ISSUES IN MATHEMATICS TEACHING DEVELOPMENT AND TEACHERS' PROFESSIONAL DEVELOPMENT

FRAME Teaching Development Group Strand

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This is a report of a special discussion group held at the BSRLM Day in Manchester on March 3rd 2001, forming a strand of three sessions throughout the day.

It was organised by the FRAME Teaching Development Group for discussion of issues arising from a draft document addressing *Mathematics Teaching Development and Teachers' Professional Education and Development* (McNamara, Jaworski, Rowland, Hodgen, Prestage and Brown, 2001.)

FRAME, standing for *Formulating a Research Agenda in Mathematics Education*, is an initiative undertaken jointly by CoPriME[1] and BSRLM. It has five groups, each working towards a 'chapter' for a proposed document that will present this agenda. The Teaching Development Group is Group 3 of the five2. The draft document (McNamara et al, 2001) will form the basis of the chapter from this group. In addition, the group intends to publish an elaborated version of the current draft later this year (McNamara et al, forthcoming).

The purpose of this day strand was to air and discuss issues raised in the draft document. The three sessions, each of one hour, were organised to mirror the structure of the document as follows:

Session 1 – Initial Teacher Training (ITT);

Session 2 – Continuing Professional Development (CPD);

Session 3 – Developing Communities of Inquiry.

A major section of the document, on Teachers' Mathematical Knowledge (TMK), was addressed as part of Sessions 1 and 2. The final half hour was a review of the day, with considerations of future directions.

The notes which follow are written to provide a flavour of the discussion, rather than to report accurately everything that was said.

SESSION 1 – INITIAL TEACHER TRAINING (ITT)

Olwen McNamara began by offering questions and issues relating to the ITT section of the document.

These questions included the following

1 Committee of Professors in Mathematics Education

2 The others are: 1. Transitions; 2. Curriculum; 4. Learning, Teaching and Assessment; 5. Mathematics and Society

Conceptualising teacher knowledge

- What is the relationship between 'academic' subject knowledge and subject knowledge for teaching?
- What conceptualisation(s) of teachers' knowledge of mathematics are of practical/strategic use in teacher education?
- What view of teacher knowledge and development is implicit in training programmes for the NNS?

Indicators of teacher 'effectiveness'

- In what ways has the link between subject knowledge and teaching been investigated and against which criteria?
  Beliefs and attitudes of teachers /student teachers
- In what ways can students be enabled to hold on to 'the ideal' when they confront the pragmatic constraints of the classroom?
- To what extent is a connectionist teacher identifiable with one with good PCK in Shulman's sense?

Models of ITT

- What theoretical models and ideological perspectives underpin the new Government flexible routes for ITT?
- How 'effective' are the alternative routes?
- What particular costs/benefits do they pose for mathematics education?
- What models of professionalism are inherent?

ITT is too prescriptive and intensive

- How can/do we as educators balance the competing demands of individual professional automony and collective state/student entitlement

Beliefs/Assessment

- What effect does decontextualised testing have on students' attitudes, beliefs and feelings about mathematics?
- In what ways can students be enabled to hold on to 'the ideal' when they confront the pragmatic constraints of classroom placements?

Mentoring

- What different models of mentoring are there?
- What criteria are applied to effective mentoring?
- How can we address issues of subject mentoring in primary ITT?
- How 'effectively' do other 'sharing of best practice models such as AST and leading teachers operate.

Initial discussion addressed the meaning of 'effectiveness' and the complex range of issues we address when considering where and whether learning and teaching are effective. One focus was on 'target setting'; what are realistic targets to set and who sets them? These include targets for children learning mathematics, and targets for student teachers learning to teach. One person suggested a question to ask is, "how do you connect with 30 people in a room so that someone learns something?"

Laurinda Brown offered a definition of effectiveness as "good for" from Maturana and Varela (1987) who "characterise cognition as 'effective action', an action that allows a living being to sustain its existence in a certain environment as it reproduces its world - no more no less" (pages 44-45). From this definition we, as researchers, teachers, and teacher educators, would be paying attention to how students act in their world. The focus would not be on trying to find out what goes on in the students' minds but observing how they act and when this is not effective action supporting them in breaking out into a new way of acting. For instance: - a student has effectively worked with the idea of dividing by a number making the answer smaller until they try to divide by a fractional quantity and are challenged by the answer becoming larger; a student, having previously only met linear proportion, applies this idea to a problem of finding similar areas; - a student teacher responds to a hand up by telling the student in the class what they think the student wants to know and is then greeted by a blank stare. Often in these instances the way through is by action, inviting the student to draw diagrams or use a calculator or look in more detail so that they see more complexity. The use of 'good enough for' in relation to 'effective action' indicates that there are many possible ways of acting which will be effective in the situation and any of them will do.

A discussion followed on notions of 'lifelong learning'. With an establishment rhetoric of lifelong learning, how do we reconcile statutory emphases on short term goals and standards, pre-packaged approaches, and content based structures? There are issues of student entitlement with regard to conceptualisation of the curriculum. In evaluating effectiveness we need to ask 'what is evident', and 'what is heard'?

Discussion moved onto the language of educational systems versus that of establishment rhetoric. Because language use is very varied, must we define effectiveness relative to differing worlds or discourses? Who controls the language? Is it possible or appropriate to resist government forms of language?

What research should we be doing in these areas to become more aware of what we mean by effectiveness of provision for teaching and teacher education? In persuading government of the need for more effective programmes than we have currently, the lack of good recruits to the profession of teaching might be a lever.

CONTINUING PROFESSIONAL DEVELOPMENT

This was introduced by Jeremy Hodgen, offering questions and issues from the CPD section of the document.

Jeremy highlighted difficulties of the broader FRAME 'what we know / don't know' framework within which the document was conceived. This tends to blur disagreements and nuances. What we 'know' is not a neat, uncontested package nor is 'what we don't know' neatly defined by 'what we know'. Moreover, re-reading the

document for the presentation, it felt more authoritative than we perhaps meant. Much of 'what we know' is fragmentary and tentative. However, this is how the document is structured, so the presentation was structured in a similar way:

What we 'know'

- Teacher change is unpredictable – different teachers change and develop in different ways and teacher education is not a process of 'doing things' to teachers
- Long-term CPD is associated with 'effective' teaching
- There are problems with the cascade model
- Learning communities – teacher change seems to be better thought of as a shared rather than an individual process

Research questions (or what we don't 'know')

We identified the following broad areas for investigation:

- The relationship between teacher change & CPD experiences.
- What is distinctive about mathematics teacher education?
- What can we learn from the NNS?
- Models of CPD – documenting & researching what models of CPD have been used in mathematics education in the UK over the past 20 years.
- We know very little about the professional development of teacher educators.

Some criticisms of the draft document:

The document was written to a very tight deadline and it is inevitable that there are some weaknesses:

- There is a danger of adopting a deficit view of teaching, simply seeing the problem in terms of knowledge that teachers don't have.
- There is little distinguishing the phases in CPD – what is different about CPD in primary, secondary, adult education?
- It is parochial – there is very little about CPD beyond the UK.
- The focus is on formal CPD initiatives – with little on teacher change as an informal or continuous process.
- Critique of government policy and wider contextual issues is limited.

Questions for the discussion:

How could we make the document more useful:

- to the mathematics education community?
- to teacher educators?
- to policy makers?
- to CPD planners and providers?
- to others?

Should we structure it in a different way? What is missing? Are the research questions helpful?

The document lists a number of initiatives in CPD that have taken place over the last 20 years. There was recognition that we need different CPD for different purposes: different purposes need different models. For example, there is a difference between a 20 day course that takes place in 20 consecutive days, and one which is held on one evening a week for two years – as evidenced by the effects on the old M.A. Diploma in Education courses. A cascade model looks very different from a personal involvement model. Derek Woodrow commented, "I once categorised cascades as looking smooth at the top but being rough at the bottom – contrasted with the marsh model where the influence seeps up from the bottom (i.e. the profession) (often smelly?) – and the gusher model where intense professional needs eventually burst up when the pressure is big enough - what we want is a calm sea of quality and competence. (see Open University Occasional Papers No.7 March 1993)" Different models achieve different outcomes. More research into and documentation of models is needed to evaluate their usefulness and impact. For example, cascade models are suggested to be more effective now than when they were used in the 80s. The new green paper 'Schools building on success' reports a 99% satisfaction or better rate for numeracy training. Why is this? What are the changing views and conditions? What is being cascaded? Knowledge? Opportunity? Ways of working?

Janet Duffin contrasted a 'cascade model' with a 'personal involvement model' She felt that there was evidence of better progress amongst pupils when a personal involvement model was used and quoted the experience of the CAN project (e.g., Shuard et al, 1991) where personal involvement undoubtedly contributed to children's - and teachers' – success: that is success in number competence in the children, and success in the ability to change on the part of the teachers. She mentioned that there was also evidence in other areas in which educators or researchers have worked closely with teachers.

Jeremy Hodgen had referred to a deficit approach to developing teachers. Perhaps if we talk about developing teaching, rather than teachers, we might avoid such a deficit discourse. After all, is professional development not seeking fundamentally to improve the mathematical learning experiences of students in classrooms? We therefore need to concentrate on how teaching can develop.

However, what about individual teachers, and their own professional development? If an individual teacher gains substantially from reading and discussing Wittgenstein, can we evaluate the contribution this makes to children's learning in classrooms?

Professional development has been available through Diploma or Masters programmes, through which teachers enhance their promotional prospects. Such programmes offer opportunity to study education in its broadest sense, as well as the teaching and learning of school subjects. Sue Sanders commented that taught masters programmes in education have been available widely in the UK for well over 20 years. Little research has been undertaken to explore why teachers choose such courses but it is probable that the increasing number of graduates within the profession and the limited nature of what was called INSET during that time led some teachers to wish to enhance their promotional prospects by gaining a higher degree. What attributes does or should the holder of a masters degree in education possess? Can these be achieved in a CPD-led programme? It would be possible for a

future historian to track government initiatives by examining the changing nature of masters modules. Whilst modules on current issues such as school effectiveness are buoyant, subject specific pathways, particularly in mathematics, attract very small numbers or in some cases none at all. What is the likely impact of this on the study of mathematics education?

We may well be overlooking a number of research questions raised by the shift to CPD driven masters programmes. What are teachers' motivations for undertaking masters courses? How has this changed over the last 10 years? Does the CPD element of the modules mean that the nature of the masters course has changed to be only about immediate and measurable outcomes which relate to professional performance? To what extent have masters programmes shifted from a personal development ethos to one of professional development which looks for immediacy of impact within the classroom/school? Do current masters programmes still allow for the advanced study of fundamental theories and questions in education? Is it important that they do? What is the impact of mathematics education as an academic subject if its study at masters level is merely CPD driven?

There are also research questions about what it means to be a 'proper professional person'. For example, how can the community produce 'learning teachers'? Teachers' attitudes have developed over the last 15 years. How can we work on these attitudes? The OISE document evaluating the National Numeracy Programme (Earl et al., 2000), indicates that cascade models achieve certain purposes, however, it does not mention purposes NOT addressed by cascade models. Derek Woodrow pointed out that the OISE evaluation clearly signals the need for '… establishing and fostering individual and organisational capacity to respond to changing demands on a recurring basis' (p 27) 'Sustaining improvements in pupil learning will require continued attention to professional development activities…' page 40 'As the strategies move beyond the initial awareness and implementation challenges, it will not be sufficient to have high quality training and strong support from headteachers. In addition, it will be essential to create 'learning cultures' at school level' p40/41.

Issues relating to the Green Paper 'Teachers: meeting the challenge of change' (DfEE, 1998) and subsequent initiatives were raised. It was felt that there was a need for a clear policy agenda within mathematics education research. What the paper does not include is what an individual teacher might wish to do for their own personal professional enhancement, rather than, say, what has to be achieved to become a deputy headteacher, or school or OFSTED priorities. There are also issues relating to the impact of initiatives such as the NNS 5-day training and teacher research bursaries. The new Green Paper 'Schools, building on success' does include best practice and individual bursaries proposals para 5.29/30/31 – we might ask for research into their four key words – observing, feedback, coaching and mentoring.

There are public relations issues associated with these questions – 'how do we spin what we say'? How can we use language effectively to achieve important goals? On the issue of "spin", Ian Stevenson commented that the government and the mainly right-wing press have been very effective in neutralising the voice of teacher/teacher educators by the "trendy-leftie", "progressive", "child-centred" labels. "It seems to me that rather than rejecting documents such as 'NC for Teacher Training' we should

welcome them as an attempt to define a professional role for teachers while rejecting the 'industrial training' interpretation of competencies. This implies a re-examination of reflective practitioner models for professional development, to show how they can lead to the appropriation of a 'professional role'."

Perhaps currently there is much mileage in the 'Best Practice' agenda with individual bursaries for teachers. We need to think how best to exploit this agenda to provide a framework in which teachers and teaching can develop. Perhaps best use of the BPResearch will emerge when it is coordinated into coherent messages for the profession – otherwise significant small messages will be lost.

Another current model that was discussed was the NOF (New Opportunities Fund) initiative. The government has allocated £230 million pounds from the New Opportunities Fund to train all serving teachers in ICT so that they are professionally competent/confident to Level 8 in the ICT NC. There are three main areas of 'Expected Outcomes' for the training. First, teachers should develop the knowledge and understanding of the contribution that different aspects of ICT can make in teaching particular subjects (no generic software training). Secondly, they should use ICT for effective planning, including the use of ICT for lesson preparation, and the choice and organisation of ICT resources in whole class teaching and assessment of pupils' learning. Finally, they should use ICT to keep up to date, share best practice and reduce bureaucracy.

Ian Stevenson commented that another issue, related to the above, is that the 'Expected Outcomes' document specifies what kinds of outcomes the training should develop. What the research on the integration of ICT into teaching indicates is that introducing technology into teaching 'opens out' the relationship between personal and professional development and makes it visible. Reflective practitioner approaches, built on the assumption that personal development = professional development, close the gap through 'ownership'. What teachers 'own', however, is very variable and difficult to predict. This is a key issue if one has to meet 'outcomes' using a competency model. The NOF training provides a site to examine models of professional development for a large cohort of teachers who are forced to change in specific ways, and, in particular, to examine the relationship between personal and professional development.

In his introduction, Jeremy Hodgen had mentioned the parochial nature of the draft document in discussing and addressing the issues of CPD initiatives. To some extent the discussion here had been limited to English models. Members of the group from Scotland and Wales mentioned, briefly, models that differ there from those in England. Sue Sanders commented that in Wales masters programmes are currently funded by HEFCW. This means that there is pressure on Education Departments to register any CPD student at masters level in order to a) gain funding and b) help the university meet its taught masters targets. This is affecting the nature of the modules offered and there is some conflict between teachers' expectations of what they should be required to produce as part of a CPD programme and the University's expectations at masters level.

DEVELOPING COMMUNITIES OF INQUIRY CRITICAL INTELLIGENCE (DCI)

This was introduced by Steph Prestage, offering questions and issues from the DCI section of the draft document.

Teachers need to be thoughtful, to have insight: i.e. to think and act *intelligently*.

However, policy presents scripts for teaching and algorithms for planning a lesson.

We might consider two triangles:

The first has the following vertices:

Learner	*Mathematics*	*Mediating tool*

The second has as its vertices:

Learner	*Mathematics Teaching*	*Mediating Tool*

And perhaps there is a third, involving

Learner	*Teacher Educator*	*Mediating tool*

Discussion focused on the meaning of the two/three triangles. What varies seems to be what is being learned in each case; i.e., mathematics in the first case, and mathematics teaching in the second - in the first case, learners are school pupils (or learners of mathematics at any level) and in the second case learners are student teachers. What are the mediating tools that allow such learning to take place? How might teachers or teacher educators think and act intelligently to devise and use such tools? The third case addresses the learning of teacher educators, with questions about the use of mediating tools, and by whom, in teacher-educator learning.

The interrelated complexity of these different levels of learning was highlighted through an example: a mathematics classroom consisting of 30 pupils and their teacher who was a student-teacher from a PGCE course. Also present were the regular teacher of the class, and the tutor (teacher-educator) from the university. All were learning from this situation. Some of this learning was implicit, some explicit. For example, the mathematical learning of the students was part of the overt agenda of the classroom. The student teacher used a range of tools to mediate this learning. The learning of the student teacher was both implicit (during the teaching) and explicit during reflection and debriefing with tutor and regular teacher who used meditational tools to effect learning. The learning of the regular teacher and the teacher educator was implicit, except to the extent that each one made it explicit for her/himself through personal reflection and critique. Reflection/critique is a model for professional development that draws on the critical intelligence of the learner within a community of inquiry in which it takes place.

Such notions draw attention to the dialectic of individual learner, and learner within society. There was discussion of theoretical notions of *communities of practice*, and how these might be seen to provide opportunities for development, or overtly to

foster development. There were differing views of such communities, some being defined according to theoretical notions of situated cognition as articulated by Lave and Wenger (1991) and others using the terms much more loosely. In Lave and Wenger's definition, there are issues about legitimate peripheral participation, and the relationships between masters and novices. What constitutes *mastery* in classroom learning? What is the product to which learners aspire through enculturation into the practice.

The difference between communities of practice (CP) and communities of inquiry (CI) was explored. A CI might be seen to be a community in which inquiry, questioning, reflection, discussion of issues etc. is encouraged overtly by the teachers (or teacher educators) in the community. Learners are drawn into practices that involve inquiring into aspects of mathematics (or mathematics teaching). Thus the practice is fundamentally one of inquiry, and the object is the learning of all practitioners. By making such learning explicit at all levels within the community, collaborative learning can result. This does not mean that all learners are learning at the same level, e.g., mathematics, or mathematics teaching, or mathematics teacher educatorliness. However, an openness to such learning across the levels may make it more possible for learners to take responsibility at their own level.

An issue was raised about normativity within certain models or practices. If the production or development of norms disadvantages certain members of the community, it can not be regarded as an effective development of practice. Perhaps, for example, students from certain social or cultural backgrounds might find an inquiry aproach one in which they are unable to participate, hence being marginalised.

SUMMING UP

Tony Brown offered a number of questions to encourage a critical view of the draft document, and the day's discussion of it.

- To whom is the draft document being addressed and through what outlet?
- Are we addressing complexity or complications?
- To what extent is subject knowledge an element of complexity?
- What is the discourse from which the questions on subject knowledge arise?
- What happens if/when we start from different discourses?
- We are not doing scientific research; it is far more complex than that.
- Where do we go from here?

There was little time for further discussion. Two issues raised were:

- The funding of teachers to come to days such as this BSRLM conference;
- The education of teacher educators.

I am grateful for the help of a number of colleagues in getting together this compilation of discussion. As well as the members of the authoring team of the draft document (Olwen McNamara, Jeremy Hodgen, Tim Rowland, Stephanie Prestage and Tony Brown), these include particularly Sue Sanders, Laurinda Brown, Derek Woodrow, Ian Stevenson, Tamara Bibby, and Janet Duffin.

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