

At Home With Numeracy: Empowering Parents to be Active Participants in their Child's Numeracy Development

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This paper reports on the nature and results of a pilot study conducted with the parents of a Grade 1/2 class. The study investigated the mathematical perceptions of a selected number of parents and used an intervention program designed to encourage them to engage in numeracy activities with their child. Preliminary results indicated that the parents were keen to support contemporary classroom practices and were able to describe and evaluate their children's mathematical understandings. The findings add to the limited research available on the role that parents can play in their child's numeracy development.

Background

According to Merttens (2005), the single biggest factor in children's educational success is their parents, with their attitudes to learning, to mathematics and to study in general formed in the context of the home. Research has shown that parental involvement affects student achievement (Sheldon & Epstein, 2005) and that students' learning is maximised when strong educational partnerships between school, community, and home are developed (Groves, Mousley & Forgasz, 2006; Vincent, Stephens & Steinle, 2005).

Unfortunately, mathematics as a subject has a negative reputation in society and being innumerate is more socially acceptable than an ability to read or write (Gordon, 1992). Parental comments, such as "I was never any good at maths *either*", send a signal that it is quite acceptable for the next generation to neither learn nor care about mathematics (NCTM, 2007, p. 3). Research findings indicate that many adults, in relation to mathematical tasks, admit to feelings of anxiety, helplessness, fear and dislike (Haylock, 2007). This is of concern as presumably many of these adults become parents who will potentially pass these feelings onto their children. The study discussed in this paper was motivated by a desire to address the cycle of negativity often associated with mathematics through providing parents with opportunities to engage in mathematical activities with their children and to take an active role in their numeracy development. Specifically, the research questions were:

- What are the perceptions of mathematics held by a selected number of parents?
- How well informed are parents about contemporary mathematical practices and curriculum and how willing are they to engage in mathematical activities in the home?
- What are the features of a program designed to increase parental involvement in their children's numeracy development?

Goos and Jolly (2004) found that 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.

Theoretical Framework

Parental Involvement

In their synthesis of effective pedagogy in mathematics, Anthony and Walshaw (2007) reported that students performed better academically and had more positive school attitudes if they had parents who were aware, knowledgeable and involved (Epstein, 1992, as cited in Anthony & Walshaw, 2007). However, it seems that many parents are more actively involved in their children's language learning than mathematics (Cannon & Ginsburg, 2008). This may be attributable to the negative attitudes previously mentioned, but may also be because parents have often been given little guidance from teachers about the ways in which they can help their child with mathematics (Anthony & Walshaw, 2007). Parental involvement has often been limited to parents' monitoring and assisting with homework, placing particular emphasis on "drill and practice" exercises and learning "tables" by rote (Goos & Jolly, 2004). Lack of involvement has also been attributed to the increasing complex nature of mathematics as students move through grades, with parents lacking the content knowledge or teaching skills needed to help their children (Sheldon & Epstein, 2005).

Despite reform documents and organisations such as the NCTM advocating the need to work with parents (NCTM, 2000), Peressini (1998) maintained that parents have traditionally been seen as "impediments to the reform of mathematics education" (p. 14). He argues however, that parents have their own expertise and unique knowledge about their children and thus can contribute to their children's mathematical development. Furthermore, those parents who had negative experiences in their own mathematical education may well view reform recommendations in mathematics education as welcome changes that may result in more engaging and meaningful mathematical experiences for their children (Peressini, 1998).

Parental Knowledge of Mathematics Curriculum and Current Practices

Many parents are not familiar with the mathematics content that their children encounter in maths classes and are thus limited in the ways that they can be involved in their mathematics education (Peressini, 1998). In a study investigating parental attitudes and beliefs, Pritchard (2004) found that many parents felt uninformed about the mathematics curriculum and the teaching methods used in their child's school. Similarly, Warren and Young (2001) found that there was a tension between teachers' and parents' knowledge of mathematics. This was also found to be the case for Chinese parents in Cai's (2003) study, with approximately 63% disagreeing with the statement, "I think I know enough about mathematics to help my child" (p. 97). 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 different backgrounds (Anthony & Walshaw, 2007).

Home Activities that Contribute to Mathematical Understanding

It needs to be acknowledged that many schools and teachers do encourage parental involvement and guide parents to participate in their children's mathematics education and learning (Sheldon & Epstein, 2005). Furthermore, this involvement has been shown to be associated with improved student performance (Sheldon & Epstein, 2005). 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. Similarly, Goos and Jolly (2004) report on a school's practice of offering individualised "take-home packs" of mathematics activities to parents who requested additional materials to use with their children. In many schools it is common practice to have a program of home reading where children take books home and share them with their parents. It is equally important to have a home-maths program, whereby children take home weekly or fortnightly maths activities which are shared and discussed by parents and their children (Merttens, 2005). These activities often become more relevant as they occur within the context of the home (Merttens, 2005) and capitalise on the unique knowledge that parents already have about their children (Peressini, 1998). The intervention program discussed further in this paper took these considerations into account; furthermore, the expectation of written feedback enabled the experiences to be valued by both the teacher and the parents.

Methodology

The study involved the parents, students and teacher of a Grade 1/2 class of 28 students in a local District High School set in a low socio-economic area. The aims of the study were to investigate parents' perceptions of mathematics and current teaching practices and involved an intervention program whereby parents became active participants in their child's numeracy development.

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 the class. The questionnaire was administered again after the intervention program using the same rating scale items but varying the nature of some of the open-ended questions. The questionnaires were coded to enable comparison between the two sets of responses to be made. Parents also had the option of participating in a follow-up semi-structured interview, of which three were conducted.

The intervention program involved each child taking home a different numeracy activity each week. The activities were designed to be interactive and support the mathematical experiences undertaken in the classroom. Every Monday each child would receive their 'numeracy bag' that would contain their activity instructions, necessary materials and guidelines for parents. There was also a short explicit rationale that explained the purpose behind the activity. Figure 1 shows an example of one of the activities and how it was presented to parents. The expectation was that the child would engage in the activity 2-3 times over 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 which required parents to provide data about the child's level of engagement with the activity and the mathematical understandings that were revealed. This procedure occurred over a six-week period and then the second questionnaire was administered. The interviews were conducted shortly thereafter and provided for participants to expand further on their questionnaire and short answer responses. A semi-structured interview was also conducted with the class teacher.

1-100 Chart

You will need:
Cut out pieces of 1-100 chart

What to do:
Place the pieces together to form a chart showing the numbers from 1-100

Purpose of activity:
This activity is designed to develop an understanding of many concepts. By placing the pieces together, children can form an understanding of the place value system and the sequence of two-digit numbers. Once the chart has been assembled, children can be asked to locate patterns in the chart (e.g., look at the multiples of 11—cover with counters, what do you notice?).

Counting with the chart:
The chart can be used to add and subtract two-digit numbers. For example, place your finger on 23. To add 34, move your finger down 3 rows (as each row represents 10) and move your finger across 4 (as each column represents 1). Try adding a variety of numbers in this way. Subtracting two-digit numbers can also be attempted using the chart—e.g., 67—32 can be found by moving up three rows, and across 2 spaces.

$$36 + 43 =$$

Figure 1. Example activity sheet.

Results and Discussion

A total of 14 pre-questionnaires and 11 post-questionnaires were returned; some participants returned both, while others returned one only. The return rate of the feedback sheets was very high; 24 parents regularly completed and returned weekly feedback sheets for their child.

Participants' Responses to First Questionnaire

As reporting on all the responses was beyond the scope of this paper, Table 1 contains a selection of the statements from the questionnaire and the parents' corresponding levels of agreement or otherwise. A particular focus has been placed on the items related to parents' understanding of their child's mathematical development and classroom practices.

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

Statement	SA/A responses (%)	SD/D responses (%)	N responses (%)
People who are good at maths are born like that	21%	43%	35%
If you're not good at maths, there's nothing you can do about it	7%	79%	14%
I have a good understanding of how my child is taught numeracy in school	36%	28%	36%
I think the way maths is taught in classrooms today is effective	36%	57%	7%
I know what types of mathematical skills and understandings my child has	64%	29%	7%
Games and activities are a good way to learn mathematics	86%	0%	14%
I regularly engage in numeracy related activities with my child	86%	0%	14%

With regard to parents' beliefs and attitudes towards mathematics, their responses in general were mixed, and to some extent support the findings claimed by other researchers. For example, there was a high level of disagreement with the statement, "I am satisfied with the way I was taught mathematics in school" and short answer responses often included reference to their mathematical ability, as the following statement illustrates:

I am not good at maths and feel irritated when I think about it. I hope my kids will like it better but I found it stressful at school and still dislike it.

The tendency to associate mathematics with numbers and particularly tables was also evident in parents' short answer responses. These responses were consistent with parental concerns identified by Goos and Jolly (2004), in that "their children were not learning tables by rote" (p. 283). According to Warren and Young (2001), a belief that mathematics is best learnt by drill and practice can undermine mathematics reform and that the teacher's role in potentially reinforcing this belief needs to be addressed.

As Table 1 shows, only 36% of parents indicated that 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 responded "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.

The above comments reflect the findings made by Pritchard (2004) and Cai (2003) and support Peressini's (1998) assertion that parents have been largely forgotten in the reform literature.

Table 1 also shows that 86% of parents reported that they regularly engaged in numeracy related activities with their child and thought that games and activities were a good way to learn mathematics. When asked to name specific activities, responses included computer CD roms, playing monopoly, snakes and ladders, UNO and cards. Other responses included involving children in shopping experiences, cooking and dividing up food. One of the more memorable comments received reflected the relevance of considering students' background numeracy knowledge and provides a good example of being numerate:

They save pocket money by bagging sheep poo. When they want to buy something, they convert the value to a number of bags.

Parental Feedback on Weekly Numeracy Activities

As previously stated, the return rate for the weekly sheets was high, with comments revealing that parents were 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 ten, one parent wrote:

Trevor [pseudonym] 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 ten-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 focused on using the 1-100 chart and included games such as 'guess my number' and instructions on how to 'count' by using the rows and columns in the chart. Feedback from these activities included comments such as "He's starting to understand odd and even", "She became better every night we did the activity" and "... understood the place value and sequence".

Mathematical 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 observed.

As previously mentioned, after six weeks of participating in the weekly activities, parents were asked to complete another questionnaire. It was hoped that the second questionnaire would provide some evidence of changes in parents' perceptions of mathematics and how it was taught. Unfortunately many of the second group of respondents had not completed a pre-questionnaire and along with the relatively small number of returns, it was difficult to evaluate individual changes. However, open-ended responses allowed parents to record whether or not the activities provided insights into their children's mathematical ability and whether or not they now had a better understanding of how mathematics was taught in their child's classroom. The following provides illustrative examples of the types of comments received:

Yes, it gave my son a better understanding of how to work out the answers to maths problems. I believe that the problems faced by doing these maths questions gave me a better understanding of where my son's level is.

I understand more how he thinks compared to myself. He sees things differently. He likes puzzles more than the ones that required a different way of thinking.

Yes, it showed me how she can think through problems and how playing a game can help with maths.

Not all parents were convinced however. Some responded with a simple "no", while others were more expansive:

I was shocked in that they only know very little at her age. I believe that maths should be taught the way it was years ago with more times tables, etc.

When asked if they would like to see the activities continue on a weekly basis, only one parent responded negatively, preferring to see "more times table/sheetwork; need to mentally consume more numbers and times tables need to be ritual".

Feedback received from the interview participants indicated that they viewed the project positively and would like to see it continued. All participants 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 challenging for their children. Ways to address this issue will be explored in the next phase of the project.

Conclusions and Implications

If schools and teachers are serious about establishing effective working partnerships with parents, then they need to empower parents to enable them to contribute to their child's numeracy development. In the project reported on in this paper, this was done through creating the opportunity for parents to engage in numeracy related activities with their children in the home environment. Importantly, the purpose of the activities was clearly stated and accompanied by an explanation of the mathematics involved in the tasks. The feedback sheets provided a mechanism for communication about the activities to occur between parent and teacher and served to make the program valuable for all parties.

The results indicate that as Sheldon and Epstein (2005) found, parents were willing to participate in their child's mathematical education and furthermore were able to contribute in a positive way, providing additional insights into their child's development that could be capitalised upon by their teacher. While no claims can be made that the six-week program significantly altered their perceptions or beliefs about mathematics, it did seem to provide them with an increased understanding of the types of mathematical activities undertaken in the classroom and the mathematical understandings and skills involved with being numerate. The next phase of the study will examine ways in which to make the process more individualised for students and whether or not similar rates of participation would occur with older students and their parents. It is hoped that teachers and educators will recognise the potential of such projects to involve and empower parents to be active contributors to developing their child's numeracy.

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Teacher Perception and Motivational Style

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A design-based intervention project was conducted to research the complexities of improving early number-sense learning outcomes for ‘at risk’ children in the first year of school. Focusing on the growth of teacher knowledge, a combination of interviews, mentoring sessions, videoed lessons and web-log reflections were used as both learning processes and data collection methods. Preliminary analysis of one teacher’s lesson revealed several key teaching strategies that will enable interpretation of how teacher growth in knowledge translates into effective teaching practice in subsequent lessons.

Background and Context

The research reported in this paper is nested within a larger study that centred on empowering Kindergarten teachers to meet the diversity of students’ mathematical learning needs particularly those ‘at risk’ of early number sense difficulty, low progress, or failure. Amongst the challenges identified and explored during the broad study, three paramount factors emerged: a) the importance of the development of each teacher’s pedagogical content knowledge (Hill, Ball & Shilling, 2004), b) the need to change their actual teaching practice, including instructional structures and subject specific teaching strategies (Loewenberg Ball, Camburn, Correnti, Phelps & Wallace, 1999), and c) the contribution of a teacher perceptions to the motivation and engagement of their students (Hadré & Sullivan, 2008).

This paper focuses on the third factor and explores emerging themes of teacher perception and motivation within the teaching of early mathematics. It moves beyond the question of what mathematical knowledge is needed to teach early mathematics effectively and looks at the task of teaching itself while considering the following questions:

- What perceptions does a teacher have of his teaching strategies in early number sense?
- What teaching strategies affect motivational processes and student engagement?

Research Literature

Schulman’s (1987a; 1987b) categories for the knowledge base of teachers, particularly the categories of content knowledge and pedagogical content knowledge have provided a robust framework for a range of studies in mathematics education. Recent research has established links between changes in teacher knowledge and changes in teaching practice (e.g., Beswick, Caney & Skalicky, 2006), and changes in student achievement (Hill, Rowan & Ball, 2005). However, much remains unknown regarding the translation of new knowledge into effective teaching strategies, the nature of its impact on student learning or the role of a teacher’s perception and the classroom effects that influence student motivation and engagement.

Teachers’ individual perceptions and the differences they bring to their classroom environments are becoming increasingly recognised as fundamental contributors influencing the way they teach, and how they motivate and engage their students (Brophy & Good, 1974; Skinner & Belmont, 1993; Hadré & Sullivan, 2008). Hadré and Sullivan (2008) note that differences within teachers’ own qualities and experience, the interpersonal way they interact with their students, together with the perceptions of their

students' characteristics and needs may determine the strategies that they use to influence student motivation and task engagement. Teachers themselves frequently need to be guided to comprehend the forces that shape a child's numeracy learning development and understand both the strengths and weaknesses that each child brings with them to their early maths classes. Discovering how to motivate all students often requires educators to change their existing perceptions of the nature and value of motivation, their beliefs of what influences student engagement within the climate of their classrooms and the actual lessons they give.

Acquiring a sense of number during the early years of schooling is crucial to the long-term development of all future mathematical knowledge. Recognition of the importance of the early mathematical capabilities of children as they enter Kindergarten indicates a growth in the awareness of the concept of number sense. Number sense or the basic ability to quantify, is increasingly regarded as an emerging construct, a prerequisite to the more formal process of mathematical thinking and a vital component of all mathematical instruction (Berch, 1998; Gersten & Chard, 1999; Griffin, 2004; Howell and Kemp, 2005; Jordan, Kaplan, Oláh & Locuniak, 2006). Research that leads to a better understanding of the relationship between teacher perceptions of their students' learning needs and their choice of teaching strategies is of value to the development of quality mathematics education, in particular the development of early number sense learning.

Teachers may be unaware of how to promote early number skills. Many teachers anticipate that as children enter school they have already acquired certain basic levels of mathematical development and are able to make connections and process basic number. They often teach accordingly, introducing number concepts that are frequently misunderstood placing a child 'at risk' of failure, low progress or difficulty with learning (Dowker, 2005, Gersten & Chard, 1999; Griffin, 2004; Seo & Ginsberg, 2003). Some young children exhibiting difficulty with their elementary mathematics may have bought with them a strong foundation from their informal mathematical experiences and understanding but find that difficulty arises when they are not able to translate or connect their "knowledge base to the more formal procedures, language and symbolic notation system of school maths" (Garnett, 1998, p.3). Garnett (1998) describes the difficulty in translation as a "collision" of their informal skills with their new school maths learning experiences. The impact of teacher knowledge and practice on the development of number sense by children in the first year of school is greatly influenced by teacher understanding of mathematical cognition, the importance of number sense within their teaching of mathematics, and how it can be recognised, understood, accommodated and therefore taught effectively.

The teaching of mathematics competence needs to have the availability of the development of the certain cognitive structures that allow a child to interpret the world of quantity and number in increasingly sophisticated ways (Griffin, 2002). Children, states Griffin (2002) need to have learning experiences that allow wide exploration and sets of opportunities for discovery, mathematical challenge and ability. Achievement within early mathematical learning stages also depends on motivational relationships, how a child navigates difficulties, and uses experiences and social interaction to build meaning.

The motivation and engagement of *all* students within their early mathematics learning experiences often requires teachers to address their own perceptions of individual differences, characteristics, experience and interpersonal styles. Of increasing interest to researchers is the relationship between a teacher's motivational style, the specific teaching strategies they use and the influence these have the motivation and engagement of both

students and the teacher within a learning experience (e.g., Jang, 2006; Skinner, Furrer, Marchand, G., & Kindermann, 2008; Urdan & Schoenfelder, 2005). For example, Roth, Assor, Kanat-Maymon & Kaplan (2007) examined educators' experience of autonomous motivation for teaching and how it correlated to both the teachers and students involved.

The role of positive teacher listening and responses to their students' feedback, while continually encouraging choices and further challenge to the learner experience, contrasted with a more controlling, authority-directed motivation where the students are told what to do and how to do it without further alternatives. Roth et al., (2007) found that a sense of autonomy within a task or lesson benefited both the student and, the teacher. They observed that, as students need a secure sense of self-determination and self-perception to maintain their mathematics achievement goals or goal orientation within a degree of autonomy supported behaviour, so did the teachers who were teaching or leading the task. A teacher's sense of wellbeing and success within the classroom climate, not only has a positive effect on the student outcomes, but on their own perceptions and motivational strategies contributing to improved effective outcomes and goals.

Methodology

A design-based research approach (Cobb, Confrey, di Sessa, Lehrer & Schnauble, 2003) that was both pragmatic and theoretical was used for the broad study. This approach allowed the targeting of domain specific learning processes and teacher involvement within their own cycles of design, enactment, analysis and solutions. A collaborative participation framework was designed to contribute to a "shared professional culture, instructional goals, methods, problems and solutions" (Garet, Porter, Desimone, Birman, Kwang, 2001, p.922) as a basis for a professional learning intervention.

Three Kindergarten teachers and their classes were recruited from one school within an urban area of the Sydney Metropolitan Region. The students within the study represented a wide range of diversity, Non English Speaking Backgrounds (NESB) and income status. Each student was pre-tested at the beginning of Term 2 and post-tested at the beginning of Term 4 of their school year using The Number Knowledge Developmental Test (Griffin, 2002; 2004). This measure was used to assess children's developing understanding of number and quantity and to identify and determine the extent to which children have acquired specific knowledge upon school entry point. Administered individually with each question read and responded to orally, students considered "at risk" were identified as those in the bottom 20% of the pre-testing scale.

All teachers were asked to teach six video-observed lessons incorporating their curriculum based lessons and identified key elements of number sense in young children (Jordan et al., 2006). Teachers logged onto their own secure web-based teacher log to submit information and personal reflection about the lesson taught. Structured classroom vignettes from each teacher's individual video observation created contextualised descriptions of their classroom situation, instructional practice and student responses. These vignettes were used as tools within a series of mentoring sessions with the researcher. The researcher viewed each web-log entry and videoed observation after each lesson locating themes and insights enabling a structuring individual mentoring sessions for the following day. Each teacher worked individually and collaboratively with the researcher co-constructing knowledge, adapting perceptions, instruction and implementation during the mentor sessions.

This paper reports on the preliminary analysis of data collected from one of the teachers, referred to as Michael. The lesson selected for initial analysis was the second in a

series of six, drawing on an initial teacher interview, two videoed sections of the lesson and the associated web-log entry. Transcripts of each of these were manually analysed and open-coded during the first pass through of the collected data, with the purpose of detecting 'located themes' (Strauss & Corbin, 1990).

The following section describes the themes that emerged, presents some excerpts from the data to illustrate indicators of the themes, and relates the finding to other research.

Results and Discussion

Theme 1: Perception of Preparedness to Teach Early Number

Analysis of the following excerpts taken from the initial teacher interview involving the researcher and Michael, presently in his third year of teaching, revealed the emergence of two concepts. The following transcripts show firstly a self-perception or awareness of his preparedness for teaching early number and secondly his insight into his own teaching practice and knowledge.

Researcher: How prepared did you feel to begin teaching numeracy in your own classroom?

Michael: I felt prepared enough in *Count Me in Too* it gave me enough to work with within the concept of number sense anyway but in the same time it can be difficult to think of lessons in any other way. Standard whole class can be difficult. More challenging!

Many beginning teachers feel unprepared for the diversity within their classrooms, feeling a lack of sufficient background knowledge or expertise (Rohl & Greaves, 2005). Though Michael's teaching experience was relatively new he expressed that as a beginning teacher, although the professional development program (*Count Me In Too*) supported his teaching of number sense, he felt somewhat daunted by teaching outside the structures of the program, particularly within the diversity of whole class lessons. Michael stated he had no expectations of children's previous skills because he didn't know what to expect. He perceived that he had sufficient background knowledge within CMIT, which allowed him to teach one way and offered him the use of one strategy. He subsequently believed that this would enable him to gauge what the students could or couldn't do and he would "take it from there". One of the challenges for Michael was how to decide what other teaching strategies to use to empower whole class learning and to meet the diversities of his students motivational needs to continue their ongoing learning achievement.

Researcher: How do you feel now? Are you having to extend your own practice and knowledge to meet the needs of your class?

Michael: I feel better this year because it is Kindergarten and it is almost like starting from the start. I felt a bit in the unknown in Year 1 because I didn't know where they were coming from. At least within Kindergarten you didn't really know about their preschool. But at least you knew they were starting from the beginning. You know that they have to count from 0-20 and 0-30 by the end of the year etc....then at least you knew where exactly where to go....designing lessons for whole class outside CMIT is a little bit easier.

The learning and teaching of mathematics in early years creates the beginning of mathematical thinking that is content specific, relative, inclusive and empowering. (AAMT, 1997; NSW DET, 2006), and so requires specific teacher knowledge. However, pre-service teachers, according to Ryan & Healy (2008), frequently bring with them both problematic and unexamined assumptions about learners and teaching as they enter their beginning teacher roles. The second excerpt (above) indicated that, although by teaching Kindergarten Michael felt he had the chance to exercise a clearer insight into what children

bring with them to the classroom and where he needs to take them, he had little specific teacher knowledge of number sense as an emerging construct or of importance of the early mathematical capabilities of children entering Kindergarten.

Theme 2: Interpersonal Styles Used to Promote the Children's Motivation and Autonomy

The following extract is from a multiplication lesson with the focus on development of number sense. In this lesson students are being taught to group, share and count collections of objects and describe using everyday language. They are recording using informal methods and are engaged in whole class activity with their teacher at the beginning of the lesson prior to moving into groups and designated task tables. Six pretested children within this lesson have been highlighted as being 'at risk' in their number knowledge each gaining scores of 4/9 or below in Level 1 (5-6 years old) of the test.

The perceptions of both beginning and experienced practicing teachers often lack an understanding of what causes task engagement or disaffection as lessons develop. The impact of the quality of motivation within a mathematics classroom setting is commonly identified by how both teacher and students perceive success, interrelate and define the significance of a task or mathematics learning situation (Jang, 2008). The following lesson observation provided an example of how a teacher's interpersonal style acts on the motivation and achievement of the students.

As the class is sitting in a group on the floor in front of the teacher his tone of voice is quietly reassuring. The pace of the lesson is even and flowing and all the children are attentive and engaged.

Jack: I made a rocket!

Teacher: You made a rocket. How many groups was it made up of?

Jack: 12

Teacher: I think you mean 12 counters altogether. How many counters were in each group?

Jack: 4.

Michael begins to motivate the children by challenging them to remember how to make groups and by personalising his interaction with each one of the children as he questions and compliments each child as they respond. The children individually record on the board as a whole class activity.

Teacher: [explains to the class] Jack says he has 4 in each group. Jack, how many groups do you have? How many do you remember?

Jack: 3 groups of 4.

Teacher: Perfect answer. Well done for remembering.

Urduan & Schoenfelder (2006) noted in their findings that a child's motivation to be engaged or disaffected in a task is often dictated by the very social-contextual factors surrounding him or her within the classroom setting. The status of their interpersonal teacher-student relationship, Urduan & Schoenfelder (2006) stated, how the lesson activity or task has been structured and the degree of autonomy encouraged plays a huge motivational influence as to whether a child chooses to engage or be disaffected. Children also frequently measure the relevance of their achievement goals by how they view the ability of their classmates, their teacher's perception of their skills, competence and understanding during a learning task. As Michael ends his questioning by reassuring Jack that he has answered correctly and compliments him on remembering, he creates continued

engagement not only with the one child, but also the rest of the class. The children are all motivated, engaged and interactive with the teacher. A strong sense of wanting to succeed with their understanding and contribution to whole class task achievement is very evident.

As the same lesson continues, Michael uses his interpersonal dialogue to maintain motivation, student autonomy and goal-related behaviour with each child as they continue their group task-work. The teacher moves from group to group interacting with each child, allowing a sense of autonomy and showing his awareness of the continuing need to keep the classroom climate productive and students engaged. Research by Skinner, Furrer, Marchand and Kindermann (2008) indicates that students who are more engaged in a task or an activity of learning are most likely to receive stronger teacher involvement than disaffected or negatively engaged children. The lack of teacher attention can further disengage children who are finding the task difficult, boring or perceive it irrelevant. A variety of key teaching strategies are used by Michael to promote student autonomy and to maintain a flow of activities. A combination of direct instruction, peer assistance and teacher modelling helped to foster student motivation and engagement within the next two groups.

Teacher [group 1]: Put two counters on each leg [direct instructs] and I will be back. [Children begin to peer assist and interact with each other].

Teacher [group 2]: How many do you have in each group? [Teacher models and the child answers]. Well done! Now can you make me something different?

In the following excerpt Michael uses the strategies of modelling and scaffolding with the identified 'at risk' children who have been placed at a task table of their own. The teacher also endeavours to raise the level of challenge though some find it difficult to meet.

Theme 3: Catering for Student Comprehension Needs

Teacher [group 3 'at risk']: [Teacher models.] There are 5 animals in each group. How many altogether? This is a group of 5 isn't it? [Not all children in the group are motivated and are looking a little lost] [Teacher begins to scaffold.] How many each groups? How many are there altogether? Let's have a look together.....

When giving task directions, Michael is aware that these students are having difficulty and need extra effort to be motivated. However, he clearly states to the 'at risk' students exactly what the lesson tasks entails and promises to re-visit each child to see what they had done once he has interacted with them and moved on around the room. It appears that this not only provides support, but also communicates the teacher's perception of the need for student self-determination, autonomy, and the valuing of each individual's learning. Within the whole class setting, constant use of mathematical language as a literacy for mathematical achievement, by repeatedly stressing key words such as groups, share, fair share, equal share keeps the children engaged and also lends relatedness to the task consistently during the lesson.

A number of the students in Michael's class needed extra support in comprehending the tasks, including some with limited understanding of the English language as well as mathematics difficulty. Therefore the strategies used during the lesson supported these needs and served to keep the students engaged.

The final excerpt comes from Michael's web based log reflection of the lesson indicating Michael's perception of the value of reflection.

Thought this lesson was a great follow up as a continued lesson. Asking students to record on the board in the whole group activity gave all students something concrete to look at and understand. The decision to keep the lower group on the same activity from the last lesson was good. It allowed them to explore different amounts and gave me an opportunity for me to work with one student struggling. The higher group had some problems recording and were a little off task.

Michael recognised the importance of continuation and follow-up for student achievement. He had very little perception of who was exactly 'at risk' within their number sense skills in his class before the research pre-testing and had not grouped any of the highlighted children together previously. However, his reflection also indicated his awareness the diversity of his students needs and that the higher group also needed as much equal motivation to stay engaged and achieving as the other groups.

Conclusion

A child's development of number sense is a critical foundation for further mathematical learning, and so is the quality of the learning experiences in the first year of school. This paper explored one aspect of a recent research study investigating the impact of kindergarten teacher knowledge and practice on 'at risk' number sense learners. The focus of this paper was a teacher's perception and motivational styles and the contributions that both had on student engagement.

Three strong themes emerged from analysis of a lesson and of teacher reflection that appear to impact on the mathematical learning experiences provided for the children: the teacher's perception of his own preparedness to teach early number sense; the use of particular interpersonal interaction strategies to promote motivation and autonomy; and the specific strategies of direct instruction, modelling and scaffolding to cater for the comprehension needs of 'at risk' students.

These findings are of course limited by the small data sample and present only a picture of *what* is happening in one lesson, not *how* or *why* it is happening. While these finding are consistent with recent research (e.g., Hadré & Sullivan, 2008; Ryan & Healy, 2008; Roth et al., 2007), the significance of the identification of the three themes lies in their potential to contribute to the deeper analysis of this teacher's subsequent lessons as he progresses through the mentoring sessions and increases his pedagogical content knowledge. Of further interest will be the comparison of the key themes that emerge from the analysis of data from the other two teachers in the larger study. The notions of teacher perception, motivational styles and strategies for supporting 'at risk' students are potentially critical factors in better understanding the development of quality mathematics teaching.

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