

# Crossing the Home-School Boundary in Mathematics

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***ABSTRACT:** Recent research recognises the importance of home factors and home-school or home-centre collaboration in the early years of a child's mathematics learning. This paper reports on the results of an action research trial of a mathematics newsletter for parents outlining current classroom activities in New Entrant to Year Three classes. The study design allowed parents to choose whether to be questioned about their use of the newsletter, and consequently the parents who participated were considered by teachers to be high-contact and involved parents. These parents found it "easy to do mathematics" within their normal routines, but were less likely to complete prescribed activities without modification. The findings indicate that parent newsletters have the potential to effectively cross the home-school boundary and lead to greater mutual support of children's mathematics learning in high-contact parent families. Future research is needed though to look at what effect newsletters may have in families with low-contact parents.*

## **Introduction**

Recent research results (Garden, 1997; Flockton & Crooks, 1998) have highlighted concerns about New Zealand children's computation skills. The low international rankings in the Third International Mathematics and Science Study (TIMSS) were particularly alarming considering the relatively high level of participation in early childhood education (over 80%) and earlier age entry to school compared to many other countries. New Zealand children appear to spend longer learning mathematics in a formal classroom setting but achieve less than most other countries in the TIMSS study.

The Ministry of Education response to these concerns has included the establishment of a Mathematics and Science Taskforce, Numeracy Think Tank (ongoing), targeting of professional development funding (e.g. Year 3 contracts and Numeracy Proposal Pool), and a public information campaign. The "Feed the Mind" information campaign which is currently running seeks to improve learning outcomes in literacy and numeracy through encouraging adults to share informal learning activities with their children.

For young children, in particular, home support has been found to be a significant factor in their mathematics learning. The differential effects of home

support are evident in the large range of mathematical competence children display upon entry to school (Aubrey, 1993; Wright, 1994; Young-Loveridge, 1987) and continue to be a significant factor in their progress during the early years (Wylie, Thompson & Lythe, 1999). The Ministry funded Curriculum Review Research in Schools Project (CRRISP) (Ramsay, Harold, Hawk, Kaai, Marriott & Poskitt, 1990) recommended increased parental involvement as a means of improving school outcomes. CRRISP was followed by the Parent Education in Relation to Mathematics in the New Zealand Curriculum (PERM) report (Cooper, 1996) which reiterated the need for improved home-school contact.

The research reported in this article was a specific parent involvement initiative; the trial and implementation of a regular newsletter, aimed at giving parents information about the mathematics their children were learning at school. New Zealand research has revealed few parents are familiar with the content or methods used in a junior primary school mathematics lesson. Visser and Walker's (1993) review of the implementation of Beginning School Mathematics (BSM) found that parents' knowledge of what was happening in mathematics classes was very low. Parents were asked to comment on whether they were happy with what their child was learning and the progress they were making after two years at school. Twenty-nine percent of the parents felt that they did not have sufficient knowledge to answer for mathematics (compared with less than one percent who felt the same about their child's reading). Content was also a mystery, with nearly two thirds of the parents responding that they did not know enough about the BSM resource to comment on it. Furthermore, some of the remarks made by the 62 percent of parents who did comment, showed a lack of knowledge about the way mathematics was taught. Parents who "wrote equations", or "did addition and subtraction" at home were probably unaware of the BSM scheme's delayed introduction of formal arithmetic skills.

This lack of awareness has implications for the effectiveness of home support. In the context of language development, Tizard and Hughes (1984) argued that familiarity with the culture and content of the (pre-school) programme is what enables home support to be effective. They discussed a "split" between home and school learning that prevented home learning from being utilised by the child at school. This split is less extreme for middle-class children, but when the home culture is significantly different from the dominant culture in the school, the split yawns open to a "chasm".

Tizard and Hughes (1984, p.251) compared the type of learning that occurs in home and school situations; reporting that in the home "learning is often embedded in contexts of great meaning to the child". In New Zealand, Carr

(1992) developed the analogy between language and mathematics learning to draw attention to the importance of embedding mathematical activities within home routines. Her comparison is supported by the finding that children from families who share a range of mathematical experiences are advantaged in the classroom (Wylie, Tompson & Lythe, 1999).

Case studies have also been used to more closely examine the differences between the homes of children who scored well in mathematics tests upon entry to school, and those who performed poorly. Young Loveridge (1989) interviewed the mothers of six children and found that irrespective of socio-economic background, or mothers' educational levels, children who scored highly came from home environments where an adult family member had confidently set out to teach the children counting skills and used counting in a meaningful way.

Studies with middle school children (e.g. Anthony & Knight, 1999; Carr et al, 1989) argued that parents are well placed to support their children in acquiring regular habits of practice, and make positive contributions to their children's metacognitive development through homework activities. However, Merttens (1999) cautioned that not all mathematics homework is equally effective; "**how** it is done is more important than **that** it is done" (p79). It may be parent's lack of knowledge about classroom mathematics that decreases the effectiveness of certain types of the homework. This study explored the possibility of bridging the "split" that occurs between home and school mathematics by the implementation of a regular mathematics newsletter (Savell, 1998). The focus of this paper is on parents' perception of the current situation and their experiences with the newsletter in terms of their support for their child's mathematics learning.

## **Method**

### Sample

An action research methodology was used to trial and improve a regular parent newsletter. After each cycle, evaluative data was gathered from both teachers and parents resulting in changes to the format, style and content of subsequent newsletters.

Classes from two different schools participated in the study. The first cycle was undertaken in the Junior Syndicate of a large, well-resourced Primary School (roll approximately 500, decile eight) which will be referred to as Milland. All children in five participating classrooms at Milland School received newsletters for the duration of a 10-week term. The newsletters, written to match activities

from the Beginning School Mathematics (BSM) programme, went home on a semi-regular basis. Each newsletter was specific to the activities undertaken by that child's particular mathematics group. Figure 1 shows a sample newsletter.

In the final week of the term, a questionnaire was sent to the approximately 100 participating families. They were also invited to make themselves available to be interviewed later. Eleven of the families at Milland School responded to a questionnaire. Five of these parents agreed to be interviewed.

The low response rate, while disappointing, reflected the relatively low parental support at Milland School. In an effort to address this concern a different school was selected for the next cycle. Pallace School was urban and enjoyed a reputation for benefiting from a high level of parental support. Instead of pre-printed newsletters the researcher worked closely with a single teacher of a Year 2/3 composite class. She identified the mathematics achievement objectives for each topic and closely critiqued the draft copy produced by the researcher. Suggested changes were integrated into a final version for distribution to parents every two to three weeks. Newsletters used at Pallace School were longer but the "tone" and topics within the newsletter were similar to Figure 1.

At Pallace questionnaires were once again used to gather initial parent feedback. Eleven were returned from twenty-four families. The parents of six children (six mothers and four fathers) agreed to be interviewed at the conclusion of both cycles. In addition to ongoing interaction, the teacher at Pallace was formally interviewed twice.

The low response rates to the questionnaire (11% at Milland, 45% at Pallace) lead to a sample that was self-selected. The interview group was relatively homogenous; categorised by the teachers as "high-contact parents". It appeared that many parents were reluctant to be interviewed about mathematics and ethical considerations precluded the interviewer contacting those that had not returned the questionnaires.

## FIGURE 1: Sample Mathematics Newsletter

BSM2-3-2,3,4,5,8,9

### Maths News

Over the next few days we will be working with groups of objects (we call them sets) and using the words “same” and “different” to decide if an item belongs with the others in the set. For instance



is a set of faces.



does not belong in this set

because it is different - it is

an envelope, not a face.



is a set of hands.



belongs in this set because

it is a hand, the *same* as the others.

In class, our teacher will create a set (eg *dog, cat, rabbit, fish*) and then ask us if the next object belongs.

If we say yes we have to say what the set has that is all the same.

- e.g. a *horse* does belong because all the things in the set are alive

If we say no we have to say why the object is different.

- e.g. a *train* does not belong because it is made of metal and all the other things in the set are not.

Sometimes our reasoning may be a little different from an adult's

- e.g. we may say a *train* does belong in the set because all the things in the set can move.

That is fine! There are plenty of right answers to mathematics questions like this. As long as we can give a sensible reason we are praised for our thinking. If you would like to support us with activities at home you could encourage us to collect sets of similar objects. For instance:

- Collections of pine cones, red pegs, or even empty yoghurt containers can be good talking points.
- Sorting the washing is great for talking about groups (sets) and differences.
- Ask us to choose the fruit for school lunches.

The key questions to ask us are “What is the same about all these things? Why do these things all belong together?” or “What is different about this one? Why does this one not belong?”

Have fun. Happy Mathematics 

## Data Collection and Analysis

Ethical considerations also affected the choice of data collection method. The researcher interviewed parents rather than the children themselves, and did not observe in the classroom. Semi-structured interviews were used to ensure coverage of important questions, allowing for digressions that might provide greater insight into parents' feelings. The interviews were taped and transcribed by the researcher. The rapport established was demonstrated by the eagerness with which parents discussed a wide range of issues relating to their child's mathematics and education in general.

The small number of respondents made it relatively easy to compare responses to particular questions. General themes were identified and the data was coded for these themes. For the early interviews, these themes gave rise to specific questions, used in the interviews following the next cycle.

At Pallace School, the same parents were interviewed after each cycle. This enabled the researcher to identify any changes that may have been a result of the newsletter. In this paper the cycles are not reported separately.

## **Results**

### Lack of Knowledge about School Mathematics

The interviews with these high-contact parents revealed that they had little knowledge of their children's progress in mathematics. This was in stark contrast to their awareness of progress in other curriculum areas. For example in an interview one parent said:

I presume that Natasha is doing fine in her maths but I don't actually know how she's doing with her maths. You never really know. They bring their reading home so you know where they are with that. You tend to get an idea of what they're doing in social studies. ... I can't think of their other subjects ... Printing is fine ... I know what she's doing with story writing ... I see her artwork. She's doing gymnastics at the moment and I see her ball skills and things like that at home all the time. **Mathematics is the big mystery one really...** I never think to ask her what she's doing in maths and she never tells me anything that she's doing. In fact **it could be the forgotten subject as far as school subjects go** (Natasha's mother, Milland, emphasis added).

Before the interview parents were generally unaware of this lack of knowledge about mathematics progress. Many had never inquired about mathematics at

parent teacher interviews, and could not remember mathematics progress being reported to them. Parents expected any questions about their child's mathematics progress to be answered in a general way rather than with a specific grade or rank. They assumed that the child was "fine" unless told otherwise. The mother of Leah at Pallace for example made the comment that:

With her maths no. I know she is probably adequate but I couldn't be more specific ... You get more information on the reading side of it and the literature and the language. I know in the parent teacher interview there was more focus on the fact that she could read extremely well and write stories extremely well and I don't remember the maths being mentioned.

This is consistent with the teacher's reporting of parent-teacher interviews. At Milland the teachers explained that parents normally had little interest in mathematics in the junior school. Parents' inquiries were more likely to be very general:

**Teacher B:** The parents' (of new entrants) first question is "How are they going?" Without actually saying it; that is what they are wanting to know. Whether their child is smart, or dumb, or average, or whatever.

**Interviewer:** Do you tell them?

**Teacher B:** No. If there are glaring omissions then you tell them. Like if they need more help with their colours or if they need more help with their shapes then you tell them.

Teachers reported that the newsletters seemed to generate interest in mathematics. However, although more parents asked about mathematics, teachers were reluctant to give parents specific information about assessment.

I had 20 out of 24 (parents attending parent interviews) and probably 50 percent of them asked about maths and that's unusual. They don't normally ask about maths (Teacher H, Milland).

I never tell them where their child is in the class anyway ... Well, it is fine if your child is in the top quarter but if your child is not then you probably feel that they should be or whatever. I tell them if there is a problem that they are not coping with some objectives but you can't always assess a child and say they are going to be in a certain place ... (Teacher S, Pallace)

### Home Mathematics in the Absence of Newsletters

It was clear from the interviews that parents' apparent lack of interest in their child's mathematics progress did not indicate that they felt that mathematics was unimportant. All of the interviewed parents used commercial resources to support their child's mathematics learning. Many had purchased books, magnetic numbers and/or mathematics games before the children had even started school. In the Year 2/3 class all of these parents had undertaken some form of mathematics coaching: two had bought books, two had mathematical games and three had questioned their children on basic facts.

We play games and we bought those books. We bought them about the second term of school. I notice they do them in spits and spats. They might see them on the shelves, so they get them out and go at them for a couple of nights and then put them away again for a while (Linda's mother, Pallace).

Leah has always done sums. Since she started school. It used to be quite a game to her. She used to do adding. We quite often used to play a game with adding between the lower numbers. She could add up to about  $10+10$ . She would just look up at the ceiling and the next minute the answer would pop out. It just used to be a bit of a game (Leah's mother, Pallace).

Rather than being disinterested, it seemed that the parents were waiting for the child to begin to bring written mathematics homework to them. There was an expectation that at some stage the children would be told to learn their 'times tables' and at this point parental assistance would be sought. Some of the parents had already begun drilling their children on basic facts. Jack's mother was a teacher aide at Pallace and she described how she modified her approach to helping Jack learn his multiplication facts.

We learnt it how I learnt it. We used to start with "two ones are two, two two's are four..." calling out loud. And we talked about it because I think at that stage I was in his class as well and I heard them talking about two groups of three and two groups of four so we talked about it like that (Jack's mother, Pallace).

### Effect of the Newsletters

The newsletters gave parents increased confidence in their ability to support their children's mathematics. For those parents who had little previous knowledge of the junior school mathematics curriculum, they found the

newsletters gave them a great deal of information. Four of the eleven families interviewed found the content of the newsletter was quite surprising:

I never thought of doing anything like that before. I mean I would have done it when I was at school but I certainly didn't think of doing it (Donald's mother, Milland).

Some parents found they were "doing that anyway" without realising their home activities supported the classroom mathematics.

... things like bigger than, smaller than. You don't realise how much you talk to your children about maths until it is brought to your attention ... because I got the Maths News (Liz's mother, Milland).

They were fairly common-sense sort of things that you would do, but it was good to have ideas written down. Especially mentioning cutting the toast different ways, ... just little things like that ... We would have talked about fractions but it made you talk about it even more. You realise the importance that they've got to get to know this and instead of just talking about it casually, you talk about it more often (Jack's mother, Pallace).

Other parents, who were more familiar with the content through teaching contacts, reported the positive prompting effect provided by the newsletters.

Even for me it served as a reminder that every now and then these are the sort of things that I need to be talking about. Remembering when you go to the supermarket to talk about the money and how many and the sizes. It was a good reminder (Joe's mother, a teacher).

Six of the parents also talked about the effect the newsletters had on their ability to support the mathematics of younger siblings.

You can teach them so easily if you know what it is they can't do. I was in class helping out and the children had to put pictures in order of size. It was amazing how many couldn't do it. And that is so easy to teach them if you know that they will be doing that at school. I'm keeping all these (newsletters) and I'll know what Jessie needs when she goes to school (Rachael's mother, Milland).

We are talking about things with (*4-year-old sister*). She may not remember everything down to the last “T”, but when she hears that word “fraction” or “quarter” or “third”, she’s going to think “Ah”, and there’s going to be an alarm bell that rings and she’s going to recognise a lot more than he would have done (Jack’s mother, Pallace).

### Mathematics in a Meaningful Context

The design of the newsletter encouraged parents to interpret the mathematics within contexts that the children were familiar with. All the interviewed parents gave examples of how they had included mathematical concepts or vocabulary in their usual family activities. The following quotes taken from the interview with Natasha’s mother were representative of the skill that parents showed in adapting activities to fit the personal interests of their children (often including younger siblings).

**Interviewer:** Did you try the first one. About patterns?

**Mother:** Yeah. With cars. I did like ... we have a set way that the toys go away. So I was putting things up like two cars and then a puzzle and she carried it on. I said “Oh let’s put them this way” and she followed my patterns.

**Interviewer:** Newsletter number four was about counting to 100.

**Mother:** That’s right. The kids were into the checkers and counters at that stage. We mucked around with the checkers. Groups and sets of them and that sort of stuff. And dominoes actually.... Distance. Yes. That was good actually. Cos (4-year-old brother) is right into dinosaurs at the moment and they say how many feet long they are. So we’ve been talking about how long it is, you know ... Telling him that the dinosaurs would be from our garage over to the school gate and how long that is ... And Daddy standing on top of Daddy standing on top of Daddy sort of thing to get the length and things. That sort of stuff. I keep meaning to tell her to measure it out to the letterbox but I forgot. (reference to a specific activity in the measurement newsletter) ...

Parents commented on the ease with which they incorporated this mathematics into their daily lives, compared to the difficulty of finding time to sit down with the child and complete homework.

We didn't try much baking. It was more with the questions. Like "Is that more than half?" or you know. It just makes your everyday thinking more aware. Like setting the table: "If two of us are going to be away tonight then how many knives will we need?" and things like that because when you are not mathematically minded it is helpful to have reminders about what you could be doing (Adele's mother, Pallace).

**Father:** Routine things are easy because it is just remembering to say it, but occasionally we'd do homework and it would be part of that. But you've got to actually sit down ... and it is the time ... It is the little things that became a habit.

**Interviewer:** Would you have been doing that anyway?

**Mother:** Now we talked about it (mathematics). It made you more aware of what you were doing. Normally you just have the shape in front of you but you wouldn't particularly notice anything about it (Linda's parents, Pallace).

## **Discussion and Conclusion**

All the research suggests that parents can and do make a significant difference to children's outcomes at school. In relation to mathematics, Young-Loveridge (1989) found that parents who deliberately set out to teach counting skills, and used numbers in a meaningful way in early childhood, advantaged their children. However, like earlier studies in New Zealand (Visser & Walker, 1993) parents from Milland and Pallace reported that mathematics was a "black hole" as far as information about classroom content or progress of their child was concerned.

Despite being interested in their children's mathematics, these parents did not readily seek information about mathematics progress in the early years of schooling. They were waiting to be given some direction from the school as to what they were expected to do. In the absence of any guidance as to what would be the best way to support school mathematics, the parents purchased commercial materials and some had begun drilling times tables. The information gained through the newsletters enabled them to support school mathematics in more appropriate ways.

For younger children, Carr (1992) recommended that mathematics should be learnt within a context that is personally meaningful. Specifically, parents can

enhance learning by sharing everyday experiences that support numeracy (Wylie & Smith, 1995). In this study the comments of parents indicated that they were skilled at individualizing tasks to suit the personal interests, activities, routines and abilities of their child – if they were given some information about the links between current school mathematics and suggested home activities.

This result gives rise to questions about the effectiveness of traditional mathematics worksheets or work samples which replicate mathematics done at school. The curriculum document for mathematics teaching in New Zealand requires mathematics to be taught “within a meaningful context” (Ministry of Education, 1992). Given the diverse range of interests, teachers find it difficult to provide contexts that are personally meaningful to a class-full of children. Yet the parents in this study reported that, given information about the current topic, it was “easy” to include the associated mathematics concepts and vocabulary within the context of the child’s normal household routines. It appears that parents can offer support that is complimentary to the classroom learning and this may be more effective than merely repeating classroom exercises as “homework”.

Arguably an important issue raised by this study is the low response rate. The very fact that most parents chose not to respond, even to a questionnaire about school mathematics, hints at a lack of confidence and/or a lack of knowledge about school mathematics. All the respondents were classified as “high-contact” parents: parents who were in and out of their child’s classroom; parents who felt comfortable talking informally with the school teacher; parents who were confident in a school setting. The fact that these parents reported that they had little knowledge of school mathematics before the newsletter raises concern about the situation for the majority of parents.

We can only speculate that low-contact parents would have even less knowledge or confidence than the respondents. Low contact parents would be less familiar with the classroom mathematics, and therefore, less able to support their children to bridge Tizard and Hughes’ (1984) “split” that occurs between home and school when the two cultures are dissimilar. It is important that future study explores the effect of mathematics newsletter in homes where parents have less contact with schools.

Parent reports of benefits for younger siblings suggests another area for future research. The start that children receive in mathematics has been shown to be critical to future success (Wright, 1994; Young-Loveridge 1987) so these comments indicate a need for a closer examination of mathematics in early childhood. Although early childhood centres generally have a stronger ethic of parental involvement, mathematics may also suffer from invisibility. Giving information that makes the mathematics learning in Centres more explicit to

parents may increase parental confidence and motivation to support their children's mathematics. The research literature clearly shows that when parents have the confidence to teach early counting skills, the children benefit (Young-Loveridge, 1989).

## **Crossing the Boundary**

For literacy education, the boundary between home and school learning has become blurred. Parents are expected to take an active part in supporting their child's reading progress, and teachers acknowledge the value of that support. However for mathematics the boundary remains. In fact the wall between home and school is so stoutly built that parents are often unaware of both what their children did during mathematics lessons, and their rate of progress.

The newsletters appeared to provide a first step in crossing this boundary. They opened a window to the school and gave parents a view of what classroom mathematics looks like. This vision enabled parents to support the teacher in a unique way, embedding learning within everyday routines that were familiar, meaningful and of personal interest to the child. Parents reported that they enjoyed being able to do this, and were confident about their ability to help their children. There was also a flow-on effect for younger siblings. The study indicates that newsletters, outlining the classroom programme and offering suggestions, may be an effective way of encouraging parental support of mathematics, thereby raising children's achievement.

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## ABOUT THE AUTHORS

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Poor mathematical attainment may lead to mathematics anxiety, as a result of repeated experiences of failure. Indeed, there is likely to be a vicious circle, where anxiety and performance affect each other negatively. The attitude questionnaire consists of 28 questions which focused on 7 areas of maths: maths in general, written sums, mental sums, easy maths, difficult maths, maths tests, and understanding the teacher. For each item, children were asked about their Self-rating (‘‘How good are you?’’) on a scale consisting of ticks and crosses (‘‘every good’’ to ‘‘every bad’’); Liking for the items (‘‘How much do you like it?’’) on a scale consisting of sweets and wasps (‘‘like very much’’ to ‘‘hate very much’’); Anxiety about them (‘‘How worried would you be?’’).

Homeschooling or home schooling, also known as home education or elective home education (EHE), is the education of school-aged children at home or a variety of places other than school. Usually conducted by a parent, tutor, or an online teacher, many homeschool families use less formal, more personalized methods of learning that are not always found in schools. The actual practice of homeschooling can look very different. The spectrum ranges from highly structured forms based on traditional school Crossing Boundaries in Mathematical Modelling and Applications Educational Research and Practice Gloria Ann Stillman, Werner Blum, and Gabriele Kaiser Abstract This chapter gives an overview on the current state-of-the-art on the teaching and learning of mathematical modelling and applications and its contribution to educational research and practice which is reflected in the various contributions in this book. Mathematical modelling and applications have the potential to appeal to a wider audience than they currently do within the field of mathematics education research. Thus, the book is intended to provide a stimulus to consider new approaches drawing on related research in mathematics education and associated domains. The average Canadian home schooled student is regularly involved in eight social activities outside the home. Canadian home schoolers watch much less television than other children, and one researcher found that they displayed significantly fewer problems than public school children when observed in free play. Feature articles on home schooling graced the covers and pages of many national publications (see Wallace, 1982; Feinstein, 1986; Stecklow, 1994; Maushard, 1996; Benning, 1997; Eisler and Dwyer, 1997; Kantrowitz and Wingert, 1998; Kay, 2001; Cloud and Morse, 2001; Wall Street Journal, 2002; USA Today, 2003 and 2005; Saulny, 2006) such as Maclean’s, Newsweek, The National Post, The New York Times, Wall.