Teaching and Learning Numeracy: Policy, Practice and Effectiveness

Initial and Continuing Professional Development of Teachers

Tony Brown and Olwen McNamara

Recent policy and prescription emanating from government bodies in relation to Initial Teacher Training (ITT) and primary mathematics teaching appears to be built upon a deficit model. Derived from interpretations of comparative international data it is sustained by a burgeoning national audit culture of league tables and targets to which the mathematical subject knowledge of ITT students will undoubtedly soon be added. This educational epidemiology monitoring the mathematical health of the nation has identified the quality of mathematics subject knowledge and understanding of students/primary teachers as a cause for concern. The prescription which, it is speculated, will guarantee a more competent and confident work force is: (a) specified and tested levels of mathematics subject knowledge for all trainees (DfEE, 1998 a); and, (b) specified mathematics content and pedagogy for all primary teachers (DfEE 1998 b). Whilst there is some evidence to support such a government agenda there are reasons for questioning the sufficiency of the account and the evidence that informs it.

1. The evidence base is fragmentary The paucity and fragmentary nature of the evidence from British studies which claim a specific focus on mathematics makes it difficult to make definitive research claims regarding ITT. Even in America the evidence base is widely thought to be 'piecemeal' and 'not systematic' (Eisenhart et al., 1991; Brown et al., 1990). Reviewing the literature there is perhaps a case for challenging the privileging of empirical evidence over theoretically constructed arguments: anecdotal accounts, not informed by explanatory theoretical frameworks, are in part responsible for much of incoherence found. Certainly much existing British research is small scale and descriptions of student teachers have presented unilateral accounts of the complex teaching equation. The fragility of the evidence base regarding the effectiveness of CPD programmes, especially those relating specifically to mathematics, is even more acute. Research on the effects of INSET is reported to be 'meagre' and lacking a 'culmulative dimension' (Halpin et al., 1990: 164).

2. Subject knowledge is only half the equation The importance of subject knowledge is well documented and its lack is linked to less effective teaching (Wragg et al. 1989; Bennet & Turner Bisset, 1993; Simon & Brown, 1996; DES, 1983, 1988; Ofsted, 1994, Rowland et al., 1999) and over reliance on commercial schemes (Millett & Johnson, 1996). Mathematics and English primary training courses have been judged to be amongst the most satisfactory (DES, 1991). Yet, the change in subject-matter/substantive/syntactical knowledge of mathematics of PGCE student teachers (n=59) during training was found to be not significant (Carre & Ernest, 1993). Indeed, they displayed the same misconceptions as children (Bennett et al., 1993; Ball, 1990). Askew et al. (1997 a: 65; n=90), however, found that 'more' was not necessarily 'better' when they correlated teachers' mathematical knowledge, measured in terms of qualifications, against pupil learning outcomes. Recent debate regarding teacher knowledge has been stimulated by the influential work of Shulman (e.g. 1987) in the USA and concerns the need to address pedagogic content knowledge (PCK) in ITT rather than subject knowledge per se. Critics challenge the credibility of such a distinction (McNamara, 1991); and, the underlying absolutist view of

mathematics, and transmission view of teaching, that it presents (Meredith, 1995; Stones, 1992). Additionally, PCK is thought to be situationally and experientially grounded in, and constrained by, classroom experience; and, related to knowledge, values and epistemological beliefs rather than ITT (Aubrey e.g.1996; Meredith, 1993).

3. Testing may be counterproductive Studies (Brown et al., 1999; Green & Ollerton, 1999) have identified students' anxiety about maths as a major issue in ITT. Additional prominence given to mathematical knowledge audits (DfEE 1998 a) and anticipated tests for trainees (June 2000) may, paradoxically, prove counterproductive and jeopardise the achievements of training courses in improving students' attitude to mathematics (Brown et al., 1999). ITT has also been shown to be successful in increasing students' confidence in their ability to teach mathematics and shifting their absolutist beliefs (Bennett et al., 1993; Carre & Ernest, 1993; Carter et al., 1993; Brown et al., 1999). The significance of beliefs and conceptions on practice is well documented: teachers' dominant pedagogic beliefs are 'not inconsistent' with their dominant beliefs about the nature of mathematics (Andrews & Hatch, 1999); and, play a significant role in shaping teacher behaviours (Askew, 1997 a; Lerman 1986, 1990; Ernest, 1989). Opinion is, however, divided as to how much ITT is able to substantively influence these beliefs. Primary B.Ed. students' images of teaching from their own school days have been shown to be highly influential in moulding subsequent classroom practice (Calderhead & Robson, 1991; n=12) and have necessitated much 'unlearning' in terms of attitude problems and subject misconceptions (Ball, 1988, 1990). Humanistic (Cheng, 1990; n=109) and pedagogic (Brown et al., 1999) views of teaching and learning developed in college sessions have also been found to be tempered by realism after teaching practice experiences. Additionally, ITT itself was not identified by serving teachers, or associated pupil outcome data, as a significant influence on the teaching of numeracy (Askew et al., 1997 a; n=33). Bramald et al. (1995; n=162), however, argue that despite the perceived/reported lack of influence - the effects of training courses were not constant and belief systems were not as resistant to change as some research suggested.

4. ITT is too intensive Highly prescriptive ITT policy requirements can render courses over-full and squeeze out key aspects of training and professional development. Carre & Ernest (1993) expressed concern that an increasingly school based training would cause the already insignificant improvement in PGCE students' grasp of content, substantive and syntactic knowledge of mathematics to deteriorate further. Teachers perceived training to be too short and too rushed, and most did not consider it to be a significant feature of their professional development (Askew et al., 1997 a). Yet ironically, in the European context, past British Governments have been on their own in attempting to erode both the length, and the university based academic rigour, of ITT (Holyoake, 1993). Identifying the more disposable components of training courses opinion suggests that 'reflection', universally popular in the 80's, 90's (MOTE, 1992), is a vehicle more appropriate for experienced teachers (McNally et al., 1994, 1997). ITT, it was felt, should prioritise preparation for the induction phase (McIntyre, 1993). There is little empirical evidence to suggest that the use of reflection in ITT is effective in connecting pedagogic theory with practice and, additionally, it was felt to be at odds with a competence based model of training. Critiques carry many health warnings (McIntyre 1993; McNamara, 1990; Smith, 1991; Leat, 1995; Higgins & Leat, 1997; Tickle, 1994). Reflective work, insofar as it exists, however, can it is suggested provide a forum in which students seek to reconstruct their

own identity as they become inducted into professional discourses (e.g. Hanley & Brown, 1996, 1999; Tann, 1993; Jones et al., 2000).

5. The effectiveness of school/teacher led CPD is unclear *Mathematics Counts* (DES, 1982) and HMI Reports (DES, 1978, 1979) generated considerable support for school-based professional development in the early 80s (Biggs, 1983; Pinner & Shuard, 1985; Pirie, 1987). This included links to the Mathematical Association Diploma in Mathematical Education (Melrose, 1982); projects such as LAMP (DES, 1987) and RAMP (Ahmed & Williams, 1991); and, 10/20 day courses (NFER). The use of advisory teachers (Straker, 1988; Biott, 1991) and mentoring of students and NQTs were identified as boosting the quality of the professional practice of the advisor/mentor as well as mentee (Vonk, 1993; Boydell, 1994; Elliott & Calderhead, 1993; Jaworski & Watson, 1994). Halpin (1990: 164), however, identified a lack of 'empirically or theoretically generalisable' evidence of the effectiveness of INSET. British studies focused specifically on the effectiveness of mathematics CPD, as regards pupil outcome data, are difficult to locate. Askew et al. (1997 a, b) identified extended mathematics programmes such as 10 and 20-day courses as the most effective way of changing beliefs and practices so as to significantly improve effectiveness in teaching numeracy. In reality, however, primary schools still retain an individualistic notion of development and one-day courses still predominate by virtue of time/cost constraints and perceived needs (Bottery & Wright, 1996).

6. The success of government directed CPD has yet to be established Current government policies aimed at raising standards in primary schools have been experienced by many primary teachers in terms of initiative overload. Such policies can be seen as part of a perpetual readjustment in teaching styles, related to the evolution of learning theories and policy fashions (Brown, 1997). The implementation of the NNS, together with its associated cascade-training programme, has been an unprecedented move towards a prescribed PCK and CPD for primary teachers. Initial indications are, however, that NNS has been well received with positive impacts reported upon teacher and pupil attitudes, and practices/outcomes respectively (Ofsted, 1998; McNamara et al., 2000). In the longer term, however, embedding policy has not always been understood in the terms in which it was presented (e.g. Millett, 1996), nor has it always been fully implemented before the next policy came along.

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