It's in the bag:
Parental involvement in a numeracy at-home program

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THIS PAPER DESCRIBES A project conducted with the parents of children in early childhood classes from two different district high schools[1]. The project investigated the perceptions held by these parents in relation to mathematics education, and used an intervention program designed to encourage them to engage in numeracy activities with their child. Preliminary results indicated that, although the parents were not necessarily familiar with contemporary numeracy classroom practices, they were able to describe and evaluate their children's mathematical understandings. The findings add to the limited research available on the ways parents can support their child's mathematical education at home through encouraging home–school community partnerships.

Background

Parental attitudes and perceptions of mathematics have been found to influence not only student learning outcomes, but student self-efficacy as well (Anthony & Walshaw, 2007). Parents may well be the single biggest factor in their children's educational success (Merttens, 2005), with research showing that students' learning is maximised when strong educational partnerships between school, community and home are developed (Groves, Mousley & Forgasz, 2006; Vincent, Stephens & Steinle, 2005). It seems, however, that many parents are more actively involved in their children's language learning than in mathematics (Cannon & Ginsburg, 2008).There is widespread agreement that children benefit from being read to at a very early age (e.g. Winch, Johnston, Holliday, Ljungdahl & March, 2002), and programs that focus on 'home readers' are commonplace throughout Australian schools. It is more difficult, however, to find examples of ongoing numeracy programs that specifically target children's early development in this area. This may be attributable to numeracy (or at least mathematics)[2] having a negative reputation in society (Gordon, 1992), but may also be because parents have often been given little guidance from teachers on how they can help their child with mathematics (Anthony & Walshaw, 2007). This is compounded as students move through grades, with parents often lacking the content knowledge, confidence and skills to help their children (Peressini, 1998; Sheldon & Epstein, 2005). Parental involvement has often been limited to parents' monitoring and assisting with homework, with a focus on 'drill and practice' exercises and learning 'tables' by rote (Goos & Jolly, 2004), rather than homework that is purposeful and engaging and promotes family interactions and discussion (Anthony & Walshaw, 2007). There is also evidence to suggest that teachers view language and literacy as more important topics to be taught in early childhood and that a focus on these subjects leaves little time for numeracy (Lee & Ginsburg, 2009).

This paper describes a project aimed at engaging parents in numeracy-related activities with their child at home on a regular, ongoing basis. Parents were initially surveyed in order to determine their knowledge and perceptions of how their child was taught numeracy and then invited to provide regular feedback on the child's activities at home.

1 District high schools in this context refers to rural schools with classes ranging from Kindergarten–Year 10.
2 The term 'numeracy' was used in order to maintain consistency with the curriculum at the time. Essentially, the activities were mathematical in nature, with the aim being to develop children's numeracy.

Specifically the research questions were:

- What knowledge and perceptions of numeracy education are held by a selected number of parents?
- What are the features of a program designed to encourage parents to participate in numeracy activities with their children at home?
- In what ways did parents engage with the program and what was the nature of feedback received?

This study is important because, as Goos and Jolly (2004) found, there has been little research on the nature of effective partnerships between school and home and the kind of numeracy learning they might support. Cai (2003) also highlighted the need to examine parental roles, especially with early childhood and elementary school children. This paper adds to the limited research in this area through providing details of an intervention program that focused on actively involving parents in their child's numeracy learning.

Literature review

Parental involvement

Although Muir (2009) found that parents were generally willing to be involved in supporting their child's numeracy learning at home, it is understandable that some can be quite hesitant in participating in their children's mathematical education and unsure how to best help their children (Civil, 2006). According to Peressini (1998), however, parents have their own expertise and unique knowledge about their children and, as Pritchard (2004) found, often have many ideas about how to assist their children at home.

On the other hand, however, many parents are not familiar with the mathematics content their children encounter in maths classes, thereby limiting the ways they can be involved. There is a commonly held perception by parents about the difference between how mathematics is taught today and how it was learned by them (e.g. Civil, 2006; Marshall & Swan, 2010) and, as Muir (2009) and Pritchard (2004) found, many parents felt uninformed about the mathematics curriculum and the teaching methods used in their child's school. There is evidence to suggest, however, that parents are keen to encourage and support their children in their mathematics education (including those from low SES and culturally diverse backgrounds), when they are supported by the school through the use of programs such as the one described here.

Home activities that contribute to mathematical understanding

According to Anthony and Walshaw (2007), a number of researchers have found that mathematical activities made available in the home are conducive to students' cognitive and affective development. Although limited, there is evidence in the literature to suggest that some schools are running programs to promote numeracy at home. Goos (2004), for example, collected information on numeracy partnerships involving schools throughout Australia, and, while there was evidence of 606 examples of such programs, there was little information on the nature of home or community numeracy events and how they could become numeracy opportunities for children. An example of an ongoing program was reported by Goos and Jolly (2004), involving a school's practice of offering individualised 'take-home packs' of mathematics activities to parents who requested additional materials to use with their children, and Sheldon and Epstein (2005) found that a number of involvement activities were effective, including evening workshops and provision of teacher-designed interactive homework and mathematics materials for families and students to use at home. More recently, Reinfeld, Lountain and Mellowship (2008) documented a South Australian practice in which a 'Maths Monster' visited children's homes to encourage them to engage with the mathematics in the world around them. It seems, however, that these examples are isolated and have not become common practice in the same way that home readers, for example, have become established. According to Merttens (2005), it is equally important to have a home-maths program, whereby children take home weekly or fortnightly maths activities which are shared and discussed with their parents. Such activities have the capacity to capitalise on the unique knowledge parents already have about their children (Peressini, 1998), and to bridge the gap between school and home practices. These considerations were taken into account when designing the intervention program discussed in this paper, with the expectation of written feedback being a key component of the communication process.

Methodology

An earlier study (Muir, 2009) documented the results of a pilot project conducted with the parents of a Year 1/2 class in a rural district high school. This paper adds to that research through extending the study to parents, students and teachers of three different early childhood classes in total, from two district high schools in a small Australian state, with children ranging in age from four to eight years. The teachers who participated were deemed to use contemporary mathematical practices in their classroom; in this context that meant a preference for hands-on activities and games, a focus on teaching for conceptual understanding and developing mental computation, and limited reliance on worksheets, drill and practice routines. The aims of the study were to investigate parents' perceptions of mathematics and current teaching practices and to document their involvement in a numeracy at home intervention program.

Using a similar methodological approach to Muir's (2009), preliminary data about parents' attitudes and beliefs towards mathematics, how mathematics is taught in schools, and how parents engaged in mathematical experiences with their children were collected through a questionnaire. The questionnaire contained 22 rating scale items and five open-ended questions, and was sent home with each child in each of the classes. The items specifically related to their perceptions of numeracy education will be discussed in this paper. Parents also had the option of participating in a follow-up semi-structured interview, of which three were conducted.

The intervention program involved a number of interactive activities designed to support the mathematical experiences in the classroom. Every Monday each child would receive their 'numeracy bag' containing their activity instructions, necessary materials and guidelines for parents, along with a short rationale that explained the purpose behind the activity. Figure 1 shows an example of one of the activities as it was presented to parents. The expectation was that the child would engage in the activity two or three times in the week with their parents and/or other family members, return the activity on Friday, and receive a new activity the following Monday. Each activity bag contained a feedback sheet (see Appendix A) which required parents to provide data about the child's level of engagement with the activity and the mathematical understandings that were revealed. The interviews were conducted approximately eight weeks into the program. A semi-structured interview was also conducted with the class teachers.

Figure 1. Example activity sheet

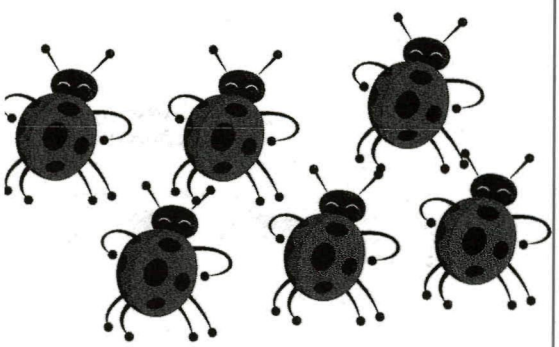
Counting Collections

Estimate how many are in this collection of objects.

How many different ways can you count this collection?

Which way was the quickest?

Purpose of activity:
This activity emphasises the importance of moving from counting by ones to counting by groups. This is more efficient when dealing with larger collections. Links can then be made with multiplication—e.g., we have 3 groups of 5—how many altogether? When counting the total, children can be encouraged to 'skip count' to reach the total (e.g., 5, 10, 15).



Results and discussion

As previously mentioned, findings from the literature indicated that parents generally felt uninformed about the numeracy teaching practices employed in today's classroom. The survey administered to parents sought to determine whether or not this was true for their group, along with seeking additional information about their perceptions of particular mathematical practices. A total of 34 surveys were returned from the 46 that were distributed. As reporting on all 22 statements is beyond this paper, and in order to focus on answering the first research question, Table 1 contains a selection of the most relevant statements from the questionnaire and the parents' corresponding levels of agreement or otherwise (SA – Strongly Agree; A – Agree; N – Neutral; D – Disagree; SD – Strongly Disagree).

Table 1. Parents' responses to the belief items in the questionnaire

Statement	SA/A responses (%) $n = 34$	SD/D responses (%) $n = 34$	N responses (%) $n = 34$
I am satisfied with the way I was taught mathematics in school	47%	32%	21%
Maths is about learning the correct procedures to solve problems	91%	3%	6%
There is a 'correct' way to do any maths problem	47%	29%	24%
Mental computation means knowing your tables	47%	15%	38%
I have a good understanding of how my child is taught numeracy in school	32%	32%	36%
I think the way maths is taught in classrooms today is effective	32%	3%	65%
I know what types of mathematical skills and understandings my child has	68%	6%	26%
Games and activities are a good way to learn mathematics	97%	0%	3%
Worksheets and textbooks are a good way to learn mathematics	85%	9%	6%
Telling children the answer is a good way of helping develop their mathematical understanding	15%	41%	44%
I regularly engage in numeracy-related activities with my child	79%	18%	3%

In terms of gauging parents' perceptions of what mathematics involves, the first four items are particularly relevant. Parents did not respond overwhelmingly negatively to expressing satisfaction with their own mathematics education, which could indicate that they are satisfied with their level of mathematics understanding. The high level of agreement with the statements that 'Maths is about learning the correct procedures to solve problems' (91%) and 'Worksheets and textbooks are a good way to learn mathematics' (85%) indicates a 'traditional' view of mathematics (Van de Walle, Karp & Bay-Williams, 2010), and probably one that reflects their own educational experiences as most of the parents had young children and would not necessarily have experienced those practices in their children's classrooms.

As Table 1 shows, only 32 per cent of parents indicated they had a good understanding of how their child was taught mathematics. In response to a question asking them explicitly to comment on this, many simply answered 'no' or indicated that:

> *No I don't. We get reports but do not really know how the grade has been reached.*
>
> *No as they do it all back to front to when I was taught and it was confusing when they showed me so I have showed them the way I was taught.*
>
> *It is all taught different to the way I was taught at school and I don't understand any of it.*

Interestingly, one parent commented that there was *'more of a focus on reading and writing'*, which supports the argument that literacy is often perceived as more important than numeracy (Lee & Ginsburg, 2009). The high level of neutral responses received to the statement 'I think the way maths is taught in today's classrooms is effective' (65%) also provides evidence for parents' lack of knowledge of contemporary teaching practices, in that it would appear they lacked enough information to either agree or disagree. Parents also had the opportunity to compare maths teaching today with how they were taught. Many chose to leave this section blank, but the following comments illustrate the types of answers received:

> *Stronger emphasis on times tables when I was at school; very repetitive.*
>
> *Teaching maths today seems much more interactive, stimulating and realistic than I can recall from my own childhood.*
>
> *I know it is different from discussing strategies with my eight-year-old.*

These comments indicate that some parents, at least, are aware of teaching emphases and approaches that differ from the way they were taught. It was also encouraging to see that 79 per cent of parents reported

being regularly engaged in numeracy-related activities with their child and that 97 per cent agreed that games and activities were a good way to learn mathematics. When asked to name specific activities, responses included playing computer games, board games such as Monopoly and Snakes and Ladders, and card games such as UNO®. Other responses included involving children in shopping experiences, counting, cooking and dividing up food. The following is illustrative of the types of responses received:

> *Using time—such as how many hours to bed, how many days in a week, how much does A & B cost in a supermarket?*
>
> *Working out people's ages, using a calculator.*

In summary, the responses showed that parents generally held a mixed view of mathematics and how it is taught. There was strong agreement that games, for example, were a good way of learning mathematics, yet they also agreed that worksheets and textbooks were an effective way of learning. Overall, the survey results indicated that parents were not well-informed about contemporary mathematics teaching and it was therefore hoped that engaging in the numeracy at-home program would lead to an increased understanding of this.

Parental engagement with the program

The intervention program involved taking home a different activity each week, one designed to develop or consolidate children's mathematical understandings. Some features of the program that made it purposeful and relevant included the careful selection of activities built on classroom experiences, the potential for the activities to be repeated or revisited, the inclusion of a rationale which explained the purpose of the activity, and the expectation that parents would complete a feedback sheet commenting on their child's engagement with, and understanding of, the activity The return rate for the weekly sheets was high and, although not all sections were always completed, most parents recorded their level of agreement with the suitability of the activity. Anecdotal comments revealed that parents were often able to identify and describe some of the mathematical behaviours they observed. For example, with reference to an activity where children had to form pairs of cards that equalled 10, one parent wrote:

> *Trevor*[3] *understood that he had to add up; he counted on his fingers at first, but towards the end could name the pairs without adding.*

Another activity required children to place counters in designated ways on a 10-frame. One of the parents provided the following feedback:

> *She placed the counters in a 'logical' way and could easily tell me how many counters she needed to make 10.*

Many of the activities used games to focus on mental computation strategies such as doubling. Feedback from these activities included comments such as:

> *Chelsea could see that doubling a number is the same as timesing [sic] by two.*

Other activities involved the use of the 1–100 chart, which proved useful for some children to 'start to understand odd and even' (Mrs Jones) and:

> *Simon was able to put the chart together easily—understanding place value and sequences; starting to understand addition and subtraction using the chart; probably needs to do this activity again.*

Parents also commented on how their child improved after doing the activity a number of times:

> *She became better every night we did the activity.*
>
> *[Trent] understood he had to add up; counted on fingers at the beginning, then remembered towards the end the pairs without adding [after completing a Make 10 activity].*

Other parental comments also gave the class teachers further insight to their students' mathematical understandings, and parents became a rich source of information for guiding the choice of future activities, as the following feedback indicates:

> *I found Jack understands numbers very well. He showed me that he works them out in his head first. He used questions well to find out the problems in the activity ['Guess my number' using 1–100 chart]. Jack and I thought it was a bit easy. He would like to try something a bit more challenging.*

Comments such as these indicate that parents can be effective contributors to their child's mathematical development and provide important information for the teacher to capitalise on. Provision of written rationales for each activity may have facilitated this, along with the expectation that parents record particular mathematical behaviours they observe.

Feedback received from the interview participants indicated that they viewed the project positively and would like to see it continued. All interviewees indicated that it gave them a better understanding of classroom practices, with one comment being, *'... even though it looked like you were just playing a game you could see the benefit of the numeracy and the maths skills that were in it'*. Suggestions for improvement included trying to 'cater for each student's level', as some parents felt that at times the activities were too easy or too challenging for their children. Feedback from one teacher, however, indicated that a greater range was required, rather than grading activities:

[1] Pseudonyms are used for names.

Really need more of every range, rather than grading them; the children really loved it especially when there were new ones arriving; adding new ones as we go was a good idea; some children, like Tina, would take the same activity home repeatedly.

Overall teacher feedback was very positive with all teachers acknowledging that *'it was a wonderful link with home'* (Jenny, Grade 1/2), and that it was well-supported by parents. The following comment is illustrative of the feedback received from teachers:

Sometimes they'll [parents] come in and say that was a bit hard; but generally really positive comments—we did that or talk about the activity; it's been really good for parents to see the purpose behind what we're doing; certainly been worth doing and I'd like to keep it going—maybe in more of a self-serve way—have a bank of about 40 in room and still monitor it to make sure everything is returned—like they do with their home readers.

Conclusions and implications

Just as children share their mathematical understandings with other children and teachers, they also need to share them with their parents (Ministry of Education, 2008), and teachers need to provide opportunities for parents to contribute to their child's education. In the past, this has more likely occurred in the area of literacy, and the project reported in this paper illustrates how similar engagement can be achieved through an at-home numeracy program. The program's success was attributable to making the purpose of the activities explicit, provision of an explanation of the mathematics involved in the tasks, and the expectation that parents would provide written feedback on their child's engagement with, and understanding of, the particular activity. This communication was vital in strengthening the links between home and school, and helped to ensure the activities were suitable and relevant to the individual child.

The results obtained from the feedback sheets indicated that, as Sheldon and Epstein (2005) found, parents were willing to participate in their child's mathematical education and were able to do this in a positive way, providing additional insights into their child's development that could be capitalised on by their teacher. According to anecdotal and interview data, the program provided parents with an increased understanding of contemporary mathematical practices and the purpose behind many of the mathematical activities undertaken in the classroom. As parents become more informed about mathematics education issues and more exposed to sound approaches to mathematics teaching and learning, Civil (2001) asks whether they will become more active advocates for a quality mathematics education for all children. In the project reported in this paper, parents were informed through creating the opportunity for them to engage in numeracy-related activities with their children at home. It is hoped that the documentation of such programs will help teachers and educators to recognise the importance of parental influences and the difference they can make to their child's education.

References

Anthony, G., & Walshaw, M. (2007). *Effective pedagogy in mathematics/Pangarau.* Wellington, NZ: Ministry of Education.

Cai, J. (2003). Investigating parental roles in students' learning of mathematics from a cross-national perspective. *Mathematics Education Research Journal, 15*(2), 87–106.

Cannon, J., & Ginsburg, H. (2008). 'Doing the math': Maternal beliefs about early mathematics versus language learning. *Early Education & Development, 19*(2), 238–260.

Civil, M. (2001). *Redefining parental involvement: Parents as learners of mathematics.* Paper presented at the NCTM research pre-session, April 2001, Orlando, FL.

Civil, M. (2006). Working towards equity in mathematics education: A focus on learners, teachers, and parents. In S. Alatorre, J. L. Cortina, M. Sáiz & A. Méndez (Eds), *Proceedings of the Twenty Eighth Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 30–50). Mérida, Mexico: Universidad Pedagógica Nacional.

Goos, M. (2004). Home, school and community partnerships to support children's numeracy. *Australian Primary Mathematics Classroom, 9*(4), 18–20.

Goos, M., & Jolly, L. (2004). Building partnerships with families and communities to support children's numeracy learning. In I. Putt, R. Faragher & M. McLean (Eds), *Mathematics education for the third millenium: Towards 2010* (Proceedings of the 27th annual conference of the Mathematics Education Research Group of Australasia (MERGA), Townsville, pp. 279–286). Sydney: MERGA.

Gordon, N. (1992). Children with developmental dyscalculia. *Developmental medicine and child neurology, 34*(5), 459–463.

Groves, S., Mousley, J., & Forgasz, H. (2006). *Primary Numeracy: A mapping, review and analysis of Australian research in numeracy learning at the primary school level.* Canberra, ACT: Commonwealth of Australia.

Lee, J. S., & Ginsburg, H. P. (2009). Early childhood teachers' misconceptions about mathematics education for young children in the United States. *Australasian Journal of Early Childhood, 34*(4), 37–45.

Marshall, L., & Swan, P. (2010). Parents as participating partners. *Australian Primary Mathematics Classroom, 15*(3), 25–32.

Merttens, R. (2005). Family numeracy. In I. Thompson (Ed), *Issues in teaching numeracy in primary schools* (pp. 78–90). Berkshire, UK: Open University Press.

Ministry of Education. (2008). *Home-school partnership: Numeracy.* Wellington, NZ: Learning Media Limited.

Muir, T. (2009). At home with numeracy: Empowering parents to be active participants in their child's numeracy development. In R. Hunter, B. Bicknell & T. Burgess (Eds), *Crossing divides* (Proceedings of the 32nd annual conference of the Mathematics Education Research Group of Australasia (MERGA), pp. 395–402). Wellington, NZ: MERGA.

Peressini, D. D. (1998). The portrayal of parents in the school mathematics reform literature: Locating the context for parental involvement. *Journal for Research in Mathematics Education, 29*(5), 555–583.

Pritchard, R. (2004). Investigating parental attitudes and beliefs in mathematics education. In I. Putt, R. Faragher & M. McLean (Eds), *Mathematics education for the third millenium: Towards 2010* (Proceedings of the 27th annual conference of the Mathematics Education Research Group of Australasia (MERGA), Townsville, pp. 478-485). Sydney: MERGA.

Reinfeld, B., Lountain, K., & Mellowship, D. (2008). Maths monsters, learning trails, games and interventions: Some of the teaching and learning resources developed by teachers in the mathematics for learning inclusion program. *Australian Primary Mathematics Classroom, 13*(4), 28–32.

Sheldon, S. B., & Epstein, J. L. (2005). Involvement counts: Family and community partnerships and mathematics achievement. *The Journal of Educational Research, 98*(4), 196–206.

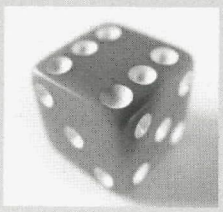
Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2010). *Elementary and middle school mathematics* (7th edn.). New Jersey: Pearson.

Vincent, J., Stephens, M., & Steinle, V. (2005). *Numeracy research and development initiative 2001–2004.* Canberra, ACT: Commonwealth of Australia.

Winch, G., Johnston, R. R., Holliday, M., Ljungdahl, L., & March, P. (2002). *Literacy reading, writing, and children's literature.* South Melbourne, Victoria: Oxford University Press.

Appendix A

Numeracy at home feedback sheet



Name of activity:

Child's name:

Date:

How many times did you and/or child complete the activity? .....

This activity was appropriate for my child	Agree	Disagree
My child enjoyed completing the activity	Agree	Disagree
The instructions were clear	Agree	Disagree

What mathematical understandings (or misunderstandings) did your child reveal when participating in the activity?

.....

.....

Do you have any other comments or questions about the activity?

.....

.....

Thank you for taking the time to complete this feedback.