

Mathematics in the Early Years



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*How can we provide effective support to develop
children's concepts for learning in mathematics in
partnership with their parents?*

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BA Childhood Practice

Acknowledgements

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Introduction/Rationale

The programme learning outcomes which I will cover in this report are as follows:

3.9 Managers/lead practitioners have the knowledge and understanding needed to support evidence informed practice.

4.5 Managers/lead practitioners engage in professional reflection for continuing improvement.

4.7 Promote and actively lead others in working with parents and carers, families and communities.

Mathematics and numeracy, two words we hear on a daily basis but what do they mean in an early years setting? The National Curriculum (Scottish Government 2011) evidences the importance given to mathematics and numeracy in the Early Years, while agreeing; I felt I needed to increase my confidence levels on planning and providing practical mathematical activities in nursery. When this topic was discussed at our staff-training day (see figure 1), there was a general feeling that there was a need to increase awareness and provision for mathematics and numeracy opportunities throughout our nursery. During discussion, it was felt that many of the Early Years Practitioners (EYP's) had similar anxieties about their skills in supporting children's mathematical development. Some staff felt less confident in identifying ways which mathematics could be progressed in our school.

Through my daily interaction and discussions with parents many say they find difficulties in knowing how they can support the development of their child's knowledge and understanding of mathematics. Although I feel able to support parents, I still felt less confident here than with other parts of the curriculum. To progress this, I plan to look closely at mathematics in the early years throughout this study. During the initial discussion with staff, all showed an interest in developing their knowledge and expressed a desire to improve their practice and confidence in supporting children and their families in this area. Based on this, I developed a plan for my project (appendix 1).

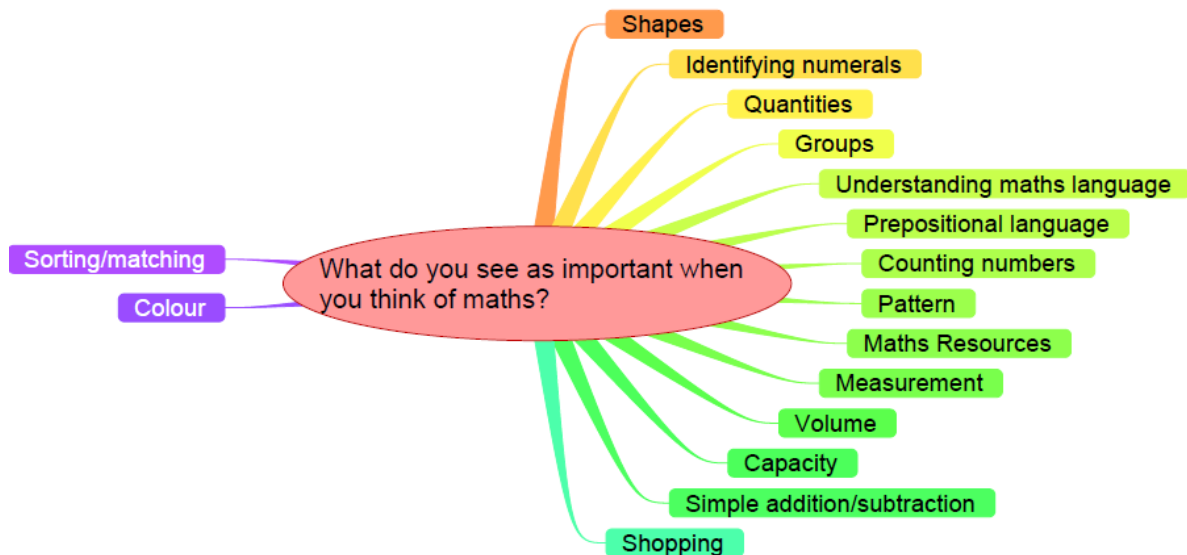


Figure 1 Summary of staff in-service discussion.

Literature Review

This literature review investigates the area of mathematics in the early years. I will research the role that practitioners have in supporting children in their development and understanding of mathematics and how parents can support their child at home. I shall be looking at the work of theorists in the field and evaluate their influence on early years teaching of mathematics today. Literacy, numeracy and health and well-being are described by the Scottish Government (2011) as the big three essentials, often referring to them as the building blocks to lifelong learning.

Many theorists believe that children learn mathematical concepts best through play both at home and in nursery, among these are Tucker(2010), Lindon(2005), Haylock and Cockburn(2008). They all believe that children learn best through practical meaningful experiences that are purposeful to the child. Similarly, Wood and Attfield (2005) argued that the early years were particularly important for developing children's ability and enthusiasm in mathematics. They believe that the more practical activities children experienced the more success they would have in becoming what they call "real-world mathematicians". There is also the belief amongst these writers and others that the key to children learning through play is having a skilled workforce, practitioners that provide high quality experiences for children who are skilled at supporting children's learning through play by extending their thinking and building on what they know (Wood, Attfield 2005).

In the late Twentieth Century, Piaget's (1896-1980) constructivist theory had a major influence in the field of education. His work led to a more child-initiated approach to learning. Piaget felt that children learned better through actively being involved with their environment,

that their cognitive development needed them to have access to a wide range of materials provided by the teacher. However, Vygotsky and Bruner (Lindon 2005) challenged Piaget's theory; they believed that Piaget underestimated young children's abilities particularly in relation to his experiments about class-inclusion and conservation. In Britain today Piaget's ideas are still influential, particularly in nursery education. (Lindon 2005:40) wrote "Bruner believed that development could be accelerated, when adults took a more active role in children's learning" Bruner (1915-) was particularly anxious for the child who had little intellectual stimulation: that they would be at a great disadvantage without access to a workforce of skilled practitioners to support development. Vygotsky (1896-1934) argued with his social-constructivist theory that adults had a key role to play in scaffolding children's learning. He referred to the child's 'Zone of Proximal Development' and the active role adults had to play in enabling children to reach their potential, this is still having a major influence in educational establishments today. Vygotsky and Bruner both believed that through play children can repeat and revisit activities to consolidate their learning and that social interaction is crucial to enable children to make sense of their world (Tucker 2010). Tucker (2010) argues that children benefit from a good balance of both child-initiated and adult led play. Things have changed quite considerably over the past fifty years, there has been "...a shift in emphasis from the teacher teaching to the child learning". (Dawes 1977:4) argued that children would produce correct answers by applying rules but they did not actually understand the concept for applying the rules, arguing that strategies used for teaching were not working well. For a long time researchers were identifying deficiencies in teaching strategies, but improvements took practitioners several years to put into practice.

Other recent changes have been the recognition that children, bring to school, a wide-ranging knowledge of mathematical concepts and experiences. Aubrey (1977) carried out research into how teachers took account of children's prior mathematical knowledge and found that teachers "were unaware" of many mathematical experiences the children had upon entry to school and that what the children knew already about mathematics was not being used to inform teaching. Research consistently showed that previously the curriculum was not well matched to the children's prior learning. Wright (1992) cited in Caddell (1998b:6) concluded that there was "an urgent need to review current practice to bring curricula into line with research findings". One result of this was the introduction of the Curriculum for Excellence 3-18 document, now used across Scotland. Caddell (1998a) also agrees that recent research signified a marked shift away from Piaget's earlier ideas and there is evidence that the role of the teacher in enhancing mathematical knowledge and understanding is crucial.

Research has also resulted in the recognition of the role parents play in their child's learning and the home environment is now being recognised as important contexts for early numeracy experiences. Similarly, the Scottish Government emphasises that "Parents are the first teachers in their child's learning, and have a key role to play in developing skills as children move through their education."(Learning Teaching Scotland 2011:1) To encourage parents to be more involved in their children's learning, the Scottish Government passed a new law, the Scottish Schools (Parental Involvement) Act 2006. The Act placed responsibility on local authorities to improve parental involvement in three ways - learning at home, home/school partnerships and parental representation. This has ensured that all schools adopt strategies for involving parents in their child's education. Although many schools were increasing opportunities, others needed the legislation enforced to ensure there was continuity across all schools. Most schools now have a parents committee with parents' views being sought and acted on. Tucker (2010:140) believes that "what parents can do with their children at home has far greater significance than any other factor open to educational influence". She believes that an important aspect of how much parents influence their child's development is their own experiences as a child themselves. Tucker believes that practitioners can positively influence parents by providing support for them, which will benefit their child. She highlights the need for good practice and argues that working in partnership with parents should be a learning experience for both practitioners and parents alike, leading to improved learning for the children. When children meet people for the first time after telling them their name the next thing they usually tell people is their age. Walk into any nursery school and after you ask a child their name you may hear "I am four now! She is only three, I'm bigger than her!" Numeracy and mathematics are important to children from a young age and as practitioners, we should build upon this.

The above research highlights the importance of the role of parents in their child's learning and my study researches how in my setting we support to do this. I also want to investigate how our school supports children in relation to mathematics and how we provide a mathematics rich learning environment and to establish if we could be doing more.

The research question(s)

After our professional discussion as a staff team, through my reading of early mathematical development and investigating the work of the major theorists in this area which I have discussed previously in my literature review I was encouraged to look at my own setting. This I planned to do under the headings of what we were currently doing in relation to mathematics and how this could be improved by perhaps linking theory with practice in a

more consistent way. I wanted to share my knowledge with the staff team and encourage us to review/improve our practice and provision while ensuring that staff, children and their families were supported both at school and at home. From this, my research question and sub questions developed.

Main Research Question

How can we provide effective support to develop children's concepts for learning in mathematics and numeracy in partnership with their parents?

Sub questions

- 1. What is our understanding of mathematics in the early years and what support do we provide in the nursery setting to develop children's learning and development in maths?*
- 2. What aspects of our practice reflect the work of the theorists in the field?*
- 3. What can parents do to become more active in supporting their child's mathematical development and what support can we offer?*

Investigative Design

The approach that I used was to gather people's opinions on how we as a staff approach mathematics, both on an individual level and that of the whole team. I planned to do this using mainly empirical research including some observational research, with the aim to moving onto action research whilst reflecting on my findings throughout with the use of my online journal. I felt that as a practitioner this would be the most effective method of research as I could observe practice daily and actively engage with children/staff and parents using a flexible approach. I planned to combine a wide range of methods and techniques, the data collected would be mostly qualitative but there were elements of quantitative features particularly within my surveys, I had a systematic approach following my planned time line (see appendix 2) using a collaborative and participatory approach throughout. I had chosen to involve the whole staff team as I had used this method in the past and I believed this increased the likelihood of change, which would then influence children, families and the staff team. When deciding on how to gather my information I had to consider carefully which methods would enable me to find the answers to my research questions. As you can see from my proposal in appendix 1, I had chosen to use a group meeting with the staff to find out how they felt about mathematics and get a general census of how we as a team felt we supported children's mathematical development. This discussion would be crucial for getting

the whole team on board with my project from the beginning. Without their support, I may have found it difficult to carry out my research project or influence practice effectively. Writing at the time in my journal, I noted that staff were all very interested and saw a need for this topic to be reviewed. Their enthusiasm would prove to be a great assistance to my research.

I decided to give the parents a questionnaire before asking them to attend a focus group, I felt that this approach would introduce the idea of mathematics in nursery and focus their thoughts on their involvement in their child's learning. As you can see from my questionnaire in appendix 3, I gave them some suggestions of children's prior learning and asked them to think about their child's ability before starting nursery. I thought this would perhaps to allow them to acknowledge that they are their child's first teachers if they were previously unaware of this. I piloted my questionnaire first and I personally handed the questionnaire to parents, attaching a short letter about my studies and confidentiality of responses. I allowed space for them to add their name if they wished to enable me to respond individually to any parent who may have queries and provide further support or clarification if needed. I hoped the focus group would be more successful because parents had already completed the questionnaire and knew the topic on the agenda. I felt it would be best to involve only the returning children's parents in my research as the new parents and children were coming in gradually over six weeks and therefore only just getting to know the nursery. This would mean that all the parents involved in the research had been in our school for approximately one year; they knew nursery practice and had access to their child's record of development (see appendix 4). This parent group had some awareness of their child's mathematical development and I had a positive relationship with them already, both of which would be beneficial.

It was agreed at a meeting with management, that we would have some time dedicated to mathematics every week at the staff meetings. At these, we would discuss one of the mathematics and numeracy outcomes weekly (see appendix 5) and go into depth by brainstorming how we meet each outcome by providing experiences for the children. I would carry out observations of children (see appendix 6) in both child and adult initiated play throughout each week and look at how we facilitate learning as practitioners and reflecting on our practice as a team. I chose to carry out interviews to allow me to have a good detailed conversation about how we are already supporting children with mathematics and find out how parents felt about the support they were receiving in this. I felt it would also be useful to interview a parent support worker who works with parents in the 0-3 age range to see if parents had access to support before starting nursery. The interview would enable me

to probe further, I prepared an interview schedule (appendix 7) to ensure the interviews stayed on focus (McNiff 2003).

Implementation

After some initial setbacks to my school based research such as school closures for holidays and new children starting, I realised that it was imperative that I make a plan (see appendix 2). Before I carried out my research, I completed an ethics form and shared this with staff, parents and my tutor (see appendix 8). Prior to any focus groups and interviews, I always began with a brief talk on confidentiality and offered people the chance to discuss any issues raised by them in private. I ensured confidentiality to all participants. It would be beneficial for us as a school to ask the parents who attended the focus group to evaluate the groups and provide feedback, therefore I compiled a short evaluation sheet (see appendix 17) but I made these anonymous to allow respondents to be as honest as possible without worrying about repercussions. To ensure that parents with little or no English were included I worked closely with our Bilingual assistant to help with translation.

Each week at the staff meetings, we used sheets (see appendix 5) with one of the outcomes for mathematics at the top and we used a new outcome each week. This would allow us as a staff team to develop our knowledge of the outcomes for mathematics, discuss and review how each influences our practice and the benefits for children. We wanted to look at how each outcome breaks down into experiences we provide for the children, reflect on our practice, and plan any improvements that were necessary. We also shared ideas for practical activities, reviewed resources and discussed the staff role in facilitating learning. I also had to prepare for my focus groups and provide items for the parents such as interactive displays and information the parents requested about the curriculum (see appendix 10).

Findings

These are the findings from my three sub questions that I have researched:

- 1. What is our understanding of mathematics in the early years and what support do we provide in the nursery setting to develop children's learning and development in maths?*

One finding from the in-service day was that all staff knew about maths concepts, knowing what to look for and how to recognise them, but there were some aspects we could cover better. Two newer staff members said they felt less confident at being able to identify and provide resources and materials to develop maths concepts. All staff recognised that opportunities for mathematics development should be everywhere in nursery, this is evidenced in the mind map activity we completed (see appendix 12). All staff said the weekly staff meetings to discuss each of the outcomes for mathematics in turn were useful as it was supportive and allowed us to learn from one another (see appendix 9). Through group discussion, I found that our staff provide lots and varied opportunities for children to revisit and consolidate mathematical understanding. This was evidenced during my observations (see appendix 6a, 6b and 6c) and in the children's record of development (see appendix 4) where staff assess where the child needs further support or challenge. We provide a mathematically rich environment where staff facilitates learning through a mixture of both child led and adult initiated activities; as discussed during our maths walk around our school (see appendix 14). During this, we looked at the provision of resources and discussed how we encourage the use of mathematical language and development of mathematical concepts through varied play experiences. The discussion we had at the in-service day (see appendix 12), allowed us to discuss our aims and values for the children and I felt that this was a good way to allow staff to reflect on their own practice as well as that of the whole school in relation to mathematics. I was pleased that I had used this method to gather information, as it proved very successful, allowing opportunities for group discussion and we were able to support the less confident staff members.

2. What aspects of our practice reflect the work of the theorists in the field?

My work with the staff, parents and children has highlighted the links between our practice and the work of a range of theorists in the field. Our school is full of opportunities which are both practical and meaningful to the child this reflects the work of Tucker (2010) and Lindon (2005) as you can see in appendix 14 when we walked around the nursery to look at provision. When observing the children (see appendix 6b), I found that they were learning through play which was mainly child initiated but also some adult led play, the way our school day is structured allows daily opportunities for some adult led activities at the end of each session. Wood and Attfield 2005 believe that this is an important factor in children's mathematical development. We assess the development of the children and build on prior learning, often referred to as 'scaffolding' by Bruner (see appendix 4), shown clearly in the next steps section of the record of development. There is evidence of active play during my observations (appendix 6), here staff were providing experiences that were rich mathematically with the practitioner using mathematical language to facilitate learning,

asking questions and getting children to think and problem solve. A very good example of supporting children's mathematical development was evidenced during my observation of the children building a large fire engine as seen below in figure 2 (see appendix 6c). I saw several examples of opportunities for children to revisit and repeat activities to consolidate learning, social interaction was encouraged by staff, which Tucker 2010 argues is important. For learning, Vygotsky and Bruner (Tucker 2010) believe that children should be allowed to revisit activities and that adults have a key role to play in extending and supporting children's learning this was evidenced during my observation of children throughout the nursery (see appendix 6c). You can see that the children were using mathematical language and processes as they solved the problem of how to build the fire engine, supported with the adult facilitating learning here. Staff at our school provide many opportunities throughout the day which are both child initiated and adult led, we feel it is important to get the balance right, this is something that (Tucker 2010) argues is important.



Figure 2 Fire Engine as discussed in appendix 6c

The curriculum used at the school advocates working in partnership with parents and at our last inspection this was scored very highly with the inspector commenting that "The quality of involvement of parents and carers was an excellent strength of the nursery school" (MacKay 2010) (appendix 15). The school has a parents committee, uses early experience sheets (appendix 16) and uses many home school resources where parents' views are not only listened to, but acted upon. The approach the school uses is to have a learning community, one where parents can help us and we can help them as Tucker (2010) argues this will have bigger impacts on children's mathematical development.

3. *What can parents do to become more active in supporting their child's mathematical development and what support can we offer?*

The questionnaires were hand delivered and I feel this personal touch contributed to the high number of returns with twenty-four out of thirty returns. All parents felt their child had some prior learning (see figure 3 below), most parents were able to identify ways in which they support learning about mathematics at home, giving examples such as hanging out the washing or counting the stairs (see appendix 13). Almost all parents knew that the nursery promoted their child's mathematical development and all felt it was important (see charts in appendix 13). Of the twenty-four parents, eighteen were able to describe how using home school resources with their child supported their maths development at home. They gave examples like "helping them develop concepts and learn order". The other six parents did not identify a link between the resources and their child's learning and said things like "lets them play with different toys to the ones they have at home" (see appendix 13) for full list of answers. Five parents left additional comments such as " I think learning about maths and English is crucial to a child's development, I have found that reinforcing and practising with **** at home is helping her to progress at a steady pace" this shows that some parents are very aware of the benefits of supporting children's learning at home (see appendix 13).

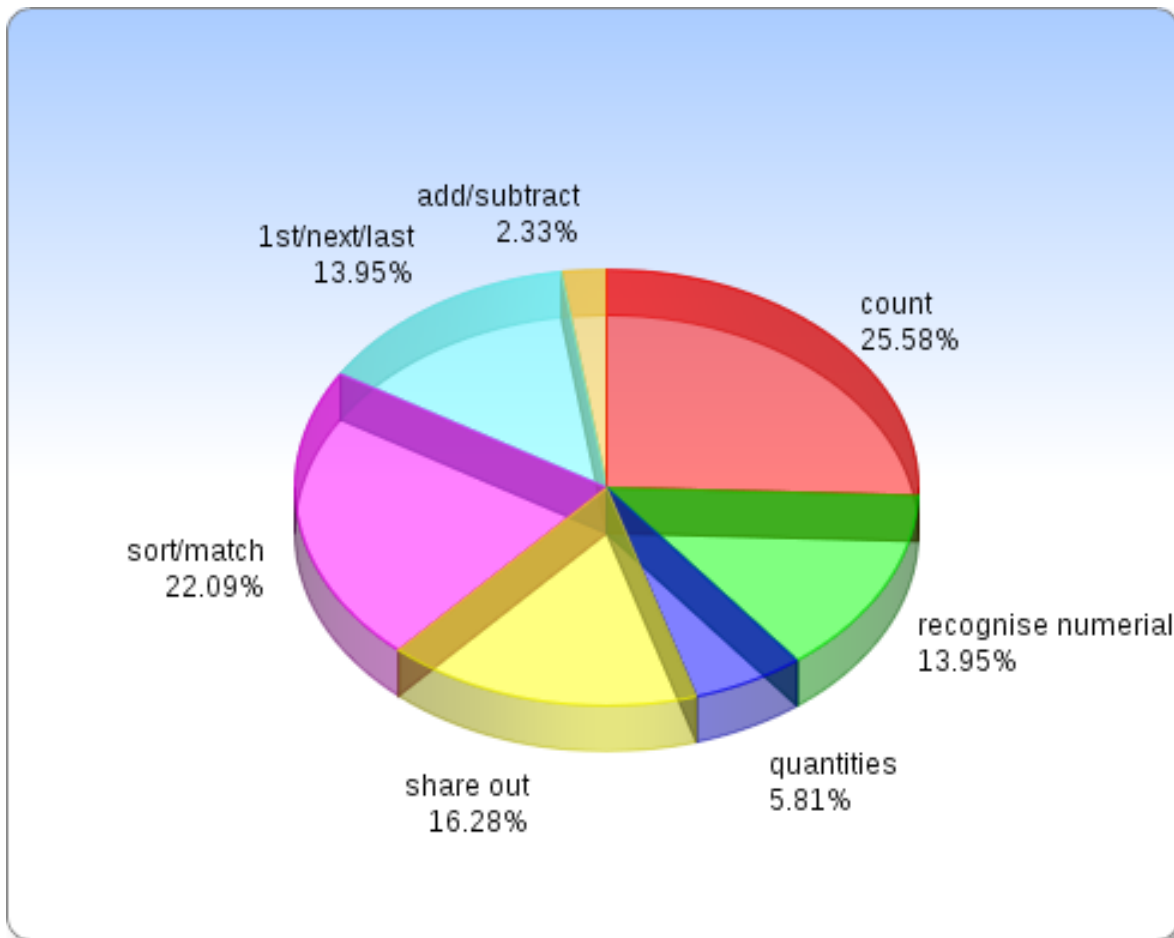


Figure 3 Question 1 from questionnaire.

The focus groups were well attended for the size of the room, the first having ten parents who also attended the second (see appendix 11) except for two who were on holiday. Most of the parents said they were worried about how to support their child mathematically at home. Three parents asked about stages of development saying that they needed to know what their child should be able to do before they could build on it. Other parents agreed and there seemed to be a lot of uncertainty around this subject. Most parents said they were thinking more about numbers in relation to mathematics, counting, identifying or writing numbers, they were not thinking about the wider variety of maths concepts. All of the parents except two were able to identify ways which they support their children and three of the parents had a good grasp of the topic and were able to share their experiences and ideas with the others. They told how they use sweets for counting and sharing, looked at bus numbers or encouraged their child to help find quantities in the supermarket. After the focus groups, all parents said they found them to be very useful and commented, "I did that with him but I never thought about him learning maths at the same time". Feedback on the evaluation forms (see appendix 17) was very positive, all parents felt they benefited in some

way and there were many good comments such as “It was good to understand how they teach kids at nursery and try to follow the school system in this country”.

Discussion of findings

How can we provide effective support to develop children’s concepts for learning in mathematics and numeracy in partnership with their parents?

I would now like to refer back to my main research questions and show how using the information from my sub questions has helped me to answer my original question. In conclusion, we have gathered evidence to support the fact that we have various strategies and procedures in place to ensure that we provide effective support to promote children’s mathematical development in partnership with parents, there is however, room for improvement. We now have in place some improved practice and have begun working more specifically on mathematics with parents, we have a good starting point for moving on to some more in depth action research in the coming months. When I looked at my sub question 1, I found that most staff were capable at identifying and providing activities that are rich in mathematical experiences. A few staff would like further training to help them build on prior learning. All staff are finding the continued use of the outcome and experience sheets useful as it helps them develop more in depth knowledge of what is still a relatively new curriculum. It was important that we learned more about the outcomes and experiences for the curriculum and using the weekly sheets (see appendix 9) proved a very useful way to do so, all staff agreed that these meetings were very productive and all staff fully participated. We were sharing ideas and developing a learning community where we could learn from one another about how we provide mathematical experiences for the children. There is still much to do here and staff development will continue in this area with the plan of reviewing progress made and the impact on the children in the coming months.

My questionnaires and focus groups highlighted that most parents seem to have some knowledge of how to support their child at home. The parents who attended the focus groups all felt they gained further knowledge and now feel more aware of developing mathematics with their child through practical home activities. Practice needs to be regularly reviewed to ensure that we are providing effective support to children and their parents in relation to early mathematics.

Implications

Action for staff

During my research, one theme that repeated throughout was ensuring that staff had the skills and knowledge that they need to support the children and the families in our school;

ongoing staff development is crucial in maintaining high standards. "If they are to learn anything about children's mathematical knowledge, teachers need to know what to look for as they observe, for example, children's block play." (Ginsburg, Joon and Boyd 2008). This paper not only highlights the importance of mathematics in the early years but the difficulties in ensuring that staff feel confident in meeting the needs of the children in terms of mathematics. Furthermore, we must be asking questions, challenging responses and getting children to think. It is important to arouse children's natural curiosity and tempt them to try new experiences; perhaps by asking questions such as "What would happen if?" allowing children time and space to solve problems, is key to developing their mathematical thinking and creating real world mathematicians. "Mathematics equips us with many of the skills required for life, learning and work" (Scottish Government 2011) and should be cross-curricular. Other implications are that now we have seen the benefits of this type of research within our school we will now carry out some action research especially in regards to curriculum work with the parents. One result of my interview with a parent support worker (appendix 18) from the Local Authority, being that another support worker asking about my research contacted me. We have compiled an action plan to further support parents from ethnic minority groups in our school to develop maths learning at home.

Action with parents:

An implication to come from my work with parents is that it would be an advantage when new parents arrive in nursery, to offer more information about the curriculum and offer ideas as to how they might, through meaningful daily activities, develop their child's mathematical understanding. We have planned to have a curriculum evening for parents, which will be similar to the focus groups but will also cover other areas such as literacy and health and well-being. We hope to be able to access parents who are unable to attend during the day due to work commitments. Indeed, there may have been a bigger impact if the focus groups were held after school, as I know many parents cannot commit to attending school things throughout the working day.

Disseminations of findings:

Having shared the findings from my research with the staff and parents in our school, I have also discussed my research with some practitioners across the city. Who have shown an interest and asked for a copy of my report to read, which I plan to do. I will also post on our school website and possibly an Early Years web site.

Conclusions

It is evident that children use mathematics and numeracy from a very young age; they have a need to learn about mathematics in order for them to be able to make sense of and live in their world. This report shows that there is research evidence to support that children benefit from an early approach to mathematics both at home from their parents/carers and from having access to a skilled workforce of practitioners. Mathematical experiences for young children should be meaningful and purposeful in order to allow the child to use familiar concepts. Research shows that focusing on mathematics particularly in the early years has major benefits throughout a child's life helping them not only in their later education but also all the way through life.

I have extended my own knowledge of how children learn in relation to mathematics. I now think more about how we can make our school richer in mathematical experiences, and how in my own setting, we could be doing more to provide experiences that are meaningful for the children. This is more than just putting out maths resources and allowing the children to explore - it is about the key learning provided by staff through quality interactions. Being observant of children what they are interested in, providing challenge for them and building on what they already know. I gained better understanding of how to develop the children's understanding of mathematical concepts by using key activities, which develop knowledge of one to one correspondence, classification and order. The most significant learning for me in my own practice was the frequency of using mathematical language with the children. Throughout the day I hear myself saying things like you are first, next, this one is thicker/thinner, using open-ended questions and giving opportunities to the children to think more about problem solving. Throughout my research I have improved my own practice and in doing so I hope I have empowered the other members of our staff team and parents to do likewise therefore raising the quality of mathematics learning and teaching within the school and at home. I gained better understanding of how to work with staff and this research has developed my own leadership skills. As a result, I am more skilled and knowledgeable in not only working in partnership with parents but also supporting them when necessary, I see more clearly that I could both lead and learn both simultaneously. More significantly, I have learnt more about how to support evidence informed practice, being a leader, empowering people, the importance of working in collaboration with a range of stakeholders and professional reflection for continued improvement. The work that has stemmed from this research will continue to go on in as we as a school strive for excellence. My work and research was best summed up by a parent who wrote after attending the focus groups and borrowing my books about Mathematics in the Early Years said

“You have inspired me to take on board the suggestions and use further learning to help my child learn about maths. I have learned the significance and importance of my time with my child out with nursery and how to use everyday opportunities to help my child learn about numbers, amount, patterns as much as I can. This has not only been fun for my child but has made everyday tasks more fun for me too” (anonymous parent 2011).

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