JOIN THE CLUB: ENGAGING PARENTS IN MATHEMATICS EDUCATION

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While extensive reference in the literature can be found in regard to professional learning sessions and workshops for teachers of mathematics, relatively little has been reported about engaging parents in learning about mathematics and mathematics education. The importance of home school partnerships is readily acknowledged, with parents being arguably the most influential factor in their children's educational success, yet many parents feel uninformed about current educational practices and how best to support their child's learning. This paper reports on an initiative undertaken with the parents from a District High School whereby they joined a "Maths club" and attended information sessions designed to familiarise them with current mathematical practices and pedagogy. The results indicated that parents were appreciative of the opportunities provided to them and that they were supportive of contemporary mathematical practices.

Background and literature review

Projects designed to engage families in numeracy have provided opportunities for families and teachers to work together to enhance children's numeracy development (e.g., Morony, 2004; Ministry of Education, 2008). Studies have found that parental support for education in the home influences students' numeracy development (Anthony & Walshaw, 2007) and participation in mathematics-focused learning-at-home activities have been consistently associated with improved student performance.

A review of the literature has shown that there are a number of examples of home-school programs and initiatives designed to encourage numeracy partnerships. Goos (2004), for example, identified 606 numeracy programs Australia-wide whose purposes were to involve parents in school activities and/or inform them about syllabus changes, and to improve children's mathematics experiences and outcomes. Two issues which arose from her research included the need to forge parental and community involvement in mathematics education and change, and a recommendation to improve teachers', parents', and communities' understanding of the nature of numeracy and numeracy learning.

In terms of examples of accounts of particular projects and initiatives, Goos and Jolly (2004) describe a school's practice of offering 'take home packs' of mathematics activities to parents who requested additional materials to use with their children. Reinfeld, Lountain and Mellowship (2008) describe an initiative whereby children took

home a 'Maths Monster' with whom they engaged in exploring and investigating mathematical challenges at home. In an earlier paper (Muir, 2009), the author described a project which involved parents engaging in mathematical activities with their children at home as part of an ongoing program. Muir (2009) found that while initially only 36% of parents indicated that they had a good understanding of how their child was taught mathematics, the project was effective in familiarising them with current mathematical practices and ways in which they could reinforce these practices at home.

Although Muir (2009) found that generally parents were willing to be involved in supporting their child's numeracy learning at home, others have found that parents can be hesitant in participating in their children's mathematical education (Anthony & Walshaw, 2007). This may be attributable to their own personal experiences with mathematics, feelings of anxiety and helplessness (Haylock, 2007) and lack of confidence in their ability to help their child (Bryan, Burstein & Bryan, 2001 as cited in Anthony & Walshaw, 2007; Civil, 2001). A lack of mathematical content knowledge can also limit the ways in which parents can be involved in their child's mathematical education (Peressini, 1998) and as Pritchard (2004) and Muir (2009) found, many parents feel uninformed about the mathematics curriculum and how it is enacted in their child's classroom.

Research has also shown that there is a tension between how mathematics is taught today compared with how it was learned by parents (e.g., Civil, 2006; Marshall & Swan, 2010; Peressini, 1998). According to Civil (2006), this perception is often reinforced through the superficial interpretations of reform mathematics education and adoption of practices, such as activities, group work and manipulatives, which do not necessarily focus on understanding students' thinking. Moreover, many parents tend to give higher value to their own forms of doing mathematics (Quintos, Bratton & Civil, 2005), which has implications for influencing the mathematical interactions they have with their children. In contrast, Quintos et al. (2005) found that children valued schools' form of knowledge more often over the parents' knowledge, hence demonstrating the potential tensions that may arise when engaging in mathematical tasks and assignments at home. Although generational differences are perhaps inevitable, Civil (2006) argues that parents were more concerned that they were not familiar with the homework tasks set, and therefore unsure about the best ways in which to help their children. It would seem sensible, therefore, to provide information and engage in dialogue with parents about what it means to learn mathematics today, how best to capitalise on the knowledge held by parents and how to involve them more actively in the mathematics education of their children. In order to inform and engage parents, the author of this paper initiated a project whereby parents were encouraged to join a 'Maths Club' and attend information sessions designed to familiarise them with current mathematical practices and pedagogy. While the project evolved from the original 'Numeracy at Home Project' (Muir, 2009), it was distinctly different in nature and involved participants that may or may not have been involved in the original project. The project helped to address recommendations raised by Goos and Jolly (2004) and Cai (2003) that further examination of parental roles is needed. Specifically, the three research questions were:

- What mathematical knowledge, skills and attitudes are held by a selected number of parents?

- How informed are a selected number of parents about current mathematical practices?
- What are the features of an initiative designed to inform parents about current mathematical practices?

Much of the extended research involving parental workshops has occurred in the United States, with Civil's research on linking home and school being particularly relevant to this paper. Programs such as *Math and Parent Partnerships in the Southwest* [MAPPS] aimed to assist parents to help children with their school mathematics work and to develop leadership capital among parents (Quintos, et al., 2005), while *Linking home and school: A bridge to the many faces of mathematics* [Project BRIDGE] focused on parents learning mathematics with understanding (Civil, 2001). Workshops encouraged the use of non-traditional approaches with a focus on investigation, often presenting a contrast with the participants' own schooling experiences. In Australia, there are limited examples of similar programs, with Marshall and Swan (2010) providing one example, involving a series of six workshops conducted with parents that focused on mathematical topics, such as place value and fractions. The workshops highlighted for them that the language of mathematics was a barrier for many parents and that parents were unsure about "the times tables" and confused about some aspects of fractions. The workshops proved to be successful in increasing parents' confidence about assisting their children with mathematics.

In summary then, most of the Australasian research involving parents has focused on home-school partnerships, with the general consensus being that such partnerships have the potential to contribute positively to students' educational outcomes. Other research (e.g., Civil, 2001) has involved parents in workshops that are aimed at increasing their own mathematical content knowledge and that of mathematics educational practices. The study discussed in this paper adds to the limited research in this area through providing an account of a parental involvement initiative and the feedback received from parents as a result of this.

Methodology

The participants were parents from a local district high school who received an open invitation to join the "Maths Club". Three workshops were offered over five months and the number of participants varied from six to eighteen. Each sixty-minute workshop had a different topic and some parents attended all sessions, while others attended one or two. The ages of their children varied from pre-school to middle school. At the beginning of each workshop, parents were asked to complete an 'Anticipation Guide' (Tierney & Readance, 2005), which varied in nature, but usually included levels of agreement responses to a number of statements and completion of some mathematics problems. A summary of the workshop topics, dates, participant numbers, and anticipation guide overview is presented in Table 1.

Because the attendance varied at each session and not all parents attended every session, it seemed sensible to evaluate and seek feedback on each individual session, rather than attempt to evaluate the effect of being a member of the maths club in general. Qualitative data analysis commenced during the data collection process and a frequency count was conducted for the survey items and levels of agreement statements.

Table 1. Overview of the workshops.

Date	No. of participants	Topic	Description of workshop	Anticipation Guide overview
3/5/10	18	Helping your child with numeracy at home	Powerpoint presentation involving responses to statements (e.g., there is one right way to do a maths problem; calculators make you lazy) and interactive activities	Circle level of agreement to 8 different statements (e.g., Maths is about learning the correct procedures to solve problems) 3 open-ended questions (e.g., Were any of your ideas challenged as a result of this session?)
23/8/10	6	Algorithms: What are they? How are they taught?	PowerPoint presentation, including alternative algorithms and traditional algorithms; demonstration; reading article (Clarke, 2005)	Questionnaire (21 Likert scale items; e.g., I am confident with my own mathematics ability); 4 open-ended questions (e.g., Why did you decide to join the maths club); 6 maths problems (e.g., 300 – 124)
11/10/10	7	Tables and mental computation	Hands-on activities and games; reference to Mental Computation: A strategies approach and *Turn the Tables* (De Nardi, 2004)	10 multiplication facts; confidence rating scale; 3 open-ended questions (e.g., Are you familiar with how children are taught multiplication today?)

Results and discussion

Parental mathematical knowledge and skills

Data obtained from the anticipation guides administered in the second and third workshops were used to determine some of the mathematical knowledge held by this group of parents. At the beginning of the second workshop, for example, the parents were asked to solve the following four problems and to provide a preferred method, an alternative method, and a child's method (if appropriate or different):

1. Susan has \$5.80 and John has \$6.35. How much more money does John have then Susan?
2. 300 – 124
3. $\frac{1}{2} + \frac{2}{3}$
4. 2.06 + 1.3 + 0.38

In addition, Question 5 required them to order three different fractions and Question 6 asked them to circle the bigger decimal number.

All six participants provided the correct response for Questions 1 and 2, and all provided a preferred method of solution. Two participants used a traditional algorithm for each of the problems, while the other participants either solved the questions

mentally or informally (e.g., "I added 20 cents to get $6.00, then added 35c). Two child solutions were provided which were "counting on fingers" and "the same as myself" [round up to $6.00 and then add 35 cents].

Question 3 posed problems for all but one participant who achieved the correct answer by using the following method: $\frac{3}{6}+\frac{4}{6}=\frac{7}{6}=1\frac{1}{6}$. Incorrect answers included $1\frac{1}{3}$ (provided by two participants) and $\frac{3}{5}$ (also provided by two participants). Not surprisingly, these results indicate that parents may hold similar misconceptions about fractions as do students and pre-service teachers (e.g., Ball, 1990; Siemon, Virgona & Corneille, 2001). A preferred solution, which resulted in $\frac{3}{5}$, was achieved by "adding the bottom figure, then the top". Interestingly, there were no attempts to show how a child may attempt the question, with one response being, "not sure at this age". This could be attributable to the age of the participant's child, or unfamiliarity with observing or discussing fraction situations with their child. Five participants could correctly order $\frac{1}{10}, \frac{1}{4}$ and $\frac{1}{3}$, with one participant identifying $\frac{1}{3}$ as smaller than $\frac{1}{4}$. In contrast, only one participant recorded an incorrect response to question 4 (3.17) and all participants correctly identified 2.46 as being larger than 2.3489.

The results from this set of questions indicate that this admittedly small selection of parents could add and subtract 3 digit numbers, calculate with and order decimals, but had less success with adding simple fractions. There is scant evidence in the literature related to parental mathematical knowledge, but extensive research conducted with teachers, pre-service teachers and students (e.g., Ball, 1990; Siemon, et al., 2001) indicate that similar problems with fractions exist elsewhere and further exploration into parental knowledge of fractions and other mathematical areas needs to be undertaken. It would also be interesting to further explore the reasons for the general lack of response to recording children's solution methods. This may indicate that the participants did not engage in doing these types of questions with their children and could not therefore record what their likely response would be, or they simply may not have had the opportunity to do this as they may have been parents of younger children.

At the beginning of the third workshop on tables and mental computation, the parents were asked to complete 10 multiplication questions (e.g., 6 × 7). They were timed and then asked to circle their level of confidence in completing the task. All but one participant (n=7) correctly answered all 10 questions, with the one error being an answer of 63 for 7 x 7. This participant indicated that they were 'not confident' with completing the task, while the other participants all circled 'quite confident'. The results indicated that this selection of parents at least had the knowledge and skills to be reasonably confident with recalling multiplication tables.

Table 2 provides a summary of the data that was obtained from the Likert scale items (ranging from Strongly Disagree to Strongly Agree) that particularly relate to parents' mathematical knowledge, skills, and attitudes. Percentages have been used for ease of comparison.

The table shows consistency with the results obtained from the number questions, in that most participants indicated that they preferred to do most calculations mentally and that they knew their multiplication tables.

Table 2. Summary of parents' perceptions of mathematics knowledge, skills, and attitudes.

Statement	SD	D	N	A	SA
I prefer to do most calculations mentally	0	0	0	83	17
I understand what algorithms are	50	33	17	0	0
I know my multiplication tables	0	0	0	67	33
I get confused with different words and terms used in mathematics	0	0	0	83	17
I am confident with my own mathematics ability	0	17	0	66	17
There is a 'correct' way to do any maths problem	0	33	33	33	0
I think rote learning is a good way to learn your tables	0	33	17	17	33

Not surprisingly, many participants agreed that rote learning is effective and all participants indicated that this was how they had learnt their multiplication tables. As Marshall and Swan (2010) found, one of the common themes that emerged from the workshops, and a topic that parents wanted further information about, was the use of mathematics terminology. There was 100% agreement with the statement that this was a source of confusion for parents. (A maths glossary of terms was provided to parents in a subsequent session.)

There was a mixed response to the open-ended question 'How did you feel about mathematics when you were at school?' Although some responded positively (e.g., "Loved it! Found it easy), others indicated that they "didn't feel comfortable with it" and "I didn't enjoy it because I wasn't very good at it, with the impression there was only one correct way to answer a problem".

Parental understandings about current mathematical practices

In order to answer the second research question, items from the anticipation guides distributed in the first two sessions were analysed, along with parents' responses to open-ended questions from all sessions. In the first session, parents were asked to circle their level of agreement (agree, disagree, unsure) with eight different statements. Following the session, they were then asked to review their responses and identify whether or not any of their ideas were challenged as a result of the session. The results showed that eight of the 18 participants indicated that they no longer agreed that "Chanting is an effective way to learn tables", and while initially five people agreed that "There is a correct way to do a maths problem", all of these changed their opinion at the end of the session. While no claims can be made as to the sustainability of these results, it is encouraging that the sessions did result in positive changes in some of the parents' beliefs. The following comments are illustrative of the changes in responses received:

> Most maths calculations can be done a number of ways

> I had the impression that maths was more recall than process. I have noted processes that I can now discuss with children.

The parent questionnaire referred to in Table 2 also contained items that were particularly related to parents' knowledge of current mathematical practices and their confidence in helping their children with mathematics at home. Table 3 shows the items and levels of agreement received for these aspects.

Table 3. Parents' understandings of current mathematical practices.

Statement	SD	D	N	A	SA
Mathematics teaching today is different to when I went to school	0	0	33	33	33
I am confident with helping my child with mathematics homework	0	0	0	50	50
I am confident with helping my child with the following specific maths topics:					
Addition and subtraction	0	0	0	50	50
Multiplication and division	0	0	0	67	33
Place value	0	33	0	50	17
Fractions	17	33	0	50	0
Multiplication tables	0	0	0	83	17
Decimals	0	17	0	66	17
Algebra	17	66	0	0	17

When interpreting the responses in relation to confidence with helping with specific maths topics, it must be remembered that many of the parents had young children and may have subsequently interpreted their confidence with younger grade levels, rather than the topic itself. Similarly it is difficult to conclude whether levels of agreement or otherwise relate to parents' own personal knowledge and confidence, or whether they are referring to their ability to 'help' their child.

Qualitative comments revealed that the parents were not familiar with current mathematical practices and were concerned that they "would teach them the wrong way". Although this issue was challenged at the workshops, parents still indicated that "I am not familiar with current practices" and "I'm not sure how it is taught". This is consistent with Muir's (2009) findings whose survey revealed that only 36% of parents agreed that they had a good understanding of how their child was taught mathematics.

Evaluation of workshops

The results indicated that the parents in this study were willing to participate in their child's mathematical education and appreciated the opportunity to become more informed about current mathematical practices. Furthermore, as Civil (2001) found, parents were also appreciative of the opportunity to engage in discussions about mathematics teaching, enjoyed doing mathematics, and were keen to improve their own mathematical content knowledge, while gaining a better understanding of reform mathematics.

The workshops were designed to be informal, with some information sharing, opportunities to interact with the presenter and each other, participation in hands-on activities and provision of resources. In the second workshop parents were asked to give their reasons for joining the maths club and what they hoped to get out of it. Interestingly all reasons given referred to the benefits they saw for their children, rather than themselves. "To get a better understanding of teaching methods to help kids at home" was typical of the comments received. Parents also identified that they would like future workshops to include fractions and ideas for extending children who are confident and helping those who are not.

As Table 1 shows, the numbers attending the workshops varied, with some parents attending all sessions and others attending one or two. The high numbers at the first

workshop were attributed to it being conducted at the same time as another initiative, which involved the taking home of numeracy packs in the early grades and which was very actively promoted with the parents. Informal feedback received from parents indicated that the sessions were valuable, with one parent expressing, "That was fantastic", and there was overwhelming support for the sessions to continue in 2011. The success of the workshops could also be attributed to the support of the school's teachers and senior staff, who prepared fliers, advertised in the newsletter, and personally approached parents to attend.

Conclusions and implications

There is still more to be done in terms of finding out the knowledge and skills held by parents and what their perceptions of mathematics are. Many parents in this study indicated that they did not have a good understanding of how their children were taught mathematics, which can be a source of tension when trying to help children with mathematics at home. More research needs to be undertaken into the reasons for these tensions – it may be because mathematics is taught in a different way to years ago, or even that parents see teachers as having the responsibility for mathematics education (Civil, Diez-Palomar, Menendez-Gomez & Acosta-Iriqui, 2008). Nevertheless, parental workshops such as the one described in this paper, and programs such as *Maths for Parents* (Civil, 2001) may help to address these concerns.

This study has also added to the literature in relation to highlighting the mathematical knowledge held by parents—such as indicating that some of the misconceptions held by pre-service teachers, teachers, and students are also held by parents. It is recommended that parental workshops should therefore address mathematical content, along with familiarising them with current mathematical practices. As Marshall and Swan (2010) found, these parents also indicated that there were mathematical topics that they would like further information about, including fractions and place value. In addition, Civil (1999) recommends that a two-way dialogue needs to be established, whereby parents are seen as intellectual resources and provision made for their beliefs, ideas and concerns to be heard.

The next phase of the study will examine ways in which to empower parents to contribute more to their child's mathematical education, particularly in the higher grades, and to explore different models or approaches to help parents understand the mathematics teaching that occurs in today's classrooms. It is hoped that the documentation of such programs will assist teachers and educators with recognising the importance of parental influences and the difference they can make to their child's education.

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