

INVESTIGATING THE EFFECTS OF SHARED PICTURE BOOK READING ON PARENTAL INVOLVEMENT IN MATHEMATICS

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The intervention described in this paper facilitated mathematical discussions between parents and children within the context of picture books. Parental involvement has been shown to have the potential to impact significantly on a child's attainment in school (Epstein, 1995; Anthony & Walshaw, 2007). The intervention took place in a rural school in County Kildare and lasted for three weeks. The research focus encompassing the intervention was the parents' involvement with their children's mathematical learning. Data collection included parent interviews and a reflective journal maintained by the teacher-researcher. Findings indicated that the majority of parents felt they were more involved in their child's learning of mathematics through the intervention. Furthermore, the participants noticed a number of benefits when using the picture books, including a greater understanding in children's mathematics, the children having a greater motivation to do mathematics, and an increase in mathematical discussions.

PARENTAL INVOLVEMENT IN MATHEMATICS AND THE ROLE OF PICTURE BOOKS

Parental involvement can have a significant impact on children's mathematical development (Henderson & Berla, 2004; Anthony & Walshaw, 2007). Recent reforms have emphasised the need to work with parents to enable them to support their children's mathematical development. For this to happen, there is a need to educate parents on current practices in mathematics education (Civil, 2006) and to address parents' own concerns and attitudes towards mathematics (Muir, 2012). In recent times, a number of initiatives between the school and the home environment have been successful in enabling parents to have a greater role in their child's mathematics learning (Merttens, 2005; Civil, 2006; Muir, 2012; Bleach, 2010).

Parents are the biggest factors in determining children's success in mathematics, with children's attitudes to learning mathematics shaped by the home environment (Merttens, 2005). Parental involvement in mathematics begins at home in the early years. Furthermore, differences in mathematical abilities of young children can be linked to the social activities they engage in at home (Benigno & Ellis, 2004). LeFevre, Skwarchuk, Smith-Chant, Fast, Kamawar and Bisanz (2009) describe the indirect and direct mathematical activities that parents and children engage in at home. Direct activities are focused on counting and numbers for the purpose of developing quantitative numerical skills. On the other hand, indirect activities include games and everyday tasks where the learning of mathematics is incidental (ibid). Boaler (2009) advocates the use of indirect mathematical activities at home and advises that we cannot overlook the "role of simple interactions in the home, and the role of puzzles, games and patterns, in the mathematical development and aspirations of young children" (p. 108). Children's understanding of mathematical concepts is shaped by the experiences they encounter at home. Parental support at home can help children develop mathematical skills and in turn their confidence in performing in mathematics can develop (Pomerantz, Moorman

& Litwack, 2007). Moreover, children's overall mathematical skills may be improved when families engage in discussion while participating in these mathematical activities (Sheldon & Epstein, 2005).

Furthermore, mathematical discussions which take place during *direct* and *indirect* mathematical activities can have an even greater impact on a child's development (Sheldon & Epstein, 2005). Parents can play a role in this by stimulating mathematical conversations at home or in the environment during everyday activities such as going to the shops, waiting at a bus stop or when cooking a meal. Traditional games such as playing cards, board games and puzzles can also be used to good effect. Skwarchuk (2008) argues that parents will often engage in discussions which focus on numbers but are unsure on how to incorporate other aspects of mathematics into the discussion.

Using Picture Books to Teach Mathematics

In recent years, the use of picture books to support mathematical development has become more common as teachers seek an integrated approach to teaching mathematics (Haury, 2001). The use of picture books for mathematical purposes has been espoused by recent literature which has advocated its use (Casey, Kersh & Young, 2004; Hong, 1996; van den Heuvel-Panhuizen & Elia, 2012; Anderson, Anderson & Shapiro, 2005). The recently established Maths Through Stories initiative reflects the growing trend of using picture books in mathematics lesson and gives teachers recommendations on suitable picture books to use. In picture books the illustrations, along with the text, play a vital role in telling the story and conveying the meaning (Elia, van den Heuvel-Panhuizen & Georgiou, 2010). Furthermore, a mathematical picture book can be defined as, "picture books with mathematical content present in both the text and images" (Marston, 2010, p. 383). Three types of mathematical picture books exist. These include: picture books where the mathematics is explicitly referenced; the mathematics is embedded within the story; or where the mathematics is perceived to be occurring (ibid).

Theoretical Perspectives underpinning the Use of Picture Books for Mathematical Purposes

The use of picture books for mathematical purposes is espoused by three long established theories of learning: the sociocultural theory of learning; the constructive approach to learning; and the importance of contextualised learning (van den Heuvel-Panhuizen & van den Boogaard, 2008). In the constructivist approach picture books offer children the opportunity to actively construct new mathematical knowledge (Phillips, 1995). The storyline or pictures often present a problem in which the children use their prior knowledge to try and come up with a solution. When doing this they develop new ideas, structures, and schemas and achieve a higher level of understanding (van den Heuvel-Panhuizen & van den Boogaard, 2008, p. 343). Similarly, the use of picture books for mathematical purposes is rooted in the sociocultural theory of learning. Shared reading experiences with a teacher or a parent, and the discussions which ensue, allow children to actively construct new knowledge in a social environment (Cobb, 1994). Picture books also allow children to encounter problems in a meaningful context. Children are able to understand and solve problems which are in context, more readily than more formal questions (Donaldson, 1978).

The role of the teacher is vital during picture book reading in the classroom. Van den Heuvel-Panhuizen and Elia (2012) contend that the dialogic book reading allows for greater mathematical understanding as the child and the teacher co construct the knowledge.

Furthermore, the teacher also needs to ensure that the mathematical concept of the story is identified as many children may struggle to realise this (Pramling & Pramling-Samuelson, 2008). Casey et al., (2004) report that picture books should be read to children in a manner similar to that of storytelling which allows the reader to connect more with their audience through eye contact, facial gestures and body language.

Several factors support the use of children's literature in mathematics. Research on picture books indicates that they can lead to an improvement in mathematical attainment (van den Heuvel-Panhuizen & Elia, 2012). Hong (1996) notes, that in one particular study, the children who experienced story book reading and complimentary activities outperformed the children in the control group in classification, number combination and shape tasks. An experiment conducted by Jennings, Jennings, Richey and Dixon-Kraus (1992) showed that children's mathematical test scores improved considerably when picture books were used as part of the curriculum. It was also noted that the instances where children would use mathematical terms increased during free play time.

Shared book reading can contribute to a child's language development (Anderson et al., 2005; Jennings et al., 1992) as the illustrations in picture books can stimulate discussion between the reader and the child (Anderson et al., 2005). As a result, these discussions enable children to learn new vocabulary and concept development (ibid). During picture book reading, teachers and pupils have the opportunity to discuss the mathematical problems highlighted in the book and come up with possible solutions. Such use of picture books can also facilitate the use of mathematical discussions at home. Van den Heuvel-Panhuizen and van den Boogaard (2008) note that children used mathematical language spontaneously during shared picture book reading with their parents. In their study, Anderson et al., (2005) videotaped thirty-nine parents and their children as they engaged in picture book reading at home. The results showed a wide diversity in the mathematical concepts that were discussed.

Picture books can also be used to develop mathematical concepts (Whitin & Whitin, 2000). For example, previous research has shown that picture books have the capacity to improve mathematical knowledge in the areas of measurement (van den Heuvel-Panhuizen & Iliada, 2011). Hong (1996) also reported that kindergarten children showed significant improvements in classification, number combinations and shape recognition when exposed to picture book reading. Similarly, Casey et al. (2004) reported that students developed their spatial and analytical awareness when exposed to storytelling sagas in the mathematics lessons. The use of storytelling sagas allows mathematical concepts to be taught in a systematic way over a number of lessons (ibid, 2004). Bjorklund and Pramling-Samuelson (2012) argue that in order to maximise a child's mathematical understanding teachers should approach picture book reading with a particular mathematical concept in mind, thus noting the importance of teacher preparation and planning.

The use of picture books also allows mathematics to be placed in context, in real life situations, which makes learning more meaningful for the children (van den Heuvel-

Panhuizen & Elia, 2012). Moreover, children can only construct new meaning when it makes sense to them. Picture books can enable children to “encounter problematic situations, may stimulate them to ask their own questions, search for answers, consider different points of view, exchange views with others and incorporate their own findings with existing knowledge.” (van den Heuvel-Panhuizen et al., 2016, p. 324). Exposure to problems which are centred round everyday life makes the learning more meaningful for the children (Donaldson, 1978).

Picture books can have a positive impact on the way children view mathematics. They have the potential to motivate children and to foster an appreciation of mathematics (Von Drasek, 2006; Jennings et al., 1992). Picture books also have the power to engage and focus the attention of children (Van den Heuvel-Panhuizen, van den Boogaard & Doig, 2009). Hong (1996) explored the impact that children’s literature and follow up activities had during free play time. She noted that the children who experienced story book reading were more likely to engage in mathematical activities during free play time than the children who were in the control group. Furthermore, a number of picture books used in mathematics can also be used to teach students how to solve personal problems, cope with conflict and to take responsibility for their actions (Hong, 1996).

METHODOLOGY

The research was carried out in a rural primary school in County Kildare. The school is a Catholic School and has a mixed cohort of approximately 230 students. The research was undertaken with first class in which there were 28 students, 13 boys and 15 girls. The school has a very active parent’s association which is affiliated to the National Parents Council-Primary.

The research question pertaining to this study is whether parental involvement in mathematics can be enhanced through shared picture book reading? From this research question a number of subsequent sub questions emerge. These are: to what extent are parents involved in their child’s mathematics education? what is the current understanding of parents in relation to their role in their child’s mathematics education? how can parents be enabled to become more involved in their children’s mathematics’ development?, and can picture books encourage parents to become more aware of the possibilities of engaging in mathematics with their child?

Prior to the intervention, all parents completed a questionnaire, in order to gauge their existing level of parental involvement in mathematics. Following this the parents were categorised into three groups: those who identified themselves as having a high, medium, or low level of involvement. One parent from each group was chosen at random and invited to participate in this study. All three parents were interviewed in order to gain a greater understanding of their perceptions of parental involvement and to discuss their level of involvement. A classroom observation then followed where the parents were invited into the classroom to observe a mathematics lesson which used a picture book. Following the classroom observation, each child took a picture book home once a week over three consecutive weeks. The child and their parent engaged in mathematical discussions based on the content of the picture book. Each

parent filled in a Parent Report Sheet at the end of each session to reflect on the process. At the end of the intervention the parents completed a final evaluation sheet which detailed their entire experience of taking part in the research. A second interview took place with the parents to gain a deeper understanding of their experience in using picture books at home.

FINDINGS

The findings from this study have shown that some parents' current attitudes towards mathematics education had been influenced by their past experiences of mathematics in school. When reflecting on her own experiences of mathematics in primary school Ann recalls, "I suppose I just found it difficult and challenging and I suppose some elements I liked and other parts I didn't like". Both Ann and Sarah stated they had a negative experience of mathematics while in primary school and both also believed that, aside from helping with homework and answering some incidental questions, they were not involved in their child's mathematics education. This correlates with the research which states that parents' who have negative experience of mathematics in school may be less likely to become involved in their children's mathematics (Boaler, 2015). The findings also suggest that Sarah may lack the knowledge on how to become more involved in their child's mathematics education, "I actually don't really know to be honest with ya cos I need to start learning maths myself to be honest". Skwarchuk (2008) highlighted how parents may be aware of how to engage in literacy activities at home with their children, but often struggle when it comes to mathematics.

The findings also highlight that parental involvement in mathematics needs to be extended beyond the scope of helping with homework and include engagement in mathematical activities which contribute more to children's mathematical understanding (Sheldon & Epstein, 2005). On analysing the Parent Report Sheets, it appears that a number of parents view parental involvement as simply helping with homework. For this change to happen parents need to be educated on how they can become more involved in their child's mathematics education at home.

This study has also shown the need to empower parents to become more involved in their child's mathematics education. This initiative allowed parents to become more involved in their children's mathematics and also established links between the home and the school. During the intervention the parents enjoyed having a greater role to play in their child's mathematics education. Ciara describes the benefit it had on her family, "definitely as a family we all became more aware of how you can learn maths through reading and through books". Similarly, Sarah enjoyed spending time with her son during the intervention, "it kinda makes you spend a bit more time with him as well". This initiative correlates with similar projects where partnerships between the school and the home were established to enhance parental involvement in mathematics (Civil, 2006). The use of picture books for mathematical purposes was a new experience for the researcher and parents and overall was very positive.

A number of parents also reported increased motivation on the part of the children after the three-week intervention and that their child looked forward to taking home a picture book each week. Not only had parental involvement increased but a number of parents noted that

their confidence in engaging with mathematics improved as a result of the three week intervention. It was apparent that by week three the parents had become confident enough to come up with their own questions to ask their child when reading the picture book.

CONCLUSION

The potential of using picture books for mathematical purposes, as evidenced in this study, is also supported by current research which advocates their use (Hong 1996; Anderson et al., 2005). In this study, parents noted that the use of picture books increased children's motivation to do mathematics (Hong, 1996), allowed them to engage in mathematical problems which were in context (van den Heuvel-Panhuizen & Elia, 2012) and lead to rich mathematical discussions (Anderson & Anderson, 1995). Furthermore, the participants also felt more confident in engaging in mathematics with their child. The need to work with parents and include them in their child's mathematical learning is a key goal of mathematics reform (Government of Ireland, 1999). Partnerships and initiatives between the school and the home can lead to enhanced parental involvement. While recent policy documents have emphasised the need to work in partnership with parents, limited guidance has been given to schools and teachers on how they can develop partnerships with parents (Gilleece, Shiel, Clerkin & Millar, 2012). Perhaps, future policy documents could include explicit examples on how to effectively involve parents in mathematics. In many cases, it is the leadership shown by teachers and principals that provide the catalyst for new initiatives which promote parental involvement (INTO, 1997). On a wider scale there is the potential for more schools and teachers to show greater initiative in establishing partnerships with parents. Perhaps, teachers need to engage in high quality professional development so that they can be exposed to current research and gain in depth knowledge on the subject. Furthermore, they must also be informed on how best they can include parents.

There is a host of activities in which parents can engage in with schools which can bring about a greater understanding of children's learning. However, research has shown that there is a lack of knowledge amongst parents about how to become more involved in mathematics at home (Anthony & Walshaw, 2009). Parents' past experiences of mathematics plays a significant role in how shaping their attitude towards mathematics today. Therefore, there is a need to educate parents on the value of mathematics in our everyday lives. Once parents come to realise the value of mathematics they are more likely to become involved in their child's mathematics at home, which in turn will benefit the child.

The findings show that many parents in this research view parental involvement as helping with homework. Consequently, it is suggested that picture books could be used as an alternative to traditional mathematics homework. Sheldon and Epstein (2005) contend that homework is a wonderful opportunity for parental participation in their child's learning. Similarly, picture books are an easy and enjoyable way for parents to play an active role in their child's homework. However, for this to happen schools will need to invest resources in supplying a wide variety of picture books which can be used from Junior Infants right through to Sixth Class. While this may be an expensive outlay the benefits of picture books far outweigh the cost element. Furthermore, there is a need for strong leadership from teachers

and principals who are willing to establish a culture in their school whereby parents are included in their child's mathematics education at home through the use of picture books.

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