

**“The Early Numeracy Project: A study of teacher
change”**

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Research Project Report submitted in partial fulfilment
of the requirements
of the degree of Master of Teaching and Learning

Christchurch College of Education

April 2003

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Abstract:

The purpose of this study is to examine the changes that occurred in teachers' thinking and practice as a result of taking part in the Early Numeracy Project (ENP). The study took place in the Junior department of a high decile primary school in the South Island. Data was collected using the following methods:

- Three in-depth interviews with four teachers taking part in the ENP
- Field notes gathered from cluster workshops and syndicate meetings

The four participating teachers in this study agreed that the ENP brought about significant changes in the way they thought about and conducted their mathematics teaching. Their increasing confidence and enthusiasm was fuelled by the commitment and interest of the children in their class. The challenges and demands of the project were balanced by the knowledge that their children were taking an active and imaginative part in learning mathematics. Children were succeeding in an area often problematic for teachers.

In what ways did the ENP change what teachers did in the classroom? What were the key factors that brought about these changes? What difficulties were encountered? This study describes the teachers' experiences on the ENP, traces significant parts of their journeys and gives a voice to their thoughts and feelings along the way.

Introduction:

The development of the ENP (Early Numeracy Project) was preceded by a decade of controversy concerning the mathematical skills and abilities of New Zealand students. In 1998 the New Zealand government announced a national goal for literacy and numeracy stating that by 2005 every child turning nine would be able to read, write and do maths for success.

The initiative for this national strategy announcement came in 1994 from the Third International Mathematics and Science Study (TIMSS). This showed that levels of achievement in mathematics of 9 and 11 year olds were lower than in most of the other western countries surveyed. In particular, the TIMSS report gave rise to questions about the quality of teaching of mathematics at the primary level in relation to teachers' confidence and personal knowledge. At the same time primary teachers were reported as having difficulties implementing the new mathematics curriculum, Mathematics in the New Zealand Curriculum (Ministry of Education, 1992). As a result, the Minister of Education established the Mathematics and Science Taskforce in August 1997.

The Mathematics and Science taskforce was charged with identifying issues and priorities arising out of the TIMSS report. The immediate priorities identified were closely associated with pedagogy and teacher knowledge (Ministry of Education, 1997). Teachers needed support in their mathematics teaching and as a result, a number of new resources were initiated and made available to schools from 1998. These included a video package, a publication focusing on mathematics, science and technology, assessment materials including the online Assessment Resource Banks (ARB's), a website based on the mathematics curriculum (the New Zealand Mathematics Website: <http://www.nzmaths.co.nz/>), and the Year Three Mathematics Contract, a professional development programme for teachers of Year Three children (Chamberlain, 2001).

Prior to the development of the Year Three Contract, mathematics in Years 1-3 had undergone considerable change in a short space of time. In 1986 the innovative thinking behind The Beginning School Mathematics programme (BSM), a resource supplied to all schools by the Ministry of Education, provided teachers with a structured, activity-based programme. With the advent of the new mathematics curriculum in 1992, many schools reorganised their BSM resources under the strands of the document and began using the curriculum document as their key planning

resource. There was to be a greater focus on problem solving strategies and the development of mathematical process skills as well as an increased emphasis on the detailed recording of children's progress. Garden (1997) noted that this change to an outcomes-based curriculum led teachers to make significant changes to their teaching and assessment methods.

The Year Three Mathematics Contract was designed to assist Junior School teachers in reviewing their current practice and resources (Higgins, 2001a). It used methods based on the Mathematics Recovery and Count Me In Too (CMIT) projects originating in New South Wales (Thomas and Ward, 2001; Wright, 2000). Using Mathematics Recovery theory and techniques, CMIT had become a major school-based professional development project aimed at improving the numeracy skills of children in the first three years of school. From its first trials as the Count Me In (CMI) project in 1996, the project sought to develop teachers' ability to better understand children's mathematical strategies and stages of development. Underpinning CMI and CMIT was the Learning Framework in Number (later, in New Zealand, called the Learning Framework for Number), developed by Dr Bob Wright.

Vince Wright and Peter Hughes used the ideas from CMIT in their work with facilitators and mathematics advisers on the Year Three Mathematics Contract. Teachers were so enthusiastic that by the end of 1999 facilitator-training programmes for CMIT were in place and in 2000, nationwide pilot projects were implemented in New Zealand (Thomas and Ward, 2001). These initiatives formed the background to a 5-year professional development project funded in New Zealand by the Ministry of Education. Based on the Learning Framework for Number, this project became known as the Early Numeracy Project (ENP), for Years 1-3, and led on to the Advanced Numeracy Project (ANP), for Years 4-6. These projects, focusing on the teaching and learning of numeracy concepts, were introduced throughout New Zealand in 2002.

The ENP was supported by the Ministry of Education and consisted of six months of school-based professional development. Professional development has long been thought of as essential in bringing about change in teachers' practice. Garden (1997), in claiming that the most direct influence on student achievement in mathematics was the teacher, explained how teachers interpret, translate and implement the intentions of curriculum according to their own experiences and beliefs. Bobis (2000) also claimed that the professional development of teachers is critical to the advancement of educational effectiveness. Poskitt (2001) listed five critical factors or phases for

successful school-based professional development, including the need to create the feeling of ownership on the part of the teachers taking part, by selecting a project relevant to their needs. Poskitt emphasised the practical implementation of professional development and the need for professional development to be thoroughly planned. Poskitt noted that the key factors in this area were:

- Ensuring that workloads were reasonable, especially for those with the added responsibility of leading the project
- Having available adequate teacher release time to account for any periods of difficulty
- Providing support staff for administrative tasks
- Allowing the project to take precedence over competing school demands
- Avoiding overload but keeping relevant people informed

Many other writers agree that what a teacher knows strongly influences what happens in classrooms and what students learn (Bell and Gilbert, 1996; Day, 1999; Fennema and Franke, 1992; Thomas and Ward, 2001). The nature of teaching requires that teachers engage in ongoing professional development, continuing to develop their own knowledge about teaching and learning.

The main purpose of the professional development offered by the ENP was to improve teachers' understanding of the development of children's mathematical thinking. Fennema and Franke (1992) found that teachers' beliefs and practices could be fundamentally changed through this increased understanding of how children learn mathematics. The Effective Teachers of Numeracy project in the United Kingdom (Askew, Brown, Rhodes, Wiliam and Johnson, 1997) showed that the beliefs of teachers were significant not only in terms of what teachers did in the classroom, but also in terms of what children learned. In this study, an effective teacher of numeracy was defined as having:

- a positive attitude towards mathematics;
- a coherent set of beliefs that underpin certain classroom practices; and
- a well developed understanding of the interconnectedness of numeracy.

Moreover, it was found that the amount of continuing professional development in mathematics education undertaken by the teacher was a key indicator of effective teaching of numeracy (Askew et al., 1997).

In Australia, in her evaluation of Count Me In, Bobis (1996) focused on teacher change brought about by that professional development. Using questionnaires and interviews she concluded that, as a result of the project, teachers had changed their classroom practice and, in addition, had enhanced their own knowledge of mathematical content, teaching strategies and how children learn mathematics. Specifically, teachers said that they asked more challenging questions of their children and encouraged them to explore, discuss and reflect on their work.

This idea that teachers' knowledge of subject matter is a critical factor in the teaching of mathematics forms a common thread through recent research. A number of writers caution against assuming that teachers begin with some expertise in the content they teach. This is particularly the case with mathematics where studies have shown that many teachers do not have an adequate content knowledge (Askew et al., 1997; Bobis, 1996 & 1999; Garden, 1997; Shulman, 1986). Garden (1997) in the Third International Mathematics and Science Study report concluded that primary teachers who lack confidence because of lack of subject matter content knowledge generally have poor attitudes to the subject and may even avoid teaching the subject. Furthermore, this lack of knowledge and confidence may preclude the teacher from understanding why something taught in the early years is important for later development.

Shulman (1986) asked questions about the sources of teacher knowledge, what a teacher knows and how new knowledge is acquired and processed. Closely related to subject matter content knowledge is what Shulman called pedagogical content knowledge. This goes beyond knowledge of subject matter to include the dimension of subject matter knowledge for teaching. Shulman explained pedagogical content knowledge as an "understanding of what makes the learning of specific topics easy or difficult" (p.9), a key aspect of which is the teacher's knowledge of the difficulties and misconceptions brought to the learning by the student. In his extended analysis of the domains of teachers' subject knowledge he identified teachers' pedagogical content knowledge as being a critical factor in the teaching and learning relationship. This type of knowledge included the topics most commonly taught in a subject, the most compelling ways to represent them to children and the illustrations, examples and explanations most likely to support learning.

Aubrey (1997) confirmed Shulman's view and with reference to mathematics, claimed that pedagogical content knowledge enabled teachers to represent key ideas in a variety of ways by using demonstrations, examples and metaphors to convey meaning. Pedagogical content knowledge also required appreciation of children's existing knowledge as well as their common errors and misunderstandings. An investigation by Anders (1995) into teachers' classroom knowledge highlighted the link between curriculum and pedagogy and the importance of teachers' pedagogical content knowledge in improving outcomes for students. Higgins (1999) acknowledged that for teachers the interaction between knowledge about content and knowledge about teaching is complex. But what seems to be unquestioned is the importance of both to the teaching and learning of mathematics.

A further critical factor in teacher change, is the role of the facilitator within professional development programmes. Higgins (2002) traced changes in the role of the facilitator from the professional development of the 1990's, when the New Zealand curriculum was introduced, to the present. This has been largely a move from a generic definition of facilitation to a subject-specific definition. The facilitator's role has changed from one of managing a group of teachers carrying out examples of student activities, to one that emphasizes the development of understanding of the complex subject matter underlying those activities. Poskitt (2001) and Parsons (2001) have both recognized the changing role of the facilitator. In addition to providing teachers with subject matter knowledge, provision of what Poskitt calls "supportive people structures" (p.5) are crucial to helping teachers initiate and sustain change during professional development programmes.

Higgins (2001b) and Thomas, Ward and Tagg (2002), identified the facilitator of the ENP as a key person in the professional development process. Higgins claimed that teachers' knowledge develops in context and is likely to increase when the facilitator works with the teacher in the context of their classroom. School policies, school structures and student backgrounds as well as the teacher's own knowledge are significant aspects of the teacher's context of practice. Fennema and Franke's (1992) model of the context-specific nature of teacher knowledge highlighted the interactive and dynamic nature of teacher knowledge. Higgins in adapting this model, elaborated on the multiple layers of context within which a facilitator works with teachers and schools. The ability of the facilitator to incorporate compelling reasons for change into the teacher's context of practice is a key factor in changing teachers' thinking and practice in mathematics.

During my own career I have been able to view teacher change and professional development in mathematics through two lenses: first as a classroom teacher and later as a contract facilitator. After a number of years as a classroom teacher, I was employed by the Christchurch College of Education as a facilitator during the implementation of the curriculum document, Mathematics in the New Zealand Curriculum (Ministry of Education, 1992). Most teachers would agree that this was a difficult time for teachers of mathematics. Lovett (2001), in her study of schools as learning organisations for teachers, stated that in recent years teachers have faced unrealistic demands in terms of new learning in curriculum and assessment. With regard to the new mathematics curriculum, it is my opinion that with limited resources available for teacher development and a tight schedule of new curriculum documents to maintain, many teachers received inadequate professional development in both the intent and content of the document.

With each new curriculum document the demands on teacher time and personal knowledge have increased. In my experience of staff room debates and discussions, teachers have been seeking guidance and support in all areas, particularly in mathematics. From the beginning, the concerns of primary teachers centred on the number of strands to be covered, and the apparent lessening of emphasis on the teaching of basic number concepts. Teachers also commented on the number of children who appeared to lack confidence in their mathematical ability and rarely enjoyed their mathematical experiences. It is my perception that teachers were hopeful that the professional development offered by the ENP would be a way forward that would free them from some of the constraints of the new curriculum and would inform their classroom practice in a relevant and meaningful way.

Research questions:

The Early Numeracy Project (ENP) has been progressively introduced into New Zealand schools since 2001. The aim of the professional development offered through the ENP is to develop teachers' knowledge of number concepts, instructional practices and children's number strategies. A series of comprehensive stages in children's mathematical thinking, the Learning Framework for Number, is central to the project. This consists of two sections: strategy and knowledge. The strategy section is about the mental processes children use to solve number problems, while the knowledge section considers the key items of knowledge children need to acquire (Ministry of Education, 2002b; 2002d). By focusing on pedagogical knowledge, and through the work of the

facilitator within the teachers' classroom contexts, the ENP aims to change teachers' thinking and practice and improve outcomes for students.

The intention of this research was to examine how the teachers engaged with the professional development of the ENP and how their experiences changed their mathematical thinking and practice. In order to highlight and understand the changes which occurred, it was necessary to consider each teacher's personal experiences. This study tracked the process of the professional development in one school through the eyes of four of the teachers taking part in the ENP.

The key research question for this study was:

- How has the ENP changed what teachers do?

And the sub-questions were:

- What changes have occurred in mathematical thinking and practice at personal and classroom levels?
- What were the key factors that brought about these changes?

These questions will focus the study on the substance and process of teacher change within the ENP. Comments by teachers will offer insights into their personal viewpoints and possible explanations will be offered as to the nature and circumstances of the changes that occurred.

Methodology:

In order to find out teachers' perceptions of the impact of the ENP on their mathematical thinking and practice, it was necessary to provide them with opportunities to talk about their experiences. This study used interviews with four teachers to gather data at three strategic times during the project. (For time of interviews, see Appendix 1: Overview and timeline of the ENP).

The interviews followed what Burns (1997) called a semi-structured format allowing the teachers to reflect, elaborate and question whenever they felt the need. Conducted individually the interviews enabled each teacher to share their personal feelings without being influenced by others. A similar method was used successfully in the Evaluation of the Year 4-6 Numeracy Exploratory Study (Higgins, 2001a) and in the Evaluation of the Count Me in Too Pilot Project (Thomas and Ward, 2001).

In the context of this study, this method of data collection had a number of advantages. Interviews were selected as the main method of data collection to ensure that the participants' perspectives would be captured and their voices clearly heard. As a colleague of the participants I felt that there was a high degree of trust already established and I was able to ask open-ended questions and probe frequently. There were four main questions in each interview and these were provided to the teachers prior to each interview. (Appendix 2: Interview questions). Each interview was, as similarly described by Neuman (1997), interspersed with asides, stories, diversions and anecdotes, which were recorded. (Appendix 3: Sample transcription). The participants and I jointly controlled the pace and direction of the interviews. The four questions of each interview also gave direction to the interviews and were used to focus the crucial issues of the study.

A disadvantage of using semi-structured interviews is that responses may be so diverse that it is difficult to extract categories and themes. In this study, however, there was a high level of agreement among the participants' statements. Another disadvantage of this method of data collection noted by Bogdan and Biklen (1992) is that by using questions in a semi-structured format, a researcher loses the opportunity to understand how the subjects themselves might structure the topic. However, in the context of this study and given my close association with the participants, I felt that the advantages of using a semi-structured interview technique outweighed

the disadvantages. By providing some guidance and being open about the focus of the study, I felt that the participants would be at ease and able to talk freely about their experiences.

Another method of data collection was field notes. These were a minor part of the overall data collection and took the form of what Neuman (1997) calls jotted notes. Written in the field as short, temporary triggers such as words, phrases, or drawings these were collected as part of my attendance at ENP workshops and syndicate meetings. These notes were used as reminders of the discussions that occurred at the meetings.

Throughout the study I was aware of the dilemma posed by my collegial relationship with the participants. It was always possible that this close relationship would colour their responses. However, the school's decision to take part in the ENP had resulted from consultation and discussion with all the staff. I felt that this indicated a high level of support for the project and overcame any difficulties that may have arisen had the decision not been widely accepted.

The four teachers selected to take part in this study taught in a Junior School syndicate of six teachers. They were chosen because of the diversity of their teaching experience and because the ENP was new to all of them. Rachel and Joanne were experienced Junior School teachers with more than fifteen years of service each. Kate and Sara had approximately seven years of service each and were relatively new to the Junior School. Included in this study were two Year 1 classes, a Year 2-3 class and a Year 3 class.

Following the selection of the teachers, explanatory letters were sent to, and informed, written consent was obtained from the following people:

- The Principal of the school
- The chairperson of the Board of Trustees
- The four classroom teachers
- The syndicate leader of the Junior School
- The district facilitator of the ENP (Appendix 4: Sample letters)

Because each of these people had responsibilities to either the school or the ENP, it was crucial to the success of the study and the safety of the participants that they be fully consulted and informed

about the investigation. The anonymity of the four teachers was ensured by the use of pseudonyms and the school was not identified.

The three interviews that formed the major data collection method occurred at the following stages:

1. Following the first two workshops and the assessment and grouping of children, but before the 15 weeks of teaching time and the first facilitator visit to classrooms.
2. Following five weeks of teaching and after the first facilitator visit to classrooms.
3. Following a further five weeks of teaching and after the second facilitator visit to classrooms.

These times were chosen for the interviews because each followed a significant part of the professional development of the ENP. Each interview followed a similar format and was conducted after school in each teacher's classroom. The interviews were tape recorded using a microcassette notetaker and later fully transcribed for coding and categorization.

Background to the investigation:

The school is situated on the outskirts of a large town and has extensive playing fields with clear views of the rural hinterland. It is well resourced and has a supportive and forward-thinking Board of Trustees. At the time of this study the school had approximately 400 children, in 15 classrooms, from Year 1-8.

Junior School classrooms are situated together. Sliding doors provide ready access from one class to another allowing for easy movement between classes. Classes are organised into six family groups of Year 1-3 children. The staff operates as a team, sharing ideas and giving support. For mathematics, classes are usually regrouped into straight year groups. For the ENP, Junior School children were regrouped again according to the information gained from the diagnostic interviews.

The ENP took place from March to the end of August, 2002. The professional development model used by the project consisted of a combination of whole and half day workshops, after school cluster meetings and class visits by a facilitator. The facilitator conducted the workshops and

cluster meetings and provided leadership and support for teachers during class visits. (Appendix 1: Overview and timeline of the ENP).

During the second workshop, the facilitator worked with teachers to develop an understanding of the diagnostic interview. On the basis of information gained from the diagnostic interview, children were grouped for instruction. Over a period of 15 weeks the teachers taught numeracy, based on the guidelines set by the professional development programme. During this time the facilitator made class visits and demonstrated ways of teaching different concepts.

Results:

The interviews were fully transcribed, providing transcript data. Specific themes were identified within the data. These themes recurred during the three interviews. They provided categories that were coded and grouped according to how they related to the research questions.

An analysis of the data from the interviews identified the following six key themes relating to the ENP and its influence on teacher change:

- the diagnostic interview
- grouping for instruction
- use of equipment
- implementation in classrooms
- increasing teacher knowledge
- teacher support

Significant data relating to each theme will be described with extracts from the transcripts included to illustrate the data.

- *The diagnostic interview:*

The diagnostic interview from the ENP was a tool designed to give teachers information about the knowledge and mental strategies of the children they worked with (Ministry of Education, 2002c). All of the teachers spoke about how the children's diagnostic interview provided them with increasing understanding of the mathematical knowledge and strategies used by their children. The detailed results from the interview were seen as being useful and new and not previously available to the teachers. Rachel's words summarised the comments of the other three teachers:

You have a test and the time to assess a child individually, which you never did really in maths before now....it gives you a better tool if you want to group your kids this way – a much, much better tool; you've got a lot more evidence rather than, probably, instinct.

Rachel, First Interview

Even as experienced teachers, Rachel and Joanne found that the diagnostic interview offered them new insights into what their children knew in mathematics. Joanne became aware of the progressive nature of the Number Framework and the need to identify and resolve gaps in knowledge before expecting a child to successfully move on. Rachel endorsed this and expressed her delight at being able to gather accurate evidence on which to base teaching decisions about her children.

In spite of these positive responses, teachers found that conducting the interviews was time consuming and disruptive. The process and content of the diagnostic interview was new to the teachers. The diagnostic interviews required teachers to be knowledgeable about the significance of each child's responses in relation to the stages of the Number Framework. Teachers were out of their classrooms for at least a day and a half conducting the one on one interview. Rachel said:

No one was slacking around - we had it down to a fine art, we were zooming. It wasn't as if people were wasting time or anything...One week my poor children didn't know who their classroom teacher was - I was in and out. We had to do it in bits and stages.

Rachel, First Interview

Although the administration of the diagnostic interview had been pressured and had taken more time than expected, all teachers spoke of the interview as a critical factor in changing their practice. Their comments reflected their realization that the diagnostic interview provided valuable information about children's knowledge about numeracy and the mental strategies they used when working out mathematical problems. As we will see in the following section, this information became a critical factor in the subsequent grouping and planning stages of the professional development.

- *Grouping for instruction:*

As a consequence of the diagnostic interview, the teachers placed children in instructional groups on the basis of their assigned strategy stages. A key part of the professional development programme was the expectation that children be taught at these stages.

The individual assessment of children was a key part of the ENP. It enabled teachers to group their class into levels according to the children's strategy levels as defined by the Number Framework.

Teachers commented that the diagnostic interview gave accurate information about important gaps in children's knowledge. Teaching became focused on the specific needs of the children.

The theme of grouping highlighted a number of issues for teachers.

These were:

- the change from whole class to group teaching
- the increased time required for preparation for teaching
- the difficulty of operating a number of groups simultaneously
- grouping the children correctly

All four teachers made the change from whole class teaching to group teaching. For each teacher this was a major shift. When asked what she was doing differently now as a result of the professional development offered by the ENP, Rachel echoed all the teachers when she said:

Consistent group teaching, whereas before it was every now and then when I could get organised for it...so it's consistent five days a week.

Rachel, Second Interview

Sara commented on the extent of the change she made from whole class teaching to teaching in groups:

It's completely different to the way I used to teach. I did mainly whole class lessons...but now I teach in small groups and it's needs based and is more like precision teaching.

Sara, Third Interview

However, the information gathered from the diagnostic interview did not always fit with the teachers' own knowledge of the children. Being confident about correct grouping of children was particularly difficult for the teachers of the Year 1 classes. Teachers commented on the speed at which the new entrants changed and progressed and the problems associated with deciding when a child should advance to another group. The other teachers agreed that grouping was not always a clear-cut decision. Sara said:

I sometimes question whether the children are working at the correct stages. I think 'you're too good for this', but I'm not sure whether I should move them or not.

Sara, Third Interview

An analysis of the statements about grouping indicates that teaching in instructional groups was a critical change for the teachers. They had welcomed the increased knowledge about their children gained from the diagnostic interview and had used it to respond to the learning needs of their children. However, they had not anticipated the increased workload associated with teaching in groups. The amount of reading required for lesson preparation was mentioned by all teachers. The draft materials from the Ministry of Education, in the form of booklets, detailed activities and examples to be covered at each strategy and knowledge stage (Ministry of Education, 2002e; 2002f; 2002g). Much of this was new to the teachers. Because they were planning for anything up to four groups, the teachers needed to spend more time than usual reading the material in preparation for each lesson. All the teachers expressed their concern about this, as Sara explained:

I'm finding it quite a lot to organise. In the morning I probably spend most of my time before school organising maths. I'm seeing two groups each day... and to be organised for those two groups with the equipment and having read what I'm to do in the numeracy book is quite a lot before school.

Sara, Second Interview

Associated with this was the need to operate approximately three groups at a time during every lesson. While one group worked with the teacher, the others worked at independent games and activities designed to reinforce concepts already taught. An increased level of independence was expected from children working away from the eye of the teacher. The teachers noted that extra time was spent keeping some children on task:

Some of them are getting really good at working by themselves...whereas others are at the other end of the scale and they need constant reminding of what they're doing...so even though you're working with your group, you've still got to have your eyes out to the side.

Joanne, Second Interview

Two teachers had classes of new entrants. The dependence of these very young children meant that the teachers spent a lot of time on procedural and organisational aspects of their lessons. Joanne noted that the expectation that Year 1 children work in groups created an added layer of difficulty. Kate explained how she hoped to develop the ability of her Year 1 class to work independently:

This week and the next couple of weeks I am just introducing activities each day and giving the children a chance to work on them independently...just trying to make them more

independent than they have been.

Kate, First Interview

Despite the difficulties of teaching in groups the teachers recognized that their children were benefitting from the changes they had made to the organisation of their mathematics lessons. Group teaching enabled the teachers to address areas of need identified by the diagnostic interview. Although the teachers were stretched in planning and organising groups for instruction, they acknowledged the value of the changes they had made. In particular, they noticed that the children were enjoying success and were increasingly eager and enthusiastic about mathematics.

- *Use of equipment:*

The ENP used a variety of equipment to develop new mathematical concepts. Most of this equipment had been hand made by the teachers in the syndicate. A small amount was commercially produced equipment purchased by the school especially for the ENP.

In each of the three interviews the teachers frequently referred to the equipment they were using in their daily mathematics programmes. They used a wide variety of equipment with the whole class to introduce or reinforce concepts at the beginning of each lesson. It was also used with groups and individuals at later stages of the lessons. Their comments indicated renewed enthusiasm and understanding of the place of equipment in mathematics lessons. Sara commented:

I have just realized how important equipment is at all stages...and we've now been taught to use things better and more effectively.

Sara, First Interview

As they spoke about integrating equipment into their lessons, the teachers identified four main aspects of equipment use:

- They were using equipment more often
- They were using a wider range of equipment
- They felt that through using equipment they were learning new ways to teach some mathematical concepts

- They felt that equipment was particularly appropriate for those children who responded well to a hands-on approach

All the teachers commented on their use of equipment and the variety it added to their lessons.

Joanne said:

It's amazing what you can do with blocks and ice cream sticks when you really need to, and digit cards and things like that. I've got heaps of variation in my teaching approaches now.

Joanne, Third Interview

As well as equipment, games were becoming an important part of Kate's and Sara's lessons. They spoke about how they used specific games as teaching tools to reinforce concepts, rather than as 'fillers' as they had in the past. Their comments reflected their growing confidence:

The ENP has given me many more games and activities and things that reinforce the concepts that we're trying to work on.

Kate, Second Interview

I now teach maths games...whereas before you always felt like it was something you did at the end or on a Friday, but now we realize that it is a successful, effective way of learning.

Sara, Second Interview

Three teachers commented on how well the children responded to working with equipment. This particularly suited those learners who enjoyed hands-on activities. Many were boys who, the teachers noted, had difficulty with the reading and writing component of mathematics before the introduction of the ENP.

One of the boys who was used to doing things with his hands certainly didn't want to do anything else...he's been able to hold things in his hands, join equipment together, make sets and play games...he's learning as far as I'm concerned.

Joanne, Third Interview

In each interview, all the teachers spoke enthusiastically about the positive response shown by the children. They were actively engaged in the activities. For all of the teachers this was an exciting and motivating experience:

They have a smile on their face when we're doing things...they're getting into it, they're

learning the routines quite quickly.

Kate, Second Interview

They are really eager. They just love maths and are enthusiastic about doing things and having a go and trying new things and challenges.

Rachel, First Interview

The teachers' statements indicated that the use of equipment and games added interest and variety to class programmes. They felt that the use of equipment gave them a wider range of teaching strategies and helped them to cater for specific learning needs.

- *Implementation in classrooms:*

A critical factor in the implementation of the ENP in this school, was funding. Being a high decile school meant that this school was ineligible for extra funding to support the project. The Ministry of Education did not meet the full cost of the project and therefore the school had to divert money from other areas to pay for resources, equipment and teacher release. Teachers spoke about the increased pressure they felt as a result of what they saw as underfunding. Extra funding for teacher release time was required so that teachers could complete the diagnostic interviews. The support of the Principal and the Board of Trustees in assigning extra funds to the project was acknowledged:

It's been a wee bit of a struggle at times. The Principal has been great. He's always said, look that's not going to work, I'll provide a reliever...

Joanne, Third Interview

Joanne summed up the general feeling of the other teachers when she said:

... if there was plenty of money and we could get the relievers for the testing, do it properly, get the relievers for the day the facilitator came - that kind of thing. It would be great.

Joanne, Third Interview

Moreover, the teachers found that without adequate funding they had to use their personal time, in holidays and after school, to make resources and equipment. Although they stated that they accepted there was no alternative, there were clear indications from the interviews that this aspect of the project added to the overall demands of the ENP.

- *Increasing teacher knowledge:*

In each interview the teachers spoke about how the ENP had changed how they taught mathematics. Teachers' own knowledge of mathematics concepts and pedagogy increased. Their understanding and acceptance of the importance of strategies in the teaching and learning of mathematics was a critical factor in the development of their own knowledge. This emphasis on teaching strategies for calculation was new for the teachers. In addition, more time was given over to questioning the children about strategies they used for working out problems. The children were encouraged to explain the different strategies they used to reach a solution. Sara commented:

Children use a real variety of strategies...No one way is the right way to do things. We never used to think about the ways that they got the answer very much.

Sara, Third Interview

Discussing strategies and ideas with a group was seen by the teachers as time well spent. Their own growing appreciation of the importance of number in the development of mathematical concepts was emphasized. The structure of the Number Framework was specifically mentioned as providing crucial guidance and knowledge for teachers. Joanne's and Kate's comments were typical:

It's made me realize just how important number is and I think we have done it a bit of a disservice in the past...we didn't ever do it as well as I think we should now.

Joanne, Third Interview

Having something so structured...for me, where I was coming from, it was exactly what I needed... I think the confidence that I've gained in taking maths is the big thing.

Kate, Third Interview

The structure of the Number Framework, the teachers' increasing understanding and knowledge of the strategy stages and the change in the use and type of equipment discussed earlier, injected new life into mathematics lessons. Worksheets were replaced by a variety of hands-on activities as teachers adopted new ways of teaching. Although three of the teachers felt they still had much to learn, all expressed the view that they were increasingly confident and satisfied with the changes they had made.

- *Teacher support:*

All four teachers commented favourably on the support offered by the professional development programme. This support came from the following sources:

- The facilitator
- The coordinator in the school
- Other teachers on the project

The role of the facilitator was varied. She conducted the workshops and observed individual teachers taking lessons in class. She was seen by the teachers as a mentor able to answer questions, demonstrate pedagogy and advise about resources and class programmes. Her accessibility was an important factor in her effectiveness. Joanne reflected on the value of the visits by the facilitator:

Facilitator visits have been excellent. She gives you lots of ideas on how to use the equipment... Questions crop up or maybe there might be a need that a child has that the facilitator can help with.

Joanne, Third Interview

Teachers commented frequently on the value of the classroom visits. Being able to see another teacher teaching was a significant experience for all the teachers. Specifically, the facilitator modelled classroom instruction. This had a positive impact on the teachers. The facilitator had skills that the teachers felt they did not have at that point. She was able to work with the children and teachers in specific situations building on and supporting the teachers' knowledge. Joanne and Kate explained:

It was good to see her working with some of the equipment that I see mentioned in the book... watching her use it and how she used it, the questioning that went along with it, and the opportunity to ask her questions about things.

Kate, Second Interview

Joanne, an experienced teacher admired the way the facilitator handled her class. She was able to learn from the visit:

I found it really useful to see the different way that she was managing the children. Just the way she spoke to them and used a basic piece of equipment in a different way. I haven't seen that way before and it opened up a whole new lot of possibilities.

Joanne, Second Interview

The interaction among the teachers on the ENP was supportive and continuous. All teachers remarked on the value of the incidental, ongoing support they gave and received from each other. The teachers shared their experiences before and after school, at lunchtimes and in syndicate meetings. This support usually involved teachers talking together about specific problems and sharing ideas and anecdotes about what they were doing. Kate illustrated the importance of this support:

A crucial part of some of the success of the programme for me is that so many of us are doing it at the same time so you can share problems. I think you definitely need the support of the syndicate.

Kate, Third Interview

The critical factor enabling this support to develop was that all the teachers in the Junior School syndicate were part of the professional development. The particular professional development model used ensured that all teachers were working together and simultaneously making the same changes to their mathematics programmes.

The ENP coordinator within the school was one of the four teachers interviewed. She provided on-the-spot help and advice for the teachers. As well as implementing the ENP in her classroom, she was responsible for ordering resources and liaising with other teachers, the Principal and the Board of Trustees. The teachers found her approachable and supportive. She was available to discuss any difficulties they were experiencing. The coordinator explained her approach in this way:

Sometimes it's been a bit hard when other teachers get stressed out and voice their concerns and so on, but I think if you try and keep a lid on that and just say do the best that you can do and that's fine...

Joanne, First Interview

The teachers viewed the coordinator as a key person to whom to turn for advice and support. Having a leader in the school who was well organised and willing to go the extra mile to find out the answers to their questions was appreciated. She also acted as a link between the facilitator and

the teachers. The facilitator frequently used her to pass on information to the teachers. Sara summed up the general feeling:

The coordinator is really organised. That's one of the key things and she'll communicate to us whatever the facilitator has told her after our workshops in a very low key, don't stress out about it way. She's a really good communicator and organiser without making us feel pressured.

Sara, Third Interview

A key factor in managing the changes was the support teachers received from each other and from key personnel in the project. In particular, the teachers agreed that the facilitator was a critical factor in their own development. All the teachers expressed their approval of the way in which the professional development programme was geared towards providing this support.

The six themes discussed above which emerged from this research, focused on the changes teachers made in their mathematics teaching and on the factors that supported those changes. These factors were the way the teachers assessed and grouped their children as a result of the diagnostic interview; how they used equipment in their lessons in new and dynamic ways; and how, with the support of each other and the facilitator, their own knowledge increased.

Discussion:

Throughout the research process I was in close contact with the teachers. As part of the staff I was familiar with the organisation of the school and saw at first hand the impact that the ENP had on the teachers and their class programmes. Knowing the teachers well and being part of the informal day-to-day discussions meant that I had a feel for the project that I might not have had if I had been an outsider. Moreover, I was able to carry out the interviews at a time that was convenient for the teachers, changing the day to avoid busy times and school-wide activities.

In addition, by attending all the ENP workshops and some syndicate meetings, I was able to examine the professional development process at first hand. An advantage of this was that I could relate what teachers said in the interviews to what had been said in the workshops. I was able to view the professional development process at the beginning when teachers received the information and later after they had put the ideas into practice in their mathematics lessons in their classrooms.

This study followed four teachers through the implementation of the ENP in one school, examining the impact of the project on their thinking and practice. The data suggested that the ENP experience was a strong catalyst for change for all the teachers. Common themes emerged about the kinds of changes that occurred and the factors that influenced those changes. The themes may be broadly viewed as being concerned with the assessment and grouping of children, the use of equipment in mathematics lessons, increasing teacher knowledge and confidence and the support offered by the facilitators and fellow teachers. However, funding of teacher release time to carry out the diagnostic interview, attend meetings and make essential equipment, was considered by the teachers to be inadequate. This added extra pressure to teachers.

The key changes that occurred in the teachers' thinking and practice were related to their pedagogical content knowledge. Bobis (1999), Higgins (2001b) and Shulman (1986) are some of the many writers who have cited pedagogical content knowledge as a critical factor in the teaching of mathematics. A key influence on the teachers' pedagogical content knowledge in this study was the Number Framework. The Number Framework, consisting of the two sections of strategy and knowledge, describes the mental processes children use to work out answers and the key knowledge that children need to learn (Ministry of Education, 2002b; 2002d). The strategy stages as set out in the Number Framework were new to the teachers. They recognised that they had previously

focused on the knowledge section of mathematics to the exclusion of the strategy section. This emphasis on strategies and the drive to involve children in explaining their mental processes was remarked upon by the teachers in this study as being of the utmost importance to their own understanding of number concepts and the teaching of numeracy. The Number Framework, underpinning the ENP, provided teachers with essential knowledge about children's thinking in number that they had not had previously. This was a major change for the teachers. As their pedagogical content knowledge increased, they were able to confidently change what they taught and how they organised their mathematics lessons.

Although the teachers did not speak of the changes in the terms outlined above, they were demonstrated in the practical changes they made in their classrooms. The shift in emphasis to mental strategies meant that teachers changed how they organised and taught their mathematics classes. The teachers' changed their method of instruction from whole-class teaching to teaching in groups. Following the diagnostic interview the teachers were able to group their children according to the strategy stages of the Number Framework and focus their teaching on the identified needs of their children. The diagnostic interview provided detailed information about children's thinking that teachers had not had before the ENP.

In turn, the children were enthusiastic and engaged in their mathematics learning. The teachers encouraged children to explain their methods of calculation and the group work provided opportunities for teachers and children to discuss and talk about different strategies that could be used in solving number problems. The teachers felt overwhelmingly that group work enabled them to focus on the identified needs of the children. However, the teachers expressed concern about the demands made on their time and energy by the increased amount of planning and reading required for each lesson. Demands on teachers have been steadily increasing (Lovett, 2001). For these teachers the ENP was particularly demanding in terms of time spent at after-school workshops and meetings, reading materials and planning and organising lessons. All four teachers had misgivings about their ability to sustain the workload.

Another way in which teachers changed how they taught mathematics was in their daily use of a wide range of equipment. Equipment became an accepted part of every mathematics lesson. The teachers used it to introduce and reinforce mathematical knowledge. It was not that they had not previously used equipment. On the contrary, equipment was frequently used in their lessons. But

the teachers felt that they now used new equipment in a variety of ways to effectively support what they were teaching. Other studies have also found that the way teachers present activities and use equipment is critical in distinguishing highly effective teachers from other teachers (Askew et al., 1997; Higgins, 2001a).

Many writers have acknowledged the importance of a support component in professional development programmes (Higgins 2001a; Poskitt, 2001; Thomas, Ward and Tagg, 2002). A critical factor in supporting teacher change throughout the ENP was the role played by the facilitator. In her work on the importance of the role of the facilitator in professional development programmes, Higgins (2001b) commented that the ENP was a teacher-centred model of teacher development and stressed the importance and complexity of the teacher's context of practice in the facilitator's work. Contrary to many professional development programmes the ENP offered teachers ongoing opportunities to work with the facilitator during workshops and in their classrooms. The facilitator provided help and encouragement throughout the project. A crucial aspect of this support was the time spent in classrooms. Although for the teachers in this study this was a new experience, it proved to be invaluable in helping them improve their knowledge and classroom practice. The teachers saw the facilitator as a model of practice. Her visits complemented the work done in workshops and were an opportunity for the teachers to have some individual time to discuss any concerns. The teachers expressed confidence in her knowledge and appreciated her calm manner. During her visits, she affirmed what the teachers were doing and provided help where necessary.

Much has been written about what makes an effective professional development programme. Investing in professional development programmes has been shown by many researchers to be the most effective way to undertake substantive change in schools (Bobis, 2000; Poskitt, 2001; Thomas, Ward and Tagg, 2002). But simply investing in professional development is not enough to ensure successful, ongoing improvement of outcomes for students. Parsons (2001) identified nine characteristics of effective professional development programmes and Poskitt (2001) outlined five critical factors, or phases, for successful, school-based professional development.

The ENP comprises many of Parson's characteristics of effective professional development. The ENP is a classroom based-programme with strong, inbuilt support in the form of the facilitator. Also, it is focused on what Parsons calls the real world of the classroom. Modelling of teaching

methods and coaching of teachers, combined throughout the programme with ongoing support and guidance from within the school, are further characteristics of the ENP which are part of Parson's model for effective professional development. The teachers working on the ENP were able to make the changes because of the structure of the programme and how it was presented to them. The ENP supported the teachers and made it possible for them to initiate changes in a secure, collaborative environment.

As an externally imposed project of professional development, the structure of the ENP was out of the control of the school and the teachers taking part. Because of the improved outcomes for their students, the teachers in this study developed a strong personal commitment to the ENP. At the same time they found that it was difficult to ensure that reasonable workloads were maintained and that adequate support in the form of teacher release time was available.

In spite of this, the professional development model used for the ENP was a critical factor in bringing about teacher change. Because of the structure of the ENP the four teachers were able to make significant changes in their mathematical thinking and classroom practice. The ENP gave the teachers a way of assessing and grouping students. It also provided the teachers with support in the form of the facilitator and led them to develop new ways of using equipment and organising their classes. The teachers felt strongly that their experiences on the ENP empowered them and benefitted their children.

Conclusion:

This study is important because of what it tells us about professional development and teacher change. As a result of taking part in the ENP all the teachers in this study reported making major changes in their thinking and practice in mathematics. They had a better understanding of the needs of their children and felt confident that they could address those needs. Through the Number Framework and the work of the facilitator, the ENP provided the structure and support the teachers needed to make significant changes to the organisation of their mathematics lessons. The teachers in this study felt invigorated by their work on the ENP. Moreover, they were encouraged by the enthusiastic response of their children and the improved learning outcomes resulting from the changes they made in their classroom organisation and teaching.

However, some serious questions have arisen as a result of this study. All the teachers spoke of the drain on their time and energy made by the ENP. This was largely due to the extra planning, reading and organising required for group teaching. While they acknowledged the value of teaching in groups the teachers were concerned about their ability to carry the workload needed for planning and preparation. Within the context of the demands of an ever-widening curriculum, teachers may be unable to sustain the extra work required to continue teaching numeracy in this way. At the time of this study the facilitator was able to offer support to individual teachers, but this will not be the case in the future when teachers are left to fend for themselves. Schools will need to consider this and discuss ways of providing adequate support structures for staff.

Another question is whether or not schools will be willing or able to fund both the release time required for the administration of the diagnostic interview and the purchase of equipment to support the programme. In this study funding was partly provided by the Ministry of Education, but when schools have completed the ENP it is up to them to decide how the teaching of numeracy will be funded. An ongoing commitment to provide this funding is required by Boards of Trustees. For this to be possible, increased Government funding may need to be made available to Boards of Trustees specifically for this purpose.

In general, teachers have been positive about the ENP and schools have been clamouring to be part of the programme. The teachers in this study considered that the extra time and effort, although adding to the pressure during the professional development of the ENP, was ultimately rewarded by

the improved outcomes for their children. The positive reaction of children is an important indicator for teachers as to the worth of any innovation. This was the case during the ENP. From the outset, teachers in this study were heartened and encouraged by the interest and enthusiasm shown by their children in their mathematics lessons.

In addition, another factor that will be of crucial importance to teachers and to the ongoing success of the ENP, is the extent to which teachers become familiar with the programme and develop personal confidence and understanding of its structure and key concepts. As teachers move into their second year of the project they may begin to feel an increasing sense of empowerment as they find it easier to plan and organise their lessons, thereby maintaining the changes they have made. Ongoing research needs to be carried out to determine whether or not this is the case.

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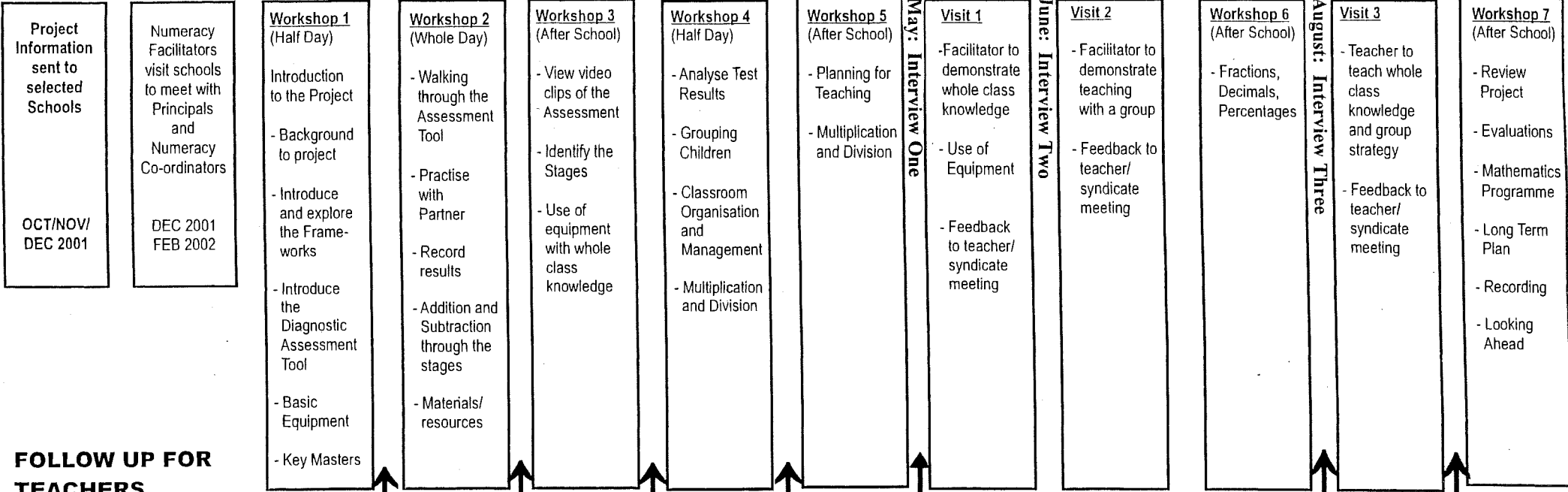
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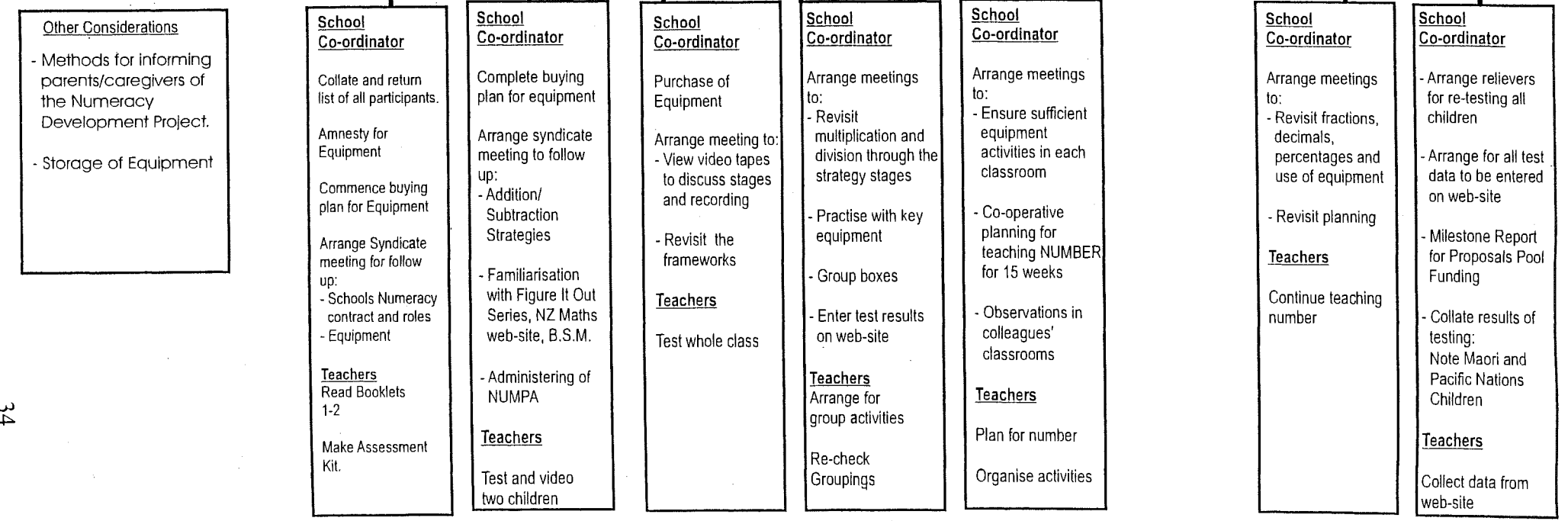
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FOLLOW UP FOR TEACHERS



Appendix 1: Overview and timeline of ENP

Appendix 2(a): Interview One

1. Now that you are about to begin the teaching stage of the Numeracy Project, what comments would you like to make about the Project to date?
2. What kinds of things have you (or your syndicate) done to prepare your Maths class for the next stage i.e. the teaching stage? This could cover things specifically to do with your students as well as what you have done in terms of your own preparation.
3. Can you make any predictions about how you think your particular Maths class will manage the next stage?
4. At this point, what effects, if any, has the Project had on your own thinking about Maths and numeracy?

N.B.

- a) **These are the key questions. They may be supplemented to enable clarification as the interview proceeds.**
- b) **Time for interview: approximately 30 minutes**

Appendix 2(b): Interview Two

Since the last interview you have had a number of weeks teaching numeracy and a lesson demonstration in your classroom by the facilitator.

1. At this point, in general, what are your feelings about the Numeracy Project?
2. How has your class responded to the daily lessons you have been taking?
3. Was the visit by the facilitator of benefit to you? If so, in what ways? If not, why not?
4. What are you doing differently now in your teaching as a result of the professional development offered by the Numeracy Project?

N.B.

- a) **These are the key questions. They may be supplemented to enable clarification as the interview proceeds.**
- b) **Time for interview: approximately 30 minutes**

Appendix 2(c): Interview Three

The focus for this interview is the process of the whole numeracy project and in particular your personal journey over the course of the project. I would like you to reflect on your experiences and your thoughts and feelings about the numeracy project.

1. Can you trace some of the key things that have brought you to where you are now? What are the difficulties and anxieties you have had? Are they still the same?
2. Looking back over the numeracy project and your experiences with it can you identify some key changes you have made in (a) your teaching, and (b) your thinking?
3. To what extent has talking with, sharing experiences and listening to other people been part of your change process? Which people and in what way?
4. In terms of ongoing implementation what is crucial for maintaining what you are doing now?

N.B.

- a) **These are the key questions. They may be supplemented to enable clarification as the interview proceeds.**
- b) **Time for interview: approximately 30 minutes**

Appendix 3: Sample Transcription

Sara: Interview Three

R - The focus for this interview is the process of the whole Numeracy Project and in particular your personal journey over the course of the Project. I'd like you to reflect on your experiences and your thoughts and feelings about the Numeracy Project.

R **Can you trace some of the key things that have brought you to where you are now, what are the difficulties and anxieties you've had, and are they still the same?**

T The key things – first of all, mainly the way the children in my class have adapted to this new style of teaching that I do in maths, and they've embraced it and the way each day they come in and look at our maths chart and see what they're on and they're quite excited about the variety that they have in one day.

R **Can you tell me what you think the new style of what you do is because that's crucial?**

T It's completely different to the way I used to teach. I did mainly whole class lessons which I know is not looked upon very favourably, but now I teach in small groups and it's needs-based and it's more like precision teaching – very small steps and geared at getting the children to get the basics before they carry on. 100% different really.

Also the guidance and support from, our facilitator, and the workshops and readings has taught me a lot and they've been very keen in implementing the Numeracy Project. The great new maths equipment we've got which is marvellous and our school co-ordinator explained to us how to use it because sometimes we don't know. Yes we've got wonderful abacuses, our flip sheet over there which cost a lot of money and is just wonderful – half the time the children are flicking their hands up and down it and just like the noise, but they love materials, they love the fact that they're allowed to use their fingers now and that we say you've got to do it on the materials first. We can always go back to them if the kids can't image or do it in their head, we say get the materials back out and they just feel so safe with those. It's really good – yes we've got all these new dice and all these wonderful things that keep coming.

R **Do you have enough resources now?**

T I think they do now. It's great. But my maths class is probably about 27 children so yes it's quite good because I know some other people have got bigger classes.

Also (the co-ordinator) is really organised. That's one of the key things and she'll communicate to us whatever (the facilitator) has told her after our

workshops in a very low key, don't stress out about it way and she's a really good communicator and organiser without making us feel pressured.

Also discussing things with others to help clarify what things mean – which I'll go into more later.

The difficulties and anxieties, I've got a few of those.

R Yes well that's what we want to hear?

T Being sufficiently organised for all the group work with the teacher and also independent activities to follow every day – I've found that pretty hard and sometimes to make the follow-up to activities relevant and easy enough for them to go on without me has been quite a challenge. I wouldn't say every day I've been able to do that.

Ensuring that the children are doing their independent activities and doing things from the fun box properly when I'm not right there – you just trust that they are and sometimes you know that they're actually not.

I also question whether the children are working at the correct stages sometimes, I think 'you're too good for this', but I'm not sure whether I should move you or, so I've still got some worries about that and I still do now.

We do very little bookwork which worries me a wee bit because when I do see the kids write down something in their book, sometimes the numbers are back to front and like I do try and get them doing it the right way but you don't really have enough time to go into those things, and they kind of lose how to set the book out properly and things like that which we might have to look at. That's one wee area that I feel is neglected at the moment.

Planning – am I doing it right? That's one of my major concerns and that's what I have to talk to ... (the facilitator) about. I don't know, she says there's no one way, it's got to work for you but I don't even know if it's working for me that well at the moment.

R Maybe that's something that will work itself out as you get to grips with this programme?

T And (the facilitator) told (the co-ordinator) to bring our planning to the last syndicate meeting, how we plan and we explained to one another and we all felt the same – am I doing it right, am I writing the right things and if it doesn't work for me so the co-ordinator said that maybe we could come up with a template for us that works for us and talk to the facilitator more about that.

A few key things and a few anxieties. But the main thing I worry about is my planning and are the children at the right stages and I still worry about that.

R **Looking back over the Numeracy Project and your experiences with it, can you identify some key changes you have made in your teaching and your thinking?**

T The main one is I've moved away from whole class lessons to group lessons and my new system is I start from the knowledge activities of everyone and then I try and see two groups a day for about 15 minutes each. Some days I get so involved in my first group that my second group don't actually get time. Then once they've worked with me they go on to an independent activity which is hopefully working on with the things that we've just been working on as with the teacher, and there's another group on the fun box and they rotate round so they get two different things a day maybe with me and an independent activity or independent activity and fun box or fun box and me – so it's kind of short and snappy.

Also much more small step teaching rather than a new concept every day or two which was what we always used to do, and if you didn't get it well too bad we're on to the next thing.

Also I use much more equipment, very few worksheets now, maybe the odd one for homework but I try and do a game for homework or something they can teach their parents. Last week because it was Maths Week we did a hat and the wee kids loved doing hats The facilitator said don't be too stressed out if they don't do their maths homework, she said you're giving it to them and you're leaving it in their hands and if they want to do it they will, and if they don't well – she said it's not your job to try chasing it up, you're juggling enough in class. You're providing it and you're hoping that the parents at home are asking them about it and doing it with them.

I teach the children a lot more maths games now which is great and we're actually allowed some time to play them and we revisit them. You know how sometimes you teach a game and you're into it for that week and then you never go back to it, well we're always taking them out again. Much more interested in how a child gets an answer than just giving it and getting it right. Heaps more are asking them how they got it and they explain and it's really good because you see the other kids in the group 'I didn't do it that way though' and they're kind of thinking everyone's thinking like them so it's quite interesting.

Changes to my thinking – that materials are so important and that it doesn't matter how good they're, they still need to use them. Children use a real variety of strategies and that's good, not one way is the right way to do things. We never used to think about the ways that they got the answer very much in the old style and that children learn in maths similarly to reading so they move through stages and they need to be taught in small groups that have similar needs really. I never really thought of maths like that before we started this project and also another thing I was thinking about was for the wee dudes that aren't very good at reading this way they get to shine if they're good at maths, they're not hindered by not being able to read the questions because we do it all on the mat together – I do the reading or I give them the number stories. I think of one wee boy in particular – at the start I didn't think he was very switched on in maths and he couldn't read most of the worksheets

or the things that we were doing on the board, and now that we're doing it this way he's fabulous and he's loving it. That's a really nice part of it.

R To what extent has talking with, and you have already mentioned some of this, and sharing experiences and listening to other people be part of your change process and which people and in what way?

T It's been a huge part – discussing what works well and what doesn't with other people in the syndicate, going to the workshops and finding out that others on the project have the same questions or anxieties, asking the co-ordinator what something means or what something's used for and she's really good about it and if she doesn't know, she'll ring the facilitator and she gets back to us straight away so yes she's been excellent at her job.

Sharing ideas – like? game in the national curriculum mathematics book and she gave me a copy because there's not many subtraction type things. There's heaps of addition. So that's really good because you learn things that you find work well and asking the facilitator major questions along the way and lots of silly ones too.

So yes, they're probably the main people.

R So being able to approach someone and feel that they're going to accept your question?

T And hope that they kind of might have thought at that too or had been worried about that too.

R And you found common problems?

T Yes.

R In terms of ongoing implementation, what do you think is crucial for maintaining what you're doing now?

T Maybe a resource of good ideas or activities for follow-up, independent activities for each set of learning experiences so if we're trying to teach them place value and we've done the activities in the place value book that are set out, maybe at the end there's a booklet or something that comes out that says 'these are the activities children can go away and do and are consolidating what you've done in those activities'. I think something like that needs to come out because I find it really hard to try and find something that has worked well as what I've just taught them, but that's easy enough to go on with without me. I think there needs to be something because my sources are almost dried out.

R And also it's hard to find things isn't it – and that's time-consuming.

T Yes it is. I mean they've given us everything else on a plate. I mean we can use and things like that but you don't know if they're the right ones. It would be nice to given something that does what you want it to do.

R Kind of topic-based support material?

T Yes. Perhaps looking at how other people are running their maths programmes for ideas and confirmation of what we're doing. I don't know how that would be organised.

R You mean within the school or other schools?

T Both. Like I'd quite like to see other peoples maths programmes here, but it would good to look further a field as well if it was possible because having the facilitator in is only for a short burst and it's one little segment of what you're trying to teach. Time for doing the testing because I don't know if we're going to keep getting days to do it and when we did do it the first time it was very rushed and we ran out of time and we were doing it at assembly times and any time we could.

R So that sort of thing should be programmed into here?

T Well it would have to be. I don't see how it would be managed otherwise. Support and understanding of what we're trying to do from parents because I don't think a lot of them realise exactly what we're trying to do even though notices have gone out and they see if someone's been moved into another class as they're either been put back or put up and I think there's a lot of questions and they need to be informed.

R Do you think a curriculum meeting or a parent meeting about that would be useful?

T Yes, maybe you might not need it after a couple of years and the whole school's on board and people have kind of got into that way of thinking.

R Do you think the pressure for testing would also lessen as the programme gets established?

T And we get better at doing it – yes, probably.

R Kids will come into your classroom at a particular level – not so much your area with new entrants, but even your Year 2's and 3's – they will come to you with an established level.

T They will. And also with our new entrants we've started taking the number test with them along with the 51 check so that makes the 51 check take a bit longer, but usually the wee ones don't get that far through that it takes too long. That part of it is taken care of – the brand new kids. Also I wonder where does it go to after we've done the testing at the end of the 15 weeks, do we just go back to teaching the other topics.

R Do you think that might become clearer in the final workshops?

T I hope so.

R And the other thing is perhaps long-term planning, is this part of what you're saying now?

T Yes

R How do you fit it in next year and where does it fit in the programme?

T Yes and do we do it all the way through or do we have little bursts of it or is it a block like this, so there's quite a few questions to ask and I'm sure we will be told. At the moment you kind of feel 'so what happens after this'? You don't want the kids to lose all the progress that they've made.

R Thanks Sara – that's great.

Appendix 4(a): Letter to Chairperson, Board of Trustees

13 May 2002



Dovedale Avenue, Ilam, PO Box 91-065
Christchurch 8030, New Zealand
Phone (64) (3) 348 2059, Facsimile (64) (3) 348 4311
<http://www.cce.ac.nz>

.....
The Chairperson
..... Board of Trustees
..... School
.....
.....

Dear

As you know I am currently enjoying two terms of study leave from my usual position at School. As part of that study I am undertaking a research project.

The general aim of the research is to investigate the Numeracy Project and its impact on the teachers involved. Specifically, I will be looking at the factors that have led them to make changes in how they think and what they do in the teaching of numeracy.

I am writing to seek the Board's permission to undertake this research in the school. At this stage, I have spoken informally to the Principal and to the four teachers involved and I will also be writing to them with a similar request, setting out the specifics of what is required.

The research will involve the teachers in approximately three interviews and two questionnaires. These will be carried out at a time that suits the teachers, outside their teaching times. The research does not involve any classroom observation. Its value lies in the voice it gives to the teachers, the opportunity it gives them to reflect and think about what they are doing and the general themes that should emerge that may impact on our current thinking about numeracy.

I hope you will view this request favourably,

Yours faithfully

Elaine Bolitho

Appendix 4(b): Letter to Principal

13 May 2002



Dovedale Avenue, Ilam, PO Box 31-065
Christchurch 8030, New Zealand
Phone (64) (3) 348 2059, Facsimile (64) (3) 348 4311
<http://www.cce.ac.nz>

.....
Principal
..... School
.....
.....

Dear

I am writing to request permission to undertake a research project in your school. As I mentioned to you earlier, this project is part of my study in the Master of Teaching and Learning programme from the Christchurch College of Education.

The research will focus on the impact of the Numeracy Project on the thinking and teaching of four of the teachers involved. I am also anticipating that the themes and ideas that emerge will inform our future thinking about numeracy at the school.

There will be no classroom observation and I will not be working with children. Data gathering will be in the form of approximately three interviews and two questionnaires. All interviews will be carried out at a time that suits the teachers outside of teaching times.

Thankyou for your time. I look forward to hearing from you.

Yours faithfully

Elaine Bolitho

Appendix 4(c): Letter to Facilitator, Early Numeracy Project



13 May 2002

Dovedale Avenue, Ilam, PO Box 31-065
Christchurch 8030, New Zealand
Phone (64) (3) 348 2059, Facsimile (64) (3) 348 4311
<http://www.cce.ac.nz>

.....
Facilitator
Numeracy Project
.....

Dear

I am writing to seek your support for a research project that I will be conducting at School.

The research will focus on the impact of the Numeracy Project on the thinking and teaching of four of the teachers involved. I am also anticipating that the themes and ideas that emerge will inform our future thinking about numeracy at the school.

There will be no classroom observation and I will not be working with children. Data gathering will be in the form of approximately three interviews and two questionnaires. All interviews will be carried out at a time that suits the teachers outside of teaching times.

I have received permission from the Board of Trustees and the Principal to carry out this research. The teachers concerned will receive correspondence seeking their interest and support and detailing what will be required. I do not anticipate that this will be a very onerous task for the participants, but hope that what emerges will be of interest to all of us.

Thankyou for your time. I look forward to hearing from you.

Yours faithfully

Elaine Bolitho

Appendix 4(d): Letter to Participating Teachers



13 May 2002

Dear

Dovedale Avenue, Ilam, PO Box 31-065
Christchurch 8030, New Zealand
Phone (64) (3) 348 2059, Facsimile (64) (3) 348 4311
<http://www.cce.ac.nz>

Thank you for agreeing to participate in this research study.

The purpose of this letter is:

- to explain about the research
- gain your written consent to participate
- point out factors concerning confidentiality and anonymity
- outline complaint procedures

The research is being undertaken as part of my study for a Master of Teaching and Learning degree at Christchurch College of Education. The general aim of the research is to investigate the Numeracy Project and its impact on you and three other teachers at School. Specifically I will be looking at the factors that may lead you to make changes in how you think about and teach numeracy during and following your work on the Numeracy Project.

The research will involve no more than three interviews and two questionnaires. These will be carried out at a time that suits you outside of teaching times. The research does not involve any classroom observation. Its value lies in the voice it gives to you, the teacher, and the opportunity it provides for you to reflect and think about what you are doing during the process of implementing the Numeracy Project in your classroom. The general themes that should emerge may impact on our current thinking about numeracy.

It is important that you know that all responses and discussions will be kept strictly confidential. The information provided will be stored in a secure location, available only to myself and my College supervisor, and will be used for statistical or illustrative purposes only. Your name will not be used and at all times your anonymity will be maintained. Therefore any quotations used in publication will be unattributable.

It is a requirement of the College that all participants are informed of complaint procedures. Should there be any concerns or complaints concerning the manner in which this research is conducted, please discuss them with me or, if an independent person is preferred, please forward to:

- The Chair – Ethical Clearance Committee
Christchurch College of Education
PO Box 31-065
Christchurch

It is also important that you know that you are free to withdraw from the project at any time by contacting the researcher.

Thankyou for your time. Please sign and return the accompanying consent agreement.

Yours faithfully

Elaine Bolitho

Appendix 4(e): Participating Teachers' Consent Agreement



Dovedale Avenue, Ilam, PO Box 31-065
Christchurch 8030, New Zealand
Phone (64) (3) 348 2059, Facsimile (64) (3) 348 4311
<http://www.cce.ac.nz>

Informed Consent Agreement

I have read the enclosed letter outlining the nature and purpose of this research. I understand that all data will be confidential and that anonymity will be maintained at all times.

I also realize that I am in no way bound to participate in the research and that no penalty or loss of benefit will occur should I choose to withdraw. I understand that I may withdraw at any time by contacting the researcher.

I have information regarding the complaints procedure and am voluntarily agreeing to be part of this study.

Full name of participant (please print):

First name: _____

Last name: _____

Signature: _____

Date: _____

Name and address of Researcher

Phone and e-mail address of researcher