An Early Years' CPD initiative for mathematics: the power of collaborative, 'grassroots' learning

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Local 'grassroots' *Children's Mathematics Network* groups are initiated and 'owned' by teachers and practitioners and they explore and develop their understanding of *children's mathematical graphics* (Carruthers & Worthington, 2005; 2006; DCSF, 2008) in their own ways. New research findings reveal the effectiveness of this form of 'continuing professional development' (CPD) and its impact on children's mathematical thinking (NCETM, 2009). This paper explores the philosophy underpinning these groups, and their inter-connectedness with children's mathematical graphics.

Keywords: collaborative CPD; co-constructing meanings; children's mathematical graphics; impact; learning

Introduction

This paper explores the findings of our recent CPD initiative and considers the impact that the practitioners' involvement has had on their developing pedagogy and on their children's mathematics. It explores the philosophy that underpins and connects both *children's mathematical graphics* and our CPD initiative and draws some conclusions about practitioner-networks.

Through our research into young children's early 'written' mathematics we originated the term *children's mathematical graphics:* this describes the wide range of graphical marks and representations children use to support their mathematical thinking (Carruthers & Worthington, 2005; 2006). These graphics have their beginnings in children's imaginative play, (Worthington, 2009). In 2008 the *Williams Maths Review* (DCSF, 4) highlighted the importance of *children's mathematical graphics* arguing 'The review also plays great score by play-based learning of a mathematical nature, and makes specific recommendations regarding early mark-making as a precursor to abstract mathematical symbolism'.

We recognize the importance of supporting children's learning to uncover their own ways of thinking: this includes a respect for young children's ability to think mathematically; to initiate and play with ideas; to make decisions and take risks and solve mathematical problems that have personal meaning for them. We recognise that (as with mental methods) there are many ways of working rather than one 'right' way generating and rather than pre-determined written outcomes, encourage children to use pen and paper to explore their ideas, rather than for pre-determined outcomes. Children have 'ownership'

of their mathematics and the emphasis is on making meanings through their mathematical representations and meanings are negotiated and co-constructed through collaborative dialogue. This led to a pedagogical shift in which teachers focus on the child's line of enquiry, adults listening and observing sensitively in order to understand the complexity of their emerging mathematical thinking. This perspective is rooted in socio-cultural and social-semiotic theories (Vygotsky, 1978; Kress, 1997) and results in an open, democratic approach to learning. We argue that *children's mathematical graphics*, and our local CM Network groups, inter-connect through their underpinning philosophies.

Mathematics CPD: reserch literature

It could be argued that one of the key determiners of an effective CPD model is that teachers make a significant 'concept shift' that impacts on their practice and has a demonstrable and positive impact on children's mathematics. In order to experience a conceptual shift, teachers must weave in and out of practice and theory: this requires time and shared socialization to supports common goals. There are likely to be a number of reasons for the limited impact of traditional models of CPD, including a lack of support for practitioners once they return to their setting and for continuing opportunities for reflection and enquiry. Whilst such conceptual shifts are what leaders of traditional models of CPD and national training for mathematics hope for, it appears that such outcomes are not always borne out by research.

Within schools and local authorities the majority of mathematics CPD appears to be a traditional 'delivery model', often termed 'training' and described by Drummond as 'learning by swallowing' (2007). Cooper & Boyd (1997) highlight the low levels of impact on teachers of this model and cite research by Joyce & Showers, (1996) and Glickman, (1993), who demonstrated that two months following a workshop, only 16-20 per cent of teachers made recommended changes. MacNaughton argues that for many early years educators, professional learning starves them 'of the nutrients that support them to proactively, enthusiastically and knowingly draw on leading edge theories to push the possibility for democracy and progressive social change in their lives with young children' (2005,190).

Involvement in teacher research has also been identified as impacting on classroom practice (Stenhouse, 1979; Slavin, 2008; Issitt & Kyriacou 2009;) and can be a valuable aspect of CPD. Yet it appears to be that many practitioners and heads of centres and schools do not necessarily recognise theory and research as rich resources of knowledge which can be used as a guide to practice. As Rodd (1994) suggests, practice is not sufficient in itself to constitute the whole curriculum design; research is equally important. The polarisation of practice and theory as two very separate entities is misleading: they depend on each other.

An alternative model for CPD

A review of 17 research studies into *collaborative* CPD found it 'was linked to a positive impact on teachers' classroom practice' (Rundell & Seddon, 2003, 3). Teachers 'shared a stronger belief in self-efficacy and reported a high level of commitment to change. Their enthusiasm for collaborative working and professional learning had increased and the recognition that peer support was beneficial featured strongly in many of the studies'. Johnson & Johnson propose 'The superiority of co-operative over competitive and

individualistic learning increases as the task is more conceptual, requires more problem-solving, necessitates more higher-level reasoning and critical thinking, needs more creative answerers, seeks long-term retention, and requires more application of what is learned' (Askew & Carnell,1989, 43).

We also questioned the extent to which our provision of one-day courses had lasting impact on teachers' thinking and practice. Moreover, we believed that the philosophies and values we espoused in our work with children should underpin our CPD. In 2003 we established the *Children's Mathematics Network* (CMN), and subsequently introduced the concept of local *'CM Network groups'*. The focus of the Network is on '…*children's mathematical graphics* and the meanings children make…. Our aim is to hear the voice of the child and to support effective pedagogy for this significant aspect of mathematics in this phase', (*from CMN website*).

Dialogue

Dialogue is a significant factor in collaborative groups, (e.g. Mercer, 2000; Mercer & Littlejohn, 2007). Keiny proposes that the social contexts promote interaction within the group, leading to 'the exchange of ideas that stem from the teachers' practice (and) leads to the decontextualization of personal experience, and construction of knowledge of a more abstract nature. Reflection of ideas within the reflective group… turns strategies into meaningful pedagogic knowledge' (1994, 165).

Teaching young children is complex and practitioners need time to think, to allow their ideas to *meander* (Carruthers, 2008). During a study of the role of research in Children's Centres, the researchers realised that in their collaborative dialogue, they were 'meandering', defining this as 'reflectivity on common concerns where time is not a barrier'.

> We were finding pathways, in our own way, in our own time. We travelled down pathways and then started from the beginning to reflect our question further. It is cathartic and gentle and can help us see clearly because we do not feel pressure to have an outcome.' It is not 'outcomes' based: *'What if we do not go anywhere - and does it really matter because just once in our meanderings we could strike upon something significant*, (Carruthers, Journal entry, March 12th 2008, 16).

Carruthers proposes that teachers need to have opportunities to self-reflect and generate their own theories rather than be 'Passive victims of the education system – it is important that teacher's know beyond the government dictates' (2008, 6). In the following section we focus on three 'grassroots, early years 'communities of practice' for Early Years teachers and practitioners which foreground dialogue, socialization and co-construction.

Collaborative Early Years CPD

Example 1: The first example is the 'Emergent Mathematics Teachers' group of which we were founder members. This was a 'grassroots' group 'owned' and shaped by its members. Meetings were based at each others schools and later at our homes, and the social aspect of our involvement was significant in sustaining interest. The group's success led to its sustained development over 6 years and significantly, to increased feelings of personal and professional empowerment resulting in to self-generated and

evolving theories. Our knowledge and developing pedagogies were supported by our research and underpinned by theories about mathematics which we read and through dialogue with leaders in the field of mathematics education. Eventually the two of us went on to research a significantly new aspect in depth, *children's mathematical graphics*.

Example 2: Support for an alternative view of CPD comes from a post-structuralist perspective which emphasises issues of power, knowledge and truth about how these issues relate to teachers and practitoners experiences in their work in early chidlhood settings in South Australia who established a 'critically knowing community'. They felt that 'important aspects of early childhood education were under attack and that the opportunities to argue differently about curriculum possibilities were limited or non-existent' (Barnes, in MacNaughton, 2005, 206). Barnes also acknowledges that they have demonstrated that educators 'do not have to wait for others to produce professional learning opportunities for them'; (in MacNaughton, 2005, 209).

Example 3: In the 1990s we were founder members of a local group, the *Emergent Mathematics Teachers*. We met through our interest in children's mathematical learning and our desire to effect pedagogical improvements. The group was self-directed and relevant to our children at the time: we drew on our experiences and the children's learning was at the heart of our discussions, influencing curriculum decisions we made. Our involvement in this group subsequently influenced our decision to introduce CM Network groups and the first of these was started (in 2007) by a teacher in Bristol who attended two of our one-day courses, which served as a useful introduction to *children's mathematical graphics*. The group attracted teachers and practitioners from the birth to 8 year age range, including mainstream and private nurseries and schools. Focusing on a new aspect of education they had chosen, and which stepped outside the 'official' curriculum, was seen as a positive experience. In turn, their developing pedagogy has had considerable impact on the children's mathematics, for example, several of the members highlighted the extent to which they valued modeling (socio-cultural, indirect adult; peer modeling and direct adult modeling; (Carruthers and Worthington, 2006).

The effectiveness of such groups has recently been independently acknowledged by the *Researching Effective CPD in Mathematics Education* (RECME). The overarching aim of the research was to investigate the interrelated factors that contribute to 'effective' CPD for teachers of mathematics and the outcomes of the study will inform future CPD and impact on policy-making in education (NCETM, 2009).

The final report includes 6 case studies to highlight various positive aspects and the CM Network group is one of these. The researchers noted that this initiative focuses 'on careful consideration and analysis of children's mathematics and the ways in which professionals can support and encourage the children's mathematical thinking' (NCETM, 2009, 65). The report observes that 'The standard of the mathematical understanding, thinking and reasoning that the displays revealed was far higher than the specified curriculum objectives for children of this age' (NCETM, 2009, 64).

For one of the teachers in particular, involvement in the group led to her 'shifting quite considerably from her previous practice and overcoming an initial reluctance to change and sceptisism about whether the change would be beneficial to the children's learning' (NCETM, 2009, 65). This is direct evidence of a teacher's significant *conceptual shift*, from previously relying on worksheets for all children's written mathematics, to supporting children's mathematical thinking through their own ways of representing their thinking. The report argues 'that ways of working with teachers that facilitate their mutual support and offer them ownership of the content, purpose and direction of their CPD may be particularly effective in supporting changes in professional practice that are radical' (NCETM, 2009, 65). Equally significant was that 'The teachers reported how the research aspect of their CPD affirmed their perceptions of their teacher-self, leading to confidence

in their professional self. They also reported how working on their existing interests and understanding led to a deepening development of their teacher-self and felt satisfying.' Furthermore it led to feelings of passion for their mathematics teaching: '*It has made me research an area of the curriculum about which I am strangely passionate, reflect on my own understanding and practice, collect and collate evidence and share this with fellow maths enthusiast within my school and the group'* (NCETM, 2009, 99). Summing up the case study of the CM Network group, the report concludes:

> Participant ownership of this initiative helps to sustain involvement and that the members support one another in sustaining this passion and enthusiasm. Overall, the initiative supported the participants in their professional change by giving them a space for the detailed and joint consideration of children's mathematical thinking. It supported them in following up research sources that would support their analysis of the *children's mathematical graphics* and enabled them to encourage children to take charge of their own mathematical activity. It also offered them a supportive and encouraging arena in which their professional concerns and difficulties could be discussed, (NCETM, 2009, 65).

Conclusion

We argue that the traditional 'delivery' model maybe good at providing an introduction of a particular aspect of mathematics for teachers, but is less effective for embedding concepts or for a sustained conceptual shift. The recent RECME research findings suggests that democratic, 'grassroots' groups appear to have important advantages over the more 'traditional' delivery models for CPD, both in respect of practitioners' professional development and their impact on children's learning. Significantly, (with the exception of our local CM Network groups) the CPD projects researched in the RECME Project all received funding. However, we believe that funding can sometimes exert pressure on teachers to take actions for specific outcomes: they are obliged to commit rather than really want to.

The success of *children's mathematical graphics* in supporting deepened understanding of the abstract, 'written' language of mathematics is dependent on teachers and practitioners having time and opportunities to think things through themselves, to reflect and to critically analyse: these skills appear to be best nurtured in collaborative groups that are 'owned' and led by practitioners themselves. The CPD described here has been acknowledged as successful in supporting teachers and practitioners in developing their understanding of this important aspect of mathematics in the Foundation Stage and Key Stage 1. However, our conclusion is that through many current opportunities for mathematics CPD, teachers and practitoners' potential may be largely unrealised: as we have shown in this paper, there are other possible ways.

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