University tutor lesson observations after the move to school based training, probably because I enjoy being in mathematics classrooms. Other tutors are happy to let the school take the major responsibility for this and will defer to teachers' judgements based on greater numbers of observations and knowledge of the context. I also feel that seeing so few lessons can make the visit and feedback seem too important or occasionally not important at all. But even seeing one lesson and linking this to what I know about the trainee from university sessions and what has been said by school in their feedback can be very illuminating. Moreover, the observation gives the tutor primary data rather than reports and reviews for which the evidence base is not always evident! Even one lesson can be a case of seeing the general in the particular.

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Observing Mathematics Lessons with Blank Record Sheets.

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This article offers a description of my practice when observing mathematics lessons. Our university report form is a blank sheet and individual tutors decide how they will record their observations. My observations are mainly descriptions with a summary table of positive aspects and things to work on, written at the beginning of the sheet but at different times in the lesson, having developed over many years.

On our secondary PGCE course, we use non-carbon triplicate sheets with no formal guidance as to how they are to be used for the observation of our student teachers. These forms are used regularly by tutors, mentors and senior mentors and sometimes by co-teachers. Any advice on how mentors should use the sheets is left to subject tutors and with our mathematics mentors we have done joint observations, read observations from other schools in mentor meetings with discussions to inform our joint practices. However, what we do is still individualistic and here I describe how I now work with these blank sheets.

History

In the sixteen years I have been working in teacher education, I have witnessed the many changes which continually impinge on all aspects of education. The two major factors which have changed my job, in relation to observing preservice teachers on placement during their PGCE year, are the introduction by the government of more formal partnership arrangements with schools, with the related payments to schools, and the introduction of the standards.

Prior to the formalisation of partnerships (DFE, 1992), my responsibility was to supervise twelve students on placement, visiting each student twice on their first five-week placement (Autumn term) and five times on their 12-week (Spring term) placement. Our formal assessment of teaching currently takes place at the end of the twelve-week placement, just before Easter. As a result, in the third placement in the summer term, I only visit those weaker students who have not yet passed the practical teaching element. With the reforms which strengthened the role of the schools in the training partnership there was new money. This was (and is) sensibly spent on mentor training, mentor meetings and shared working on the PGCE programme. However, sacrifices had to be made in the university provision to pay for the supervising and assessment role schools were to play in training. This meant that tutors now had twenty students to supervise. There was insufficient time for seven visits to schools, so the decision was made that tutors would visit only once in the first placement and twice in the second. The tutor's official role is now one of moderation rather than assessment. The mentor and senior mentor are responsible for the decision to pass and fail, moderated by the tutor. The change from seven to three visits (even though the latter are on average longer than the original visits) has, for me, changed the way in which I relate to students during my school visits.

The other major change to my practice has been, naturally, the introduction of the standards (DfEE, 1998; DfES, 2002). As a group of tutors, we have never been in favour of working to the standards, so that they dominate our practices. We see them as guidelines to aid assessment not things to be constantly accounted for. In some recent research¹ with mentors and trainees on Graduate Teacher Programmes (GTPs) (Prestage et al., 2004), one of the tasks, which caused most complaints from both GTPs and mentors, was the process of collecting three pieces of written evidence for each of the standards. Our focus group of mentors questioned why they could be trusted with the training of the GTPs yet had to account for the evidence of their reaching the standards in such a cumbersome way. They argued that there was plenty of written evidence available as part of their students' usual practice; lesson observations, observations and written details of meetings were part of the ongoing routine. They argued that extracting from this data pieces of writing which related to a specific standard was unnecessary. There were even cases of trainees asking for witness statements to say "I have seen ... doing ...", if they could not find it written elsewhere. Many of the GTPs spent the last months of their training collecting and cross-referencing the evidence. This ran to four archive boxes for one of our case studies. Fortunately, we are trusted to make judgements and we trust our mentors and senior mentors to make judgements without always referring to the standards or expecting our students to collate such evidence in so explicit a way. I refer to the standards when there is work to do on them, but otherwise it is the teaching and the pupils' learning which tend to be my major focus

As a group of secondary PGCE tutors, we have always had a strong team focus and we discuss the administration of the course regularly. Whenever observation

¹This research was sponsored by the Teacher Training Agency, 2004-2005.

of teaching has been discussed, tutor of trainee or tutor of tutor, the team has always rejected structured observation sheets and refused tick lists. As a result, our observation forms are blank sheet style. They are triplicate sheets, one for the student, one for the mentor and one for the tutor, where the continuation sheets are only printed with a place for the signature of the observer and the page number. The first sheet has a little more information expected and asks for names, date etc., see figure 1.

Figure 1: Reduced Version of the First Observation Sheet.

UNIVERSITY ^{OF} BIRMINGHAM	Student:	
School of Education	Observer:	
	Lesson: 7M2 9-15 to 1055 Topic: Rotate.	
Observation focus (if appropriate): TARGETS (D 3.3.1 Heck Experience: Explain Ne marks (D) 3.3.6 (3) Noice		
Ne marie © 3.3.6 3 Voice Observer's comments: + · Calm, professional · Calm, professional · Calm, professional · Calm, professional · Varie - go for deep when attracting · Varie - go for deep when attracting attention · I would query he rature of all roranew 180° - what offers a Visual check · good management · clear signal. · planned collection, cleary · NB Justification		
Lesson late starting - extended assembly. 936 Pupils shel arriving		

There is a space for "Observation focus", based on the idea that as tutors and mentors we might find it useful to discuss with the students what the students would like us to observe. I have never managed to have this sort of conversation, probably because I much prefer to see what the students notice from their own review of the lesson. The setting up of a particular emphasis, in my mind, can lead to the student concentrating on that rather than the learners. I found it very difficult listening to mentors in the focus group saying that their GTPs, towards the end of their time, were asking them to notice and record x as they needed some more evidence related to that standard. The mentors confirmed that the emphasis did change how their students taught and reacted to pupils in order to be seen to demonstrate x. So I go in to watch a lesson with a copy of the student's lesson plan, sometimes having had a discussion before the lesson, but

this rarely touches on the actual lesson, in case I put the student off by offering 'helpful' advice. It is too easy to get carried away with one's own way of doing things, which is not helpful just before the student has to go and do. The student may offer some pointers about the lesson, although this is often about the class in general, their behaviour etc., or the influences on this particular lesson, time of day, previous lesson. I begin my observation having read the lesson plan and marked aspects that I feel may need careful watching. So what do I record?

My Observations

When I am in the classroom, as well as observing the lesson I read through the student's teaching file, making comments on lesson plans and their evaluations, checking that every aspect requested is in the folder. How much detail I write on the folder depends on how much I feel I have to write about the lesson, but in most lessons I do have a good sense of at least the work relating to the class being taught and the overall status of the file. If I feel that there are major or regular issues with the lesson plans and evaluations in the folder, then these points are also written on the observation sheet.

When observing a lesson I tend, on average, to write about three to four sides of A4, with fairly small writing (see figure 1). I try to write what I am seeing and hearing, including the time at transition points or where I notice an aspect of time keeping I would like to discuss. I record what I see on the board, some snippets of what the teacher says and some responses from pupils. What I write has changed a lot from the first model of visits I worked with. When visiting seven times, I tended to write less and stay focussed on a few things. I would think about the major things which the trainee needed to develop and would look for this in the lesson and how I might comment on it. I could build up the amount and type of feedback bit by bit and my discussions with the student were shorter and concentrated on fewer issues. Now having only three visits, I feel the need to have as much information available as possible and I spend longer on the debrief at visits (see table 1).

	Average Length of Observation	Average time of Debrief
Earlier Model		
1.Visit 1 (SP1)	1 page	30 minutes – this tended to be discussion of timetable and reassurance
2.Visit 2 (SP1)	2 pages	60 minutes, student expected to be beginning to be critical of performance

Table 1: Amount of observation and debrief time

3.Visit 1 (SP2)	2 pages	45 minutes
4.Visit 2 (SP2)	2 pages	30 minutes – student also given
		expectation of type of lesson for
		next visit
5.Visit 3 (SP2)	1 page	30 minutes – student also given
		expectation of type of lesson for
		next visit
6.Visit 4 (SP2)	1 page	30 minutes (sometimes it was not
		a whole lesson that I saw)
7.Visit 5 (SP2)	2 pages	45 minutes
Current Model		
1.Visit 1 (SP1)	3 pages	60 minutes – the student is
		immediately expected to be
		aware/critical of performance
2.Visit 2 (SP2)	3 pages	75 minutes – the student is
		expected to be able to deal with
		all issue that arise from the lesson
3.Visit 3 (SP2)	3 pages	60 minutes

This increase in writing and discussion may be a function of the fewer visits, feeling that I have to tell the student more, but I do believe that it is also as a result of my being able to notice more now, with the only limitation being the time I am in the classroom. I am much better at seeing things in the classroom. It still surprises me that when we begin this job we think we can do observations without any real practice or work with others. Why do we assume that because we were good teachers we are also good at noticing how others do it? I feel sure that I capture more of the teacher and pupil talk because I now realise the significance of that talk. I do not write in generalities, but I capture specifics. I write down all of the examples on the board so that we can discuss the nature of these examples. I do not assume that they will be the same as those in the plan (I used to!) I keep track of the time because I find that students are often surprised at the amount of time they have spent on some aspects of the lesson to the detriment of others. I have found it useful to capture direct quotes from teacher and children, as the exact phrase seems to hold more relevant information. Other than what I see, I will sometimes capture my own thinking in the moment on the points I notice.

Often what the student says is in contrast to what they write on the board, for example in a lesson on ratio with girls and boys coming to the front in the ratio 2:1,

the student wrote on the board: whilst saying

Fraction girls = $\frac{2}{3}$ The fraction of girls is two-
thirds.Fraction = $\frac{1}{3}$ The fraction of boys is one-third.Fraction of girls = $\frac{4}{6} = \frac{2}{3}$ The fraction of girls is two-
thirds, four-sixths in its lowest
terms.Fraction = $\frac{2}{6}$ The boys are one-third.

Of course sometimes the student will say almost exactly the same as they write on the board. The same student had written earlier:

As long as the ratio of girls to boys is the same (11:13) fractions are the same (Boys
$$\frac{13}{14}$$
 Girls $\frac{11}{14}$)

There is much potential for discussion in these two examples; the potential confusion over the 'whole', what aspects are the 'same' and how the board might be read by some pupils. I wrote no comments about this on the sheet, because I wished to use the points to assess whether the student would begin to see the issues for himself when the descriptions were reported to him. As tutors we must recognise that we can all say nonsense in the moment and being observed makes students more nervous and prone to such errors.

I will, if there is time as I write, offer advice on the mathematics, particularly if it is something we have worked on in method sessions. For example, a student was teaching 10% of £50 as:

10% of £50 =
$$\frac{10}{100} \times 50 = \frac{1}{10} \times \frac{50}{1} = \frac{1 \times 5}{1 \times 1} = 5$$

We had worked in a method session on mental methods for '10% of', so my comments included the statement "What happened to the units?" and "Is this an appropriate method?" Again I am writing this in the knowledge that this aspect of the mathematics will feature as part of the post-lesson discussion.

I may also suggest an alternative to the examples offered. One student began his lesson on sharing in a given ration with the tale of Megan and Sam. Megan was 13 and Sam was 15. Their uncle gave them £56 for Christmas, but they had to share the money in proportion to their ages. The class happily argued about the fairness of this, but then began to offer ideas about the method amongst themselves. The solution was then set out on the board and the example copied into books. The student did not assume that one worked example was sufficient, but gave them yet another story. This took a couple of minutes and the relative

fairness of the shares of sweets raise management issues as the discussion got more heated. My notes show - "You could have done the money next Christmas, say £60, and got them to work on the same problem ... The pupils' energy is with the story not with the maths."

If there are errors in the mathematics on the board, I highlight these in my notes. There is a tendency for Carol Vordemann maths to appear, one example I observed was on the volume of a prism:

Area of cross-section =
$$\frac{1}{2}base \times height$$

= $\frac{1}{2} \times 7 \times 10$
= $35 \times 20 = 700cm^3$
= Volume of Prism

More frequently I see one of my pet hates,

$$0.27 = 0.27 \times 100 = 27\%$$

My comments on this vary from "?????" to "I don't expect to see this" or statements that demonstrate even stronger objections.

I try to capture parts of teacher talk which, in my opinion need a rethink, or pupil responses where there may be alternative ways of interpreting what the pupil has said or places where there is potential for misunderstanding. In an example where a recipe needed flour and sugar in the ratio 3:2 of a total of 10kg, a pupil offered the correct answer and when asked for a method said "I just doubled them", the student response was "You have to do three-fifths of ten and two-fifths of ten." In the moment, the student teacher did not appear to recognise that this could be an example of the pupil demonstrating good number sense or that the teacher was pre-occupied by the algorithm.

My observation sheet tends, in the main body, to contain points I will discuss in the debrief. Fortunately many of the students will only need a brief hint from my notes on the mathematics for them to notice the incorrect mathematics or the potential for confusions. The discussions on examples will often be accompanied by the "Why didn't I think of that?" To which the response has to be that it will come with practice/experience.

One aspect, which is always very limited in my writing, is praise – there is the occasional 'good', for a decision in the moment or if I am trying to find something to offer as positive about a weak performance. But unless I can offer something extra to go with this comment, as in Dweck's (2000)

recommendation of praise with strategy, I tend to miss such praise out. When I do there is often a caveat; in my notes for one lesson I wrote:

"absolutely fantastic" – be careful not to over praise – nice to see you congratulating pupils but 'too' much can appear patronising.

My excuse for not offering much praise is that this is because I am writing commentary. This is probably not an acceptable explanation for the students for the lack of any overt reward for aspects well done.

As for assessment, this may be implicit in my notes but little is explicitly written on my observation sheets for the stronger students. Only if there are many areas of weakness or suspicions of lack of effort from my reading of the teaching file will there be statements made as to these weaknesses. Because of these major omissions, I have in the last few years adapted how I set up my sheets. I now head the first sheet with a 'positive' column and a 'things to work on' column, where I offer brief points as an overview. Even for the weak students, I feel it is necessary to be able to say something positive about the lesson, whilst the stronger students do need recognition. I recognise that here can be an issue with positive comments to the very weak student. They can often seem to see only these positive comments and by ignoring the 'to work on' argue that you have said they were working well. All experienced tutors must have met those students who cannot teach yet cannot recognise the fact. The list of things to work on can be quite long and as it is written as the points occur to me, they are not in any order of importance. The major points need to be extracted. The 'observation focus' section then becomes a target setting place where the main areas of work are highlighted. This is linked to the standards as I carry an abbreviated list of these. This was originally designed by Anne Sinkinson, Cambridge, and student, mentors and tutors have a laminated half side of A4 as in figure 3, so I can write 2a by my target, rather than having to write the standard in full.

The sheets are signed and finished as the lesson closes. I rarely add anything more to them unless I want to highlight a particular point where I feel the student needs to having a stronger written reminder of something which emerges from the debrief. These notes then form an aide memoir as the student and I talk about the points in the lesson. The observations about the board, the talk and the examples can be very useful to help the student to understand how I see the lesson and how I would like them to use these issues to develop their teaching further.

My final act, at the end of the debrief, is to hand over to the student the two top copies, one for the student and the other for the mentor, and to ask the student to read through them, firstly to check that they can read my writing, but also to take any questions about points they do not follow. I do not add to the notes after the session with the student. If I were to write the notes up afterwards I might be tempted to change the reading of the moment but also the student would not have the opportunity to discuss them whilst the memories of the lesson are still fresh. I also recognise that I would find this difficult because it is a time issue.

Table 2: Shortened Standards (adap	oted from DfES, 2002)
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1.	Professional Values & Practice
1.1	High expectations of all pupils. Respect social, cultural,
	linguistic, religious & ethnic backgrounds.
1.2	Treat pupils consistently, with respect & consideration.
1.3	Demonstrate & promote positive values, attitudes &
	behaviour expected from pupils.
1.4	Communicate effectively with parents/carers.
1.5	Contribute to the corporate life of schools.
1.6	Understand the contribution that support staff & other
	professionals make to teaching & learning.
1.7	Improve teaching by evaluation, the effective practice of
	others & from evidence. Able to take increasing
	responsibility for own professional development.
1.8	Work within the statutory frameworks (teachers' duties).
2.	Knowledge & Understanding
2.1	c. Secure knowledge & understanding of the subject, NC
	PoS, NS for KS3, cross-curricular expectations of the NC.
	d. Aware of the pathways for progression (including
	qualifications) through the 14-19 phase.
2.2	Know the Values, Aims & Purposes & the General
	Teaching Requirements. Familiar with the PoS for
	Citizenship & the NC Framework for PSHE.
2.3	Aware of expectations, typical curricula & arrangements
	before & after the 11-18.
2.4	Understand how pupils' learning can be affected by their
	physical, intellectual, linguistic, social, cultural &
	emotional development.
2.5	Know how to use ICT effectively.
2.6	Understand & use the SEN Code of Practice. G
2.7	Know a range of strategies to promote good behaviour &

What would I do differently?

Reading through some of my observation reports for this article, I am happy with the body of the reports, although I do, perhaps, need to be more explicit about the way I correct the mathematics for some of the weaker students, with a few more pointers. The area I feel I need to work on lies with my 'positive/things to work' on summary which comes at the top of the first sheet. I wonder if I am too vague for some and am expecting students to be able to do more with the list than is possible. For one (weak) student table 3 shows the summary.

The target is extracted from the 'to work on' list and is an attempt to prioritise where the major effort needs to go. This student had had very little in his evaluations on a previous visit, some annotations on his lesson flow and a 'this went well' as a conclusion, so there was significant progress and this was noted in his file as well as being written in the summary. However, these evaluations were still not at the standard expected so they still have to be worked on (hence the arrow.) The statement "you offer lots of algorithms with no purpose" was not understood by the student. My "you tell them how to get the answer, rather than helping them to understand so that they can do the maths" got me no further. However, I think for some students this would be a reasonable trigger for looking at their practice. Some statements seem, to me, to be clear, as in "explanations – you need to record the detail in your plan" or "use the IWB/plan board. However, statements such as "selling the maths", "create a need to know" may be of no use whatsoever unless we have worked on the ideas as a group.

Table 3: Summary Table for a Lesson

TARGET: Better explanations (NB plans) 3.3.1, 3.3.2, 3.3.4 *Expect more work from the pupils,* 3.3.1.

positives	things to work on
• evaluations better	• but try to focus on the maths – how
	learning might improve
 interactions with pupils going 	 transitions – mixed signals to
well, but many not paying	pupils
attention	 pupils need to be expected to do
• good to see the room prepared	more
• praise	• selling the maths
	• you offer lots of algorithms with no
	purpose
	• explanations – you need to record
	the detail in your plan
	• use the IWB/plan board
	• create a need to know
a team of tutors the idea of a summ	ary has been raised as something we

As a team of tutors, the idea of a summary has been raised as something we would like to work on together, so perhaps by sharing with others I may find a way to help my students by being more informative.

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Observing Trainee Teachers

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Learning to teach is a complex process and trainees need to be provided with both theoretical and practical experiences to develop their skills. Lesson observations and feedback can play an important part in trainee' development because they provide the opportunity to identify the current position, to discuss the place they are aiming for and strategies to 'bridge the gap between current and intended performance'.

This account focuses on an observation method (figure 1) that has been used successfully at the University of Birmingham for trainees early in their teaching experience. It aims to record the structure of the lesson by breaking it down phases that have beginnings, middles and ends. The recording method enables trainees and observers to follow the 'story' of the lesson and to identify significant events that have aided or hindered the lesson.

The author works in Geography Education.

First encounters with classrooms can be daunting and trainees may feel overwhelmed by the experience. The multitude of activities and teacher-pupil interactions can make it difficult for trainees to 'see' what is going on. Teachers may make the 'art of teaching' appear simple because they have the respect of the pupils, confidence in their procedures and routines that they have worked hard to establish.

Initially therefore trainees need to be informed about class entry, dismissal, teacher-pupil relationships, seating arrangements, acceptable noise levels, techniques for issuing/using resources, marking and homework policies, discipline policy and the myriad day-to-day practices that come naturally to experienced teachers. They may find this information difficult to absorb, or have naive views about it. When they start teaching they will begin to realise the complexities.

The stage model can help us to understand how many trainees learn to teach:

The Stage Model.

1. 'Pre-teaching' stage - trainees are idealistic, but naive about pupils and classrooms.

- 2. 'Survival' stage concern about class control, subject mastery and lesson planning bring reality and anxiety into their lives.
- 3. Teacher's performance' stage'- as confidence and competence grows, concern turns to teaching performance lesson starts, instructions, explanations, questioning, transitions and the management of resources.
- 4. 'Learner's performance' stage attention shifts to the pupils- their social, academic and emotional needs and the teacher's ability to deal with these needs.

This observation may be of most use in stages 1, 2 and 3 where trainee teachers experience a steep learning curve as they begin teaching because they are trying to keep a number of different balls up in the air at the same time. Trainees are usually keen to start teaching to test themselves but are often nervous about their 'performance' in front of the children, about their subject knowledge and ways to communicate that knowledge effectively. They may have little idea about structuring lessons, managing transitions from one phase of the lesson to the next developing activities that interest the pupils, methods of organising resources or how to ask questions. They may feel uncomfortable with formal procedures for getting the pupils in and out of the room and overlook the need to leave the room tidy. Managing groups of children can be a big issue, especially as there is usually a strong desire to be 'liked' and they may have negative feelings about 'disciplinarian' teachers.

At this time they find it difficult to handle all the skills needed to teach successfully. As a result they tend to start by focusing on delivery of content and observations that record lesson structure can help them review their learning in a broader manner. Trainees are usually anxious to start teaching. It is important here to warn them against 'role-playing' or thinking they have to do things 'your way'. Trainees often try to copy not only the techniques but also the personalities of teachers that they have seen. They need to be convinced that this is unsustainable and that they must draw on their own personality to find out who they are in the classroom.

Trainees often expect that the observation of their teaching will take the form of a judgment about the quality of what the observer has seen. As they start teaching appropriate feedback is very valuable, but it should take the form of a dialogue, with the trainee playing a major part in identifying strengths and weaknesses. As they inch towards a feeling of being able to do the job, trainees are very concerned with, and sensitive about, the adequacy of their performances. They want to know how they are doing and even what image they present as a teacher. They want to have their views of themselves confirmed. Positive, affirming feedback can be very helpful, but negative feedback can be very damaging and may only be justified if the observer feels that there is a serious problem or the trainee shows no awareness of the issue.

Trainees soon get used to being observed and value supportive constructive dialogue about what happens within their lessons as this usually helps them to make progress. Observation of what is going on in a lesson is a complex process and can take a number of forms depending on the trainee's needs. One basic principle is that records of observations should be objective - recording what was observed - and judgements should be discussed and clarified with trainees. The nature of observation may change over time. It may

- become more focused on specific areas of interest and concern
- tend towards the trainee directing the focus and purpose of the observation
- tend towards collecting data that is more open to interpretation as trainees become more confident, self aware and able to recognise the complexities of teaching.

Effective observation methods

General observation, while useful early in training, may not throw up the most valuable information about how the trainee is progressing. 'Objective' data allows a different relationship to develop between observer and trainee, as the trainee has the chance to interpret the data rather than simply being judged. Trainees can be asked to predict what patterns will emerge, thus creating the possibility of an interesting challenge to their expectations. Observation can take a wide variety of forms. There is no one best way and it is important to consider the principle of 'fitness for purpose'.

One method of recording the structure of lessons is illustrated in figure 1. While initially confusing this 'cloud' diagram has three specific functions.

- 1. It is a time line with the timing of events recorded inside the cloud so that the trainee knows how long each phase of the lesson took.
- 2. The structure of the lesson is identifiable. A key feature is to demonstrate visually how an observer can see the different elements of the lesson. Each phase of the lesson may have a beginning, middle and end. The whole lesson should also have a beginning, middle and end. Each cloud therefore records either a starter, middle or plenary activity.
- 3. Significant action by trainee teacher or pupil(s) is recorded in a clockwise manner around each 'cloud' so that particular events, phrasing and discipline procedures can be discussed later.

Recording the lesson using a 'time line'

This data allows trainees to compare their planned time with the reality and to discuss why there were differences. It also allows the observer to check the

trainee's perceptions of the length of time taken over particular activities. Examples are:

- how long it takes to get the class in and settled,
- the length of time the trainee spent talking to the class in their introduction,
- the length of time spent doing one activity,
- the time available for a plenary,
- the time spent packing up and getting them out in an orderly fashion.

All of these are areas that trainees find difficult to judge early in their teaching.

The Structure of the lesson

Experience suggests that trainees will need guidance in planning the structure of a lesson. It is important to encourage them to break down their lessons into manageable activities for their pupils. The process of recording phases and activities encourages them to reflect on the need for a beginning, middle and end to both the whole lesson and each activity within the lesson. It helps them recognise where they have given clear instructions, incorporated a 'starter' activity that interests and engages the pupils, or demonstrated and modelled an activity. It helps trainees recognise that plenaries can come at the end of an activity or the end of a lesson and that a plenary may turn into an introduction for the next task. Often it helps them recognise that plenaries are features of lessons that are often weak or non-existent!

The record of significant action

This records events, phrases used by the trainee teacher, interactions and pupil actions along with the times they occurred. This 'evidence' can then form part of the feedback discussion highlighting key events and their consequences. This discussion should be trainee led where-ever possible and the time line used as evidence to support or challenge their assertions. It can be used to praise where something has been successful or to challenge where changes can be made.

The record allows issues raised by the trainee, such as 'they seemed to be getting off task at this point' or 'how do I differentiate when some finish a task quickly and others take ages?' to be discussed in the light of the recorded evidence. It is important that as far as possible the points recorded are statements of observed activity rather than interpretations or judgements, so that discussion of the issues is facilitated and trainees engage in more detached reflection on what has occurred. There will always be issues of observer bias as decisions have to be made about what to record and how much detail to include – there is not much space on a page and you can miss significant events if you are writing rather than observing. However if the record provokes discussion and helps the

trainee to distance themselves from their performance in the lesson it can prove a useful tool.

This record helps beginning trainees see that transitions between activities can be clearly signalled with specific instructions such as 'pens down and look at the board'. The focus here is on their use of very specific 'command phrases' so that youngsters are clear about when to start and stop. Trainees in the early stage of teaching forget or don't realise that the pupils don't have their knowledge of where the lesson is going or that these phrases are useful and effective management tools. Trainees find it helpful to reflect on their use of these type of phrases before they learn to use them automatically and unconsciously.

The record also allows the observer to record events that the trainee teacher does not are happening. For example if the trainee is talking to particular individuals then they may have their back to others who may be off task. This can be then be recorded.

The cloud observation record may be most useful for observing trainees who are learning to structure lessons early in their course. It is less useful later on when this skill has improved, unless they are still struggling with this aspect of their planning and teaching. At this point it may be worth considering other observations such as mapping interactions between trainee and pupils or assessing the extent of off-task behaviour. In all observations the purpose is not to judge or berate the trainees about off task behaviour, but to explore the patterns and causes. Another form of observation later in the course is recording the questions being asked. In this case the purpose is to explore the type of questions a trainee is using so that you can discuss the pattern.

Giving feedback

The basic principle in giving feedback is to focus on 'What can we learn from this experience?' In general feedback should take place as soon as possible after the lesson has ended - while recognising that since teaching is a highly emotional activity some trainees may find it difficult to fully engage with feedback at this point. If the feedback cannot take place immediately then some brief positive comments should be made and the trainee can be encouraged to evaluate the lesson before the feedback occurs.

Feedback is best if there is a dialogue between the trainee and the observer. Trainees should always be encouraged to express their views about a lesson and the observer can use the trainee's comments to support or challenge judgments being made. Key questions might be: What do you think went well? What would you change next time if you taught this lesson again? Do not couch questions/statements too heavily into what was good/bad, as trainees often dwell on the latter and quickly become discouraged. Proper feedback can be time consuming but is important as observers have a responsibility to provide detailed, professional feedback.



Figure 1: A 'cloud' observation record

Admissions to secondary mathematics PGCE courses: are we getting it right?

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A simple statistical model was used to explore the relationship, over a five year period, between the degree results of students on a secondary mathematics PGCE course and how successful they were on the course, demonstrating that there was no relationship between the two. Implications of this are considered, both for the nature of degree courses and admissions to secondary mathematics PGCE courses.

By what criteria do we assess applications for secondary mathematics PGCE places? My standard response to this question is: written and spoken English; knowledge of and enthusiasm for mathematics; experience of and enthusiasm for working with children. Speaking to colleagues from other institutions, whilst these may be expressed and assessed differently, there is considerable commonality in terms of what is deemed to be important.

Of particular interest for this paper is mathematical subject knowledge and, more specifically, the use of degree classifications and precise subject of degree as indicators of what candidates know and can do mathematically, and how successful they are on PGCE courses.

My motivation for considering this arose whilst writing the end of academic year report 2003-2004 for the secondary mathematics PGCE course for which I am the tutor. Preparatory to doing so, I reviewed my former student group in order to comment on the subject of their degrees, degree results, and how well they had done on the course; which is to say, students are given a grade for each of the standards areas on a five-point scale, consisting of 2 fail and 3 pass grades for final assessment.

Whilst doing this, it occurred to me to question the extent to which students' initial degree results correlate with how well they do on the course. I therefore set up a simple model, giving 5 points for a first class honours degree, 4 for a 2:1, 3 for a 2:2, 2 for a third and 1 for a pass or ordinary degree. For the pass from the PGCE course, I gave 1 for a basic pass, 2 for what we call a 'high' and 3 for an 'exceptional' pass for each of the three standards areas, so students passing the course received between 3 and 9 points.

With this is in place, I then did a simple linear regression, expecting a weak positive correlation, on the assumption that in general, the better one's initial degree result, the better one does on a teacher-training course. Somewhat to my surprise, there was actually a weak negative correlation of -0.2: the initial degree result has almost no predictive power as to how well students will do on a PGCE course and, insofar as it does, the better one does in the initial degree, the worse one does on a teacher training course.

Now rather interested in this issue, I then thought to give a weighting to the degree results as to the estimated mathematical content. The full breakdown is available on request, but to give examples, straight mathematics degrees scored 100%, engineering degrees 70%, psychology 30%. So, I used these percentages to calculate a weighted degree result by mathematical content. Once this was correlated with the result of the PGCE course, the negative correlation grew to -0.52: those who do better on PGCE courses have worse degree results containing smaller amounts of mathematics. And, indeed, correlating the weighting with the results of the PGCE course again gave a negative correlation, this time of -0.25 – irrespective of class of degree, the smaller the mathematical content of the degree, the better one does on a PGCE course.

This analysis is based on a group of only 21 students in one year group. When each of the five previous year groups was examined separately, it turned out that in some years the unweighted correlation between degree result and success on the course was positive, in one year, getting to 0.55. Using all 92 students who have successfully completed the secondary mathematics PGCE course in the 5 academic years from 2000 to 2005, the unweighted correlation between degree result and success on the course was 0.11, the weighted correlation was -0.05, and the correlation between the weighting and success on the course was -0.16.

These correlations are, of course, extremely small, so the conclusion based on these 92 students would appear to be: there is no connection between either degree result and success on the course, or mathematical content of the degree and success on the course.

There are, of course, many objections one could make to this analysis. The numbers involved are very small, and the mathematical content of the degrees is an educated guess at best. No allowance is given for masters or PhDs, nor for the institution at which the degree is awarded. Also, whilst a considerable amount of effort goes into moderating the grades given to students by schoolbased colleagues, it could easily be that grades could differ by one in each standards area.

The biggest gap, however, is any analysis of candidates who are not accepted onto the course. At my institution, candidates who are rejected on paperwork are not entered onto the database, whilst those who are rejected at interview prior to the award of their degrees, or having given incomplete information initially, are not then chased up. I am therefore reluctant to try to do any work on the information I do have. It is, however, likely that those rejected from the course have disproportionately lower classification degree results with less mathematical content. One way of interpreting these results, then, is that students who are accepted with lower classification degrees, and with degrees in subjects without, apparently, a high mathematical content, are those with strong compensatory qualities which shine through at interview and serve to ensure that they work well in the classroom.

Proceeding on the basis that the correlation between degree results and success on PGCE courses is at most small, what conclusions can one draw? One possibility is to suggest that the skills required for successfully obtaining a first degree are rather different to those required for teaching. Certainly my experience as the *de facto* admissions tutor for a secondary mathematics PGCE course leads me to believe that one can emerge from a degree, including a straight mathematics degree, with very local knowledge and understanding for any one module studied, with no real sense of overview of the subject or the interconnections which are, arguably, the lifeblood of the subject – and, indeed, unable to do basic GCSE questions, including those not requiring the use of memorised formulae. I would go so far as to say this: most people (but by no means all) emerging with a degree in mathematics would be better served by exploring fully the material currently in further mathematics 'A' level rather than struggling to understand material currently deemed to be suitable for a mathematics degree. Marketing such an approach would require very careful thought, as this could easily be deemed to constitute a lowering of standards, when in fact, I would want to contend, it would do exactly the reverse.

In terms of admissions to secondary mathematics PGCE courses, the clear implication is that precise subject of the degree and classification are not good indicators as to how successful candidates are likely to be if accepted onto the course. This strongly points to the importance of finding ways of assessing mathematical subject knowledge as part of the admissions process, which already is the case in many institutions to my knowledge. Arguably, of rather more importance than subject knowledge is subject approach: having a working understanding of the power of algebra in enabling generalisations to be made is something which cannot easily be taught in a PGCE course; that it is the sine rather than the cosine which is the opposite over the hypotenuse is.

In many respects the implications here are for subject areas, including history, social sciences and also primary, which are competitive, which means that admissions criteria need to distinguish between candidates who meet basic entry requirements. It is, I believe, frequently the case that degree classifications are used for this purpose, whereas the results of this study would indicate that this is

not a good discriminator. Whilst in principle the above analysis could be replicated for these other areas, in practice the fact that degree results are used as discriminators means that the degree results of candidates on the course are in a very narrow band – mostly 2:1s, with a few 2:2s and 1sts, so the dataset would be too narrow for a meaningful analysis to be undertaken.

The clear implication here is that degree results cannot reliably be used as indicators of subject knowledge for teaching purposes. However, HEIs cannot reasonably be expected to devote massively greater resources to assessing applications for PGCE courses admissions. A debate, across subjects and across age phases, could usefully be held as to what really are the important qualifications, qualities and experiences for admission initial teacher training courses, and how we can assess them properly and fairly.

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