

Final Report: Researching Effective CPD in Mathematics Education (RECME)

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The following sections are taken directly from the Report and relate to the Research Team's findings on the **Children's Mathematics Network Group (Bristol)**.



We are delighted that the Researchers identified many positive aspects of the *Children's Mathematics Network Group* as a powerful means of CPD. These findings confirm our beliefs in teachers; in the need to trust teachers and to give back professionalism to teachers in order to empower them.

The findings also support the success of our initiative in supporting high levels of children's mathematical thinking, reasoning and problem solving and contributing to deepening understanding of the standard abstract symbolism of written mathematics, captured in this comment from the research team: *'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'*

Executive Summary

Background

The Researching Effective CPD in Mathematics Education (RECME) project was set up under the umbrella of the National Centre for Excellence in the Teaching of Mathematics (NCETM) in England.

The overarching aim of RECME was to provide advice, guidance and recommendations for the NCETM, in order to inform future plans and to point to the types of evidence that could demonstrate that continuing professional development (CPD) is informing teachers' practice and students' learning. The specific aims of the project were:

Aim 1: To characterise different types of continuing professional development for teachers of mathematics (to include both formal and informal experiences).

Aim 2: To investigate the interrelated factors that contribute to effective CPD for teachers of mathematics.

Aim 3: To investigate evidence of effective CPD for teachers of mathematics.

Aim 4: To establish the roles of research in professional development for teachers of mathematics.

1. The CPD Landscape – an analysis

Case Study 5: Early Years Foundation Stage (and Key Stage 1) (4).

Networks

The Network for EYFS teachers formed part of a group of initiatives that were complex, all of which had been initiated by two researchers, Maulfry and Elizabeth.

The first strand was part of a national Children's Mathematics Network for Foundation Stage and Key Stage 1 teachers and practitioners (**A**). It was founded by these researchers and has its own designated website for teachers and practitioners (<http://www.childrens-mathematics.net>). A central feature of the researchers' philosophy is to support and encourage local grassroots teachers' and practitioners' network groups as an effective means of CPD that focuses on children's mathematical graphics (**20**). Their aim is to develop a national network throughout England. Their work is independent and unfunded. The local 'CM Network group' consisted of teachers and practitioners from a number of different settings and schools (Foundation Stage and Key Stage 1) who meet termly. One of the teachers' of this group had previously attended two, one-day courses led by Maulfry. The courses introduced and explored aspects research on *children's mathematical graphics*, and those attending were encouraged to consider setting up a local group of their own. The intention was that practitioners should 'own' their CPD by taking responsibility for organizing all aspects of the meetings. The researchers do not attend the meetings of the group unless they are invited (as guests). This CM Network aims to support teachers in taking control of their learning and professional development and during the first few months of the network group, the researcher provided support and guidance by telephone calls and email.

The second strand was led by Elizabeth, who was also the headteacher of a Children's Centre providing care and education for children up to the age of five. She provided CPD activities for her staff as part of their normal weekly staff meetings. These weekly meetings focused on considering the activity in which the children in the Centre had engaged in the previous week. Different practitioners on the staff brought examples of the children's work and activity to share with the rest of the staff and a particular emphasis was placed on the children's mathematical activity.

The third strand involved the other researcher, Maulfry, who was collecting data for her PhD study on children's mathematical graphics (**B**). As part of their normal practice, three teachers from the Children's Centre became involved in the research. They made observations of the children's symbolic play and their *mathematical graphics*. This research was collaborative with the researcher and teachers co-constructing their understanding through shared dialogue and reflections about the observations and the children's meanings, and discussion about points raised in articles and papers the researcher provided throughout the years. Maulfry suggested that their involvement in the research acted as CPD for the teachers, who learnt from their discussions with the researcher about the children's mathematical development and reflected how they might best support it (NCETM, 2009: p.28).

In the network there was an expectation that participants would put their CPD learning into practice between meetings, either by trying out new ideas in the classroom (**C**) by sustaining or embedding changes already made in their practice (NCETM, 2009: p.29).

3.3.2 Students' mathematical conceptions

The initiatives that seemed to be successful in engaging teachers in such analysis devoted a lot of time to it and made it a central focus of their work, for example, as seen in Case Study 5 In the network there was an expectation that participants would put their CPD learning into practice between meetings, either by trying out new ideas in the classroom (**C**) by sustaining or embedding changes already made in their practice (NCETM, 2009: p.32).

Courses and some networks tended to introduce participants to new ideas and knowledge, frequently focusing on specific mathematical knowledge for teaching (**E**) (NCETM, 2009: p.39).

Notes in the report:

4. In the UK, the Early Years Foundation Stage (EYFS) was introduced in September 2008 and refers to the stage of education for children aged up to five years. In this report we use EYFS to refer to this phase. The revised curriculum for EYFS includes guidance on the kinds of learning opportunities that should be offered and the developmental progression that might be expected. In the context of EYFS settings children are offered many learning opportunities to engage in *problem solving, reasoning and numeracy*.

However, unlike the *communication, language and literacy* section of the curriculum which emphasises the importance of mark-making, *problem solving, reasoning and numeracy* does not. The 'learner centred' approach of the Foundation stage curriculum contrasts with a more teacher directed approach that is sometimes characterised by heavily structured and teacher led approaches, for example worksheets and following a template to create artefacts (NCETM, 2009: p.23).

20. Mark making in mathematics has been identified in recent years as significant for children's understanding of written mathematics in a similar way to children's early mark making in the realm of writing (Carruthers and Worthington, 2006) (C). Children start to attach mathematical meanings to some of the marks they make in play, when supported by sensitive adults who understand and value their marks and representations and this emergent mathematics is analogous to emergent writing. To encourage the children to develop their own mathematical thinking, teachers offer them many opportunities to make their own marks which are called *children's mathematical graphics*, to support their mathematical ideas. The most significant aspect of children's mathematical graphics is that they support children's mathematical thinking and help them understand the standard, abstract written symbolism of mathematics (including written calculations) at a deep level (DCSF, 2008).

Additional notes from Carruthers & Worthington:

- A. The **Children's Mathematics Network** is an international, not-for-profit organization for teachers, practitioners, students, researchers and teacher educators working with children in the birth – 8 year age range: www.childrens-mathematics.net
- B. This research is an ethnographic study exploring the relationship between children's imaginative play, meaning-making (semiotics & multi-modality) and their mathematical graphics.
- C. Or nursery.
- D. However, we acknowledge some distinct differences between written symbolism for writing and for mathematics (Carruthers and Worthington, 2009).

4.6. Case Study 5: EYFS network (see pages 60 – 65 Of the final report)

The case study presented in this section concerns one strand of the EYFS network discussed in Chapter 3. 'Context', below, begins by providing some background to the Case Study and then describes the Case Study initiative.

4.6.1 Context

This initiative is set in the context of EYFS (4) education in which a group of teachers and practitioners established a network group in a city in the south west of England. The network was initiated by two researchers, who seem to be passionate about children's early mathematics. The researchers, Maulfry and Elizabeth, said that their passion was evidenced by:

... our strong desire to help make mathematics more meaningful, challenging, accessible and interesting for young children.

... our deep and enduring interest in young children's learning.

... our belief in the significance of research.

... the considerable number of research projects on children's mathematical graphics (and the related pedagogy and CPD) that we have conducted during the past 18 years.

... the numerous articles, papers, chapters and book we've published (with many more due to be published in 2009).

One reason that our work has been successful is also that we have been teachers (and Elizabeth is still directly involved with children) and developed children's mathematical graphics when we were teaching in the nursery and in schools in the 2- 8 year age range: this means we both really understand what is possible for mathematics in Foundation and Key stage 1.

This description shows that **for these researchers, involvement in CPD was driven by a passionate commitment to children's mathematics and to ways of working with other professionals to develop it. This had originated in their own teaching experiences as a result of careful research into teaching and learning mathematics and reflecting on their practice over a number of years.** The theme of passion and its relationship with CPD is picked up in Section 6.4.

Sarah, a teacher who went on a course run by one of the two researchers, said:

This was an inspirational course and came at exactly the right time for me and my setting where I am maths coordinator. I initiated the Group in March 07 under the umbrella of the two researchers' organisation and Maulfry has been very supportive throughout.

At the course, Maulfry and Elizabeth suggested that forming groups at a grass-roots level would help to encourage and support teachers and other professionals in working with children's own mathematics. In the context of Early Years education, this means focusing on mathematical graphics that children initiate themselves to explore and communicate their mathematical thinking, and using their attempts to express mathematical meaning as the basis for their teaching and learning. Sarah acted on this suggestion to form this group. As she said:

I was enthused by Maulfry and, having identified a gap in the curriculum in the transition between Foundation Stage (preschool and reception) and Key Stage 1 (first years of formal schooling), which my own setting was seeking to fill, I was able to pursue the ideas.

Within the school over the previous year or so there had been a significant change in the approach to teaching in the reception year, especially in mathematics, which had been driven by new Early Years Foundation Stage Curriculum guidance.

The leader, Sarah, describes the work of the group as follows:

I have introduced practice and understanding from the CPD I received from Maulfry and fed back to both my own setting and the group. 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 enthusiasts within my school and the group.

So the group was set up partly in response to Sarah's perception of a gap in the curriculum and in provision for transition between Early Years Foundation Stage and Key Stage 1 in the school in which both teachers work, as well as in response to the suggestions made by Maulfry and Elizabeth at the course Sarah attended.

4.6.2 Aims of the CPD

- To develop teachers' and other practitioners' professional understanding of young children's understandings of mathematics and to support them in developing strategies to develop and support children's early mathematical development, through considering examples of children's mathematical graphics and reading relevant research literature.
- To encourage teachers to observe children's spontaneous mathematical graphics in terms of problem solving and communication.

4.6.3 Intended professional development

The intention of the group was that the professional development would involve:

- Supporting teachers and other professionals in developing effective strategies to support children's mathematical development.
- Developing an understanding of the importance of children's mark making and the ways in which children make sense of early 'written' mathematics.

4.6.4 Intended changes in practice

Maulfry and Sarah hoped that the participants' practice would:

- Move away from imposing (ways of representing) mathematics on children and work towards supporting children in developing their own mathematical understandings and representations in meaningful contexts.
- Support children in adopting conventional symbols, such as the numerals, by working with the children's own representations and understandings.

4.6.5 Content and processes of the CPD initiative

The group was informal and met about once every six weeks. It involved teachers and nursery nurses from a number of different primary and nursery schools in the local area. In most cases more than one teacher participated from each school. Meetings were held after school and the venue changed from school to school. They lasted an hour and a half, with refreshments provided by the host school. The leader of the group, Sarah, intended to delegate more responsibility for convening the meetings and managing the discussion to others in the group and welcomed participation at all levels from everyone. The group was observed to be supportive, open and egalitarian in its structures. For example, at the observed meeting Sarah did take the lead, but all the participants brought their own contributions and all commented freely on each others observations without Sarah dominating the meeting. Towards the close of the meeting another member of the group offered to host the next meeting and the agenda for the following meeting was collaboratively decided upon as an outcome of the observed meeting.

One of the participants said that colleagues from another school had seemed interested and the group decided that they should be included in the next meeting.

The group receives no funding from the schools or any other source, except in the supply of venue and refreshments by the host school. The agenda and content of each session is decided co-operatively by the whole group, which means each participant is supported in their participation by the relevance of the content of each session and the collegial support from their peers. During the meeting that I observed, the participants all contributed examples of children's mathematical problem solving which they had observed in their own settings. These examples were shared with the group and the scenarios from which they had arisen were discussed. The topic had been chosen at the previous meeting in response to the focus of the Revised Numeracy Strategy and in the Early Years Curriculum Guidance on problem solving. Sarah described this as follows:

At the group meetings we share examples of our children's mathematical learning supported by photographs, quotes, samples of work etc. We are currently working towards a shared file of examples of children's problem solving as a resource for all members of the group. Sharing our experiences, children's work, information from Maulfry, other CPD training and ideas, adds to our collective knowledge of teaching mathematics.

This sharing of children's work formed the substance of the observed meeting and included a tremendous variety of examples which had been carefully analysed by the professional presenting it. In many cases, these examples involved accounts of what the children had done, examples of their productions in terms of marks made on artefacts created and photographs of the children in action. The group discussed in detail the mathematical aspects of each example and talked about how they could support the mathematical thinking that it represented.

4.6.6 Teacher 1

Sarah was the leader and administrative organiser of the group. She was an experienced teacher with a post graduate teaching qualification and had studied mathematics to GCSE level. She specialised in Early Years and Key Stage 1 and took a leading role within her school for provision within the reception year, and so managed the transition from EYFS to Key Stage 1.

Actual professional development

For Sarah the main gain from the group was in:

... enabling me to continue to keep abreast of current thinking, be reflective and share my ideas and experiences with fellow early years practitioners, teachers and nursery nurses in the private and maintained schools, in a safe, supportive, non-threatening environment.

Her involvement in the group and attendance at various conferences in the area run by Maulfry and Elizabeth had developed her understanding and enthusiasm and she was in the process of becoming a researcher in her own classroom. This is evidenced by the following comment:

I have done additional research to promote children's mathematical graphics and problem solving, which are the main things that the group has focused on so far.

Sarah had read a lot of research articles about children's mathematical graphics and problem solving and felt that this was important:

I liked knowing that I am aware of current thinking, research and best practice.

Sarah's participation in the group had made a significant contribution to her professional development. She had become more confident, as she said in her questionnaire response:

I feel more confident in my teaching of mathematics and proud of my school's early years team's development in this area. The group is a lot of extra work for me but I find it personally rewarding, professionally exciting and socially enjoyable. It has been great to visit other settings as we take it in turns to host the meetings – and the next meeting will be chaired by the person hosting the meeting, so I might feel less responsible!

For Sarah, one of the key outcomes of involvement was the opportunity to discuss ideas related to EYFS teaching with colleagues from within her school and other schools, and to share examples of good practice as well as current guidance and issues arising from practice.

Changes in practice

Sarah was now committed to practice focused on children's mathematics as a result of her extended study of children's graphics and problem solving. This involved a way of teaching that was completely different from a worksheet-and textbook-based approach that used to exist in her school. Evidence of this change was observable in Sarah's classroom. Examples of the children's spontaneous mathematical work were displayed in annotated form on the walls and in their books. The environment offered a huge range and variety of resources for mathematical investigation which were all freely available to the children. Sarah voiced her enthusiasm and passion for the CPD and her work in leading it but also expressed the sense of pressure that taking on a commitment to leadership of the group had engendered. She said she would like to:

Feel less overwhelmed by my overall work load and how many balls I am trying to keep in the air while making directed changes and keeping abreast of new initiatives and government requirements. I would like to feel less pressured all the time so I could really get down and focus on the children, Their understanding and interests and then work with them to develop their mathematics within a balanced and meaningful curriculum.

This quotation illustrates that for Sarah children's mathematical learning was centred on the children's interests, understanding and the meaning that they could attach to it. Developing her own professional understanding of this process was time consuming but very worthwhile. Sarah voiced her frustration at finding it difficult to find time for this work that she regarded as important.

Student (children's) learning

Evidence of changes in children's learning of mathematics was displayed on notice boards around the classroom as well as in the children's books and they were able to articulate their mathematical understandings clearly. As Sarah said:

The children in our classes have a positive attitude to sharing and representing their mathematical thinking. They are developing confidence in their mathematical graphics which are valued, they are developing fluency and a willingness to talk about their thinking. By focusing on problem solving they are identifying meaningful problems, rising to the challenge and developing a sense of achievement and satisfaction in finding a solution. They are sharing ideas and drawing on prior experiences to inform their strategies. Hopefully this positive attitude to mathematics and problem solving will stay with them. The children are able to demonstrate their individual ability and explore concepts beyond the normal curriculum.

The displayed work, both within children's books and on the walls, demonstrated the detailed observations and analysis that Sarah made of evidence of the children's mathematical thinking and understanding on a day-to-day basis. It also illustrated the importance of mathematics for these children in this class.

4.6.7 Teacher 2

The second teacher involved was Anne, who was working with a reception class of children aged four to five years in the same school as Sarah. She was an experienced teacher who had worked in primary education for over 20 years in a number of schools. Much of her teaching prior to her involvement with the group had been traditional and based on working with young children using schemes of work and worksheets drawn from published resources. Her participation in the CPD arose through the leadership and encouragement of Sarah, who felt that they would both benefit from the added support that the group might offer them. Anne was convinced by Sarah's argument and willing to try the approach out in her classroom (and also to support Sarah within school against some opposition from teachers of older children to the changes in approach).

Actual professional development

Anne suggested that before taking part in the CPD, she had found teaching mathematics less interesting than literacy and some other subject areas. However, having adopted the new approaches suggested by the CPD, she said she had become passionate about teaching mathematics. Anne was initially resistant to the idea of changing her mathematics teaching to focus on the children's mathematics. She said that she was uncertain about how much mathematics the children would engage with if they were not involved in filling in worksheets. As she said at interview:

I didn't feel that comfortable to start with and it wasn't until I realised they (the children) were learning so much more that I was convinced. Pursuing their own maths gives them unlimited potential to develop imaginative games they have come up with that are far beyond the maths in the scheme. I could never go back to that now. The meetings gave me confidence to speak to parents and feel sure that I could justify our decision.

Changes in practice

Anne described her teaching of mathematics before her involvement with the group as traditional and based on worksheets and teacher-led activities. She described how she had moved from directing the children's mathematics to stepping back and offering the children prompts and suggestions so that they could pursue their own mathematical ideas. As she said:

I am more confident now but there is still more to learn. It's a learning journey and it's lovely to observe the children carefully... For me seeing 'is that really maths?' was a revelation and now I am so excited about what they produce and waxing lyrical about the marks they make and we all (teachers and nursery nurses in the group) enthuse and gain from each other.

In the lesson observed, the children were working on a variety of different mathematical tasks of their own invention that were triggered by some initial counting activities as a whole group. After this, the teacher prompted the children by sharing with them her mathematical problem for the day. She told the children that she needed to work out how much money to take with her to the staff barbeque that evening and then suggested that they might work something out themselves. No constraints or questions were offered and the children were entirely free to choose their own activity, mathematical or not. They all chose to do something that had some mathematical element to it, probably prompted by the counting activity that had been the starting point for the session. One child chose to count and record the number of syllables in the first line of various songs so she wrote down that Baa baa black sheep was four. Another child was involved in making a chart like a register for an imaginary class of

children. Several children acted in the role of teacher to one another, including one girl explaining very patiently to a boy how he should write a '5' so that it was the right way around. The boy concerned was writing numbers to represent a quantity as part of his own activity and asked his peer whether he had written the number correctly, which prompted her support. Three children wrote numbers with marker pens on a whiteboard and carried on writing correctly all the numbers to 31, correcting each other's errors in the orientation of the digits. The order of the digits was not problematic for them.

Student (children's) learning

Anne offered many examples of the richness and high mathematical content of the children's mathematical productions. She described a boy, aged four years, who had got interested in big numbers and counting in her class the previous year and who had been fascinated by a pedometer that she wore, to the extent that he would tell her how many more steps she needed to take that day to reach her target of 5000. He also suggested to her that she should keep walking around while she was talking to him so that she would increase her count. Several children in the class had their work displayed on the walls and they were able to tell the stories that lay behind their productions very clearly and coherently. **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.** For example, one girl showed photographs of a paper chain that she had made and described how she had estimated the number of links she would need to make to ensure that it was the same length as the table. She had also made a tape with numbers written on it in order to create her own measuring tape, so she was beginning to conceive ideas about measurement and estimation not usually introduced into published schemes until children reach the age of six. There were many other similar examples of children's mathematical thinking.

The following example, Figure 4, shows the detail of the accounts that Anne's descriptions offered, both in work from their books and on display on the classroom walls.

Figure 4 Display in the EYFS classroom



4.6.8 Case Study 5: Conclusions

This network of EYFS teachers is very much a bottom-up initiative and the starting point was input from two experts. The ownership of the network was devolved and the organiser sought to empower all the participants to take it in turns to lead sessions. The venue of the meetings changed on a regular basis,

as did the person who led the meetings. These were decided upon co-operatively. Membership of the network group was open and growing but involved a strong commitment to participation. All members of the group were expected to contribute to meetings and to share their experiences. The focus of the meetings was children's mathematics and the teachers brought examples of children's work and photographs to share. The central focus of the teachers' work was on supporting children as they developed their mathematics and in allowing them to pursue the mathematics in which they were interested. Sarah described how the CPD had helped her to reconcile new curriculum guidance with approaches to teaching mathematics to young children that needed to change. Her reading of research literature about children's mathematical graphics and her involvement in courses led by Maulfry and Elizabeth had led her to set up the group. Anne became involved in the group as she was a colleague of Sarah's and they were both concerned about implementing the new curriculum guidance that involved changes in practice from their previous ways of working. In Anne's case especially, this involved shifting quite considerably from previous practice and overcoming an initial reluctance to change and scepticism about whether the change would be beneficial to the children's learning.

The changes that the teachers made in their practice were fully in line with the aims of the CPD. We would suggest that the success of Anne in overcoming her reluctance to change may have been due to the support that she got from the group and especially from Sarah. This suggests 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 radical changes in professional practice. 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.

Another significant feature of this initiative is its focus on careful consideration and analysis of children's mathematics, and the ways in which professionals can support and encourage the children's mathematical thinking and reasoning. We were struck by the emphasis on observing and analysing children's spontaneous mathematical activity. This emphasis seems to shift the teachers' focus from teaching to learning and to give them the opportunity to consider the children's mathematical understanding and thinking. The teachers are then able to use this to support the children in their mathematical development and to plan appropriate adult-led activities that help the children build their mathematical thinking and reasoning, such as the counting.

Teacher learning

Other comments from teachers related to increased awareness of their teaching, and sometimes awareness of student learning. Increased awareness influenced the practice of the teachers by encouraging them to think about their own teaching approaches and the learning of their students. However, it seems that teachers found it difficult to talk about their students' learning and tended to talk about the behaviours of their students or their reactions to the tasks they were asked to complete. To support teachers in discussing learning, deliberate and careful efforts need to be made, such as in Case Studies 4 and 5 (NCETM, 2009: p.72).

Teacher attitudes

Evidence from the case studies showed that engaging in CPD could increase teachers' enthusiasm for, as well as their enjoyment of, teaching mathematics. For example, in Case Study 5, a teacher

described herself as having developed a 'passion' for teaching mathematics because she had developed her understandings of children's ways of making informal representations on paper (mark making) and the relationship between these marks and mathematics. **Another theme was increased teacher confidence. Teachers reported increased confidence to try things out, and it was apparent that the support of the school or department, or even a colleague, was important in building this confidence. Increased confidence seemed to be important for teachers in introducing changes in the classroom, such as using more open and unpredictable tasks, letting go of control and letting students take the lead. Changes in practice related to this included using more open questioning techniques, moving away from relying on textbooks and becoming more relaxed with students** (NCETM, 2009: p.73).

Student learning

We suggest that improved student learning provides crucial evidence of effective CPD, but teachers tended not to report improved student learning or changes in ways of working as evidence of the effectiveness of their CPD. However, when questioned, teachers reported such improvements by referring to students' work, what students said and improved attainment. These improvements seemed to be important in convincing teachers that they should sustain the changes they had made to their practice, as described by Anne in Case Study 5 (NCETM, 2009: p.73).

In some of the networks, such as in Case Study 5 there was no clear leadership. The teachers involved thought this was effective because it kept the content closely related to their needs. As one said:

We run it ourselves and it follows the needs of the group. The impetus is talking to other people and valuing the presentation (of the children's own mathematical work) and keeping the evidence. Once I saw that others were valuing this I became much more comfortable with it... now I couldn't go back to the textbooks (NCETM, 2009: p.75).

One of the Early Years teachers explained how she had become more aware of the mathematics of the children and of how she could help children:

I think I am probably more aware of what the children are trying to achieve and what I should be trying to teach them and more aware of the skills they need to get out of the maths lesson; more aware of this now I recognise the maths in the children's play that I used not to see (NCETM, 2009: p.84).

Changes in student (children's) attitudes

Teachers often reported that students' attitudes had improved since the teachers had participated in the CPD, with students being more willing to share knowledge and collaborate, to engage in discussion and communication about mathematics and to persevere in tackling difficult tasks. It was often reported that these changes improved the atmosphere in the classroom and led to increased confidence and motivation on the part of the students.

Student interactions

Students in the observed classrooms seemed to be engaging in mathematical thinking and reasoning in collaboration with others and discussing the mathematics they are working on with their peers and their teachers. Teachers also described ways in which their students had changed the ways they worked together, such as discussing mathematics more, working collaboratively and sharing knowledge (NCETM, 2009: p.94).

Research informed CPD

Several of the initiatives mentioned research in connection with their aims and objectives. For example, one said that they wanted to engage the teachers with relevant research. Another aimed for teachers to

evaluate their experiences through action research. Research also informed many of the initiatives in a variety of ways.

(All members of the department in the secondary school involved were made aware of the research underpinning the initiative through the enthusiastic dissemination by the leader, and some of the other teachers had been encouraged to read the research for themselves). A similar connection occurred in the EYFS initiative described in Case Study 5, where **the teacher who set up the network had begun to read about research related to children's mathematical graphics as a result of her attendance at conferences run by the researchers involved. This teacher then used her knowledge as the basis for the network group meetings, became involved in further research in her own classroom and supported her colleagues in the network to do the same** (NCETM, 2009: p.97).

Doing research as CPD

Other initiatives included, to different extents, trying out new ideas and reflecting on professional activities. Descriptive illustrations of this can be found in Case Study 5 (see page 60). **In Case Study 5, Sarah reported she is 'becoming more of a researcher in her classroom'. Also, as a group they were developing an 'enquiry approach' in this initiative** (NCETM, 2009: p.98).

11. CPD initiatives

Early Years Foundation Stage (EYFS)

A network offering a grass-roots model for teachers of children in Early Years Foundation Stage (EYFS) and Key stage 1. The network supports teachers in developing their professional knowledge of young children's learning and development of mathematics and in linking evidence-based research and theory with practice. They encourage teachers to take ownership of their learning and professional development as they learn about and develop their pedagogy. For the purposes of this research we focus on three aspects:

- A collaborative Children's Mathematics Network group (See CASE STUDY 5)
- Mathematics CPD at a Children's Centre
- A group of teachers involved in EY mathematics research (PhD) project (also professional development) at the same Centre (NCETM, 2009: p.113).

For the full RECME Report go to:

<http://www.ncetm.org.uk/files/387088/NCETM+RECME+Final+Report.pdf>