Teacher Change

and

the Intermediate Numeracy Project:
A Narrative Analysis

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Abstract

This thesis focuses on the process of change. In particular, how schools and the individual teachers who make them up experience and manage the change process brought about by their involvement in professional development programmes. The context for this study was the Intermediate Numeracy Project (INP); a project initiated by the Ministry of Education that was designed to enhance the teaching of numeracy and improve student achievement in mathematics in New Zealand schools.

The results reported in this thesis focused on the teachers’ stories of their experiences of implementing the INP as documented over a three-year period. The teachers’ changing confidences and the multiple and diverse realities that existed within the school over time were reported on. Ongoing data from a core group of eight classroom teachers and the principal provided a longitudinal perspective to both the individual and whole school narratives. The participants in this investigation shared their beliefs, teaching practices and personal journeys, refining, revisiting and reframing their stories during a cycle of four interviews over a three-year period. This longitudinal data was used to address the following research questions:

- What was the process of change for this school over the three year period?
- What was the process of change for individual teachers over the three year period?
- What were the catalysts and barriers to the change process and how were these managed by the teachers and the school?

Models of change for a whole school and individual teachers are outlined and critiqued in the literature review. Following this, key catalysts and barriers to the change process were identified. Qualitative methods of inquiry, including interviews, narrative, change journey graphs and a written survey were used to collect the data. I constructed narratives based on the data; firstly, a whole school story and secondly, five individual teacher narratives. These narratives were subsequently mapped against the change models in the discussions that follow both the school and the individual stories. Barbara Rogoff’s (1995) method of three plane analysis relating to processes at the personal, interpersonal and community level was used to
explore knowledge that was created through participation in the school setting. The final implications of this research for the management of change were presented within the framework of Rogoff’s three planes.

Evidence from the interviews, narratives and the journey graphs, drawn by the teachers to show their perception of the changes in their ability to implement the project in their classrooms over the three years, showed a diversity of individual responses to change and idiosyncratic coping strategies. The roller coaster ride involved and the need to be cognisant of the role of emotions during a period of change emerged strongly from the data. The catalyst and barriers to change that either inhibited or enabled actions are explored and integrated into the discussions of the change paths for both the whole school and specific individuals. The ability to take ownership of the initiative through collegial, school-wide strategies and the motivation to persevere that developed out of student successes were critical to changing teacher practice. The important role of the principal and lead teachers in providing opportunity for, open discussion of progress and collaborative problem solving emerged as crucial to the change process.

Although this study focuses on the teachers in one school, the findings should provide useful insights for schools, teachers, school leaders, professional development facilitators and pre-service educators who grapple with reforms in teaching and learning and curriculum change, not only within numeracy and mathematics but within the broader school curriculum.
Preface

Completing this thesis has been a long-term project and I wish to thank the following people who have supported me and contributed to this thesis over more years than I care to admit.

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Chapter One - Introduction

Remember that a culture of change consists of rapidity and non-linearity on one hand and equally great potential for creative breakthroughs on the other. The paradox is that the transformation would not be possible without the accompanying messiness. Michael Fullan (2001, p.31)

Although much has been written about the problematic nature of change within the school setting, there is much that we do not know about the process of change and what can guide teachers and leaders as they grapple with managing change processes in their schools in order to improve outcomes for the students they teach. The quote from Michael Fullan above highlights the unstructured, unknown and diverse trajectory that change can assume, and the “accompanying messiness” that is fostered by the multiple layers that impact on the investigation of change. Change is both an individual and organisational process, and individual change is influenced by, and influences, any wider school or systems transformation (Bishop, O'Sullivan, & Berryman, 2010; Fullan, 2006b). Unsettled, changing times arouse emotive words: “fear, anxiety, loss, danger, panic” on one hand and “exhilaration, risk-taking, excitement, improvements [and] energizing” on the other (Fullan, 2001b, p. 1). At the micro level, these personal emotions, along with individual beliefs and practices (Guskey, 2002), need to be considered in understanding and managing change. At the macro level, how teachers interact and learn together as a ‘community of professionals’ where evidence-based learning, participation and student achievement are the focus, has been identified as necessary to sustainable change (Bishop, et al., 2010; DuFour, 2004; L. Shulman & Shulman, 2004; Timperley, Wilson, Barrrar, & Fung, 2007). More recently, the complexity of change in schools was confirmed in the findings from the New Zealand Curriculum Implementation Exploratory Studies (CIES) project, which concluded that the change process “is complex, with different aspects mutually informing and guiding each other” (Cowie, Hipkins, Keown, & Boyd, 2011, p. 2). The effectiveness of professional development practices in meeting these complex needs, linked with building sustainable school-wide change, has been a research focus in New Zealand.

Educators, researchers and policy makers have become increasingly interested in the role of teacher in-service professional development as part of sustaining educational change (Higgins & Parsons, 2009). Within the Te Kotahitanga professional development project, designed to raise the achievement of Maori students, Russell Bishop, Dominic O’Sullivan, &
Mere Berryman (2010) highlight the role of teacher collegiality and within-school generated change. They note the importance of:

Strengthening the capacity of teachers to set the agenda for change... because it is intended that the primary ongoing source of professional advice is not the outside (usually government-funded) expert but the teacher’s professional colleagues in the workplace. (Bishop, et al., 2010, p. 81)

In their Best Evidence Synthesis Iteration (BES) of Teacher Professional Learning and Development, Helen Timperley, Aaron Wilson, Heather Barrar, and Irene Fung (2007) presented multi-interwoven factors as linked to professional development and teacher learning and hence the fabric of change in schools. They identified seven elements or catalysts to change related to professional learning that made an impact on student outcomes. These were:

- providing sufficient time for extended opportunities to learn and using time effectively; engaging external expertise; focusing on engaging teachers in the learning process rather than being concerned about whether they volunteered or not; challenging problematic discourses; providing opportunities to interact in a community of professionals; ensuring content was consistent with wider policy trends; and, in school-based initiatives, having leaders actively leading the professional learning opportunities. (p. xxvi)

The previous research has clearly identified the multi-faceted nature and “messiness” of the change process as part of professional development in schools.

**The background to this thesis**

The research in this master’s thesis investigated the professional development journey of the teachers in one Intermediate School as they implemented the Intermediate Numeracy Project (INP). Although numeracy teaching was the context for this school-wide project, the focus in this thesis is on the change process initiated by the professional development programme and how the individual teachers and the school experienced the changes. I was a co-facilitator of the INP professional development programme in the school as well as the researcher. This meant I was regularly engaging with the teachers over the three year period when coordinating and running workshops and working with the teachers in their classrooms.

The professional development programme took place from 2002 to 2004 and I completed this thesis in 2011. I started to write up this thesis in 2005, but unexpectedly I took up a position as the principal of a girls’ secondary school during 2005. I was unable to find time to complete this thesis alongside the fulltime role as a principal until 2011 when I was
granted a ten week period of sabbatical leave. Some may say the results reported here are dated, and had I focused on the changes in mathematics teaching brought about by the INP, then questioning the usefulness of this thesis could be justified. But this inquiry into the broader nature of change is relevant despite the gap in time between the data gathering and the final reporting of the results because change is not time dependent, but rather omnipresent in education (Fullan, 2001a; Piggot-Irvine, 2005). Research reports focusing on the changes brought about by the New Zealand Numeracy Development Projects (NZNDP) abound (Higgins & Parsons, 2009; Higgins, Parsons, & Hyland, 2003a; Ministry of Education, 2005b, 2006, 2007a, 2008a, 2009, 2010; Thomas & Tagg, 2004, 2005). However, I have not focused this inquiry specifically around the presented results of the NZNDP, but rather on the process and management of change over time, from the perspective of the teachers in one school. The context for this inquiry happened to sit within the NZNDP, but the process of change for the individual teachers and the school brought about by the professional development programme (as perceived by the teachers) was under the spotlight, rather than the INP as such. The following were the questions I explored:

- What was the process of change for this school over the three year period?
- What was the process of change for individual teachers over the three year period?
- What were the catalysts and barriers to the change process and how were these managed by the teachers and the school?

The context of this study

Intermediate schools.

The school reported on in this thesis is an Intermediate School. Intermediate schools catering solely for year 7 and 8 students (age 11-13 years) are a feature of the New Zealand school system. But these two-year only schools are rare in other countries where middle schools (year 7-10) or other wider age groupings are more prevalent (Ministry of Education, 2008b). Teachers in Intermediate Schools are physically removed from both their primary colleagues in year 1-6, or year 1-8 Primary Schools, and also from their secondary colleagues in either year 7-13 or year 9-13 Secondary Schools. Intermediate school students usually learn within a homeroom, primary school-based environment with one teacher, but have time out of the weekly programme for classes with specialist teachers in specialist rooms, generally for technology and art. There are very few specialist mathematics teachers in Intermediate
schools and mostly mathematics is taught by the homeroom teacher. Intermediate schools are a unique environment, and as such are particularly worthy of study. The professional development programme that the Intermediate School in this study undertook was part of a New Zealand system-wide project called the New Zealand Numeracy Development Project.

**New Zealand Numeracy Development Project.**

The strategic focus of the NZNDP was established by the Mathematics and Science Taskforce in 1997 in response to the poor performance of New Zealand students in the Third International Mathematics and Science Study (TIMSS). Developing teachers’ pedagogical content knowledge, improving teacher quality and confidence and the provision of resources to support mathematics teaching and learning were identified as key issues for mathematics education (Parsons, 2005). The prime objectives of the NZNDP were to improve the knowledge, skills and confidence of all primary teachers in mathematics and subsequently improve the achievement of all New Zealand students in mathematics (Parsons, 2005).

The NZNDP was initially implemented in 2001 subsequent to a pilot project in 2000. In 2002, the New Zealand Ministry of Education offered selected schools the Intermediate Numeracy Project (INP) pilot professional development programme at year 7 and 8, to explore possible models for implementing Numeracy projects at this upper primary level following from the success of the Early Numeracy Project (ENP) at years 0-3 (Thomas & Ward, 2001, 2002) and the Advanced Numeracy Project (ANP) at years 4-6 (Higgins, 2001, 2002). The INP focused solely on year 7 and 8 (Irwin, 2003, 2004) and became one of five projects that formed the Numeracy Development Project in New Zealand. The fourth Project was the Senior Numeracy Project (SNP) for teachers of year 9 and 10 students and the fifth Te Poutama Tau (the Māori medium numeracy project) (Ministry of Education, 2010).

The INP is a within-school based professional development programme where trained facilitators run workshops and work alongside teachers in their classrooms. The outline of the three-year INP programme implemented at Kiwi Intermediate School (KIS)\(^1\), the school researched in this thesis, is included in the methodology in Chapter Four. A Number Framework that explains how children’s understanding of number concepts develops forms the basis of the project. The focus of the INP is on strategic thinking and the development of mathematical knowledge through students sharing their multiple strategies to solve a problem.

\(^1\) All names of the school and participants are pseudonyms.
This approach contrasted with previous teaching practices that focused on set textbook procedures for solving problems followed by written exercises (Timperley, et al., 2007). The facilitator supports the teachers to assess student knowledge and problem solving skills using a one-to-one diagnostic interview based on the progressions in the Number Framework. Discrepancies with teacher expectations of the students often emerge from the interviews providing motivation for changing practice.

A teaching model (Figure 1) based on the on the work of Susan Pirie and Thomas Kieren (1989) is a key teaching tool used in NZNDP. This is designed to assist the teachers to help the learners bridge the gap between concrete material and abstract number properties, when promoting the use of problem solving strategies. The model identifies “levels of abstraction in representations of mathematical ideas” (Higgins & Parsons, 2009, p. 234).

![The Teaching Model](http://nzmaths.co.nz/node/1517)

**Figure 1 - The Teaching Model - Retrieved from http://nzmaths.co.nz/node/1517**

In this model differences are drawn between representing mathematical ideas with concrete materials such as number lines, “using students’ images in their minds as an aid to solving problems, and the most abstract stage of the use of number properties to represent number ideas” (Higgins & Parsons, 2009, p. 234). When meeting new ideas, the strategy model promotes a progression from using materials to imaging those materials to using the associated number properties as a teaching approach to develop abstract thinking. To support new learning teachers may direct students to refer back to previous levels as indicated by the arrows in the diagram.

The professional development facilitator models a number of lessons in the teacher’s classroom using the teaching model and in subsequent visits observes the teacher’s practice. The pedagogy of the facilitator is based on using the contributions of the students, discussing...
the student’s conceptual developments with the teachers and being responsive to the teacher’s specific classroom context (Higgins, 2006). In-class sessions are followed by debrief discussions with the facilitator and the teacher.

**Why this thesis is important.**

This thesis is important because it fills an identified gap in the research literature in the following three areas: longitudinal studies of change in intermediate schools (Ministry of Education, 2008b), studies that detail the sequence of events in teacher professional development (Timperley, et al., 2007) and the linking of a theoretical framework with practical empirical data in studies of teacher professional learning and change (Anderson, 2010; Timperley, et al., 2007). Writing the results of this study in narrative form also adds to the significance of this thesis because a wide range of people can read and relate to stories (Lyons & Kubler LaBoskey, 2002). I hope that not only researchers, but teachers, principals and teacher educators can connect with and learn from the narratives told in this thesis. The research stories could also be used as part of staff professional development sessions when preparing teachers to undertake new initiatives and to help them manage the subsequent change process.

Although there are a number of studies about middle schooling (years 7 to 9 or 10) in New Zealand (Ministry of Education, 2008b) there is a lack of research studies in Intermediate schools (year 7 to 8) and in particular longitudinal studies of curriculum change. Other than the INP research (Irwin, 2003, 2004; Irwin & Niederer, 2002; Thomas & Tagg, 2005), I found only three longitudinal studies specifically located in New Zealand Intermediate schools concerned with teacher change or professional development. One was a four-year study on teacher stress (Manthei, Gilmore, Tuck, & Adair, 1996), one about intermediate and secondary teachers working together over a two-year period to improve their teaching of mathematics (Britt, Irwin, & Ritchie, 2001) and thirdly, a study on science professional development by Brian Leithwaite (2005). Leithwaite concluded that teachers needed to work in a “well-resourced collaborative and supportive environment” (p. 133) where the learning needs of participants were met and progress was made towards specific targets. Hence there is a need for further research about how Intermediate teachers experience the process of change.

The gap in the literature identified by Timperley et al (2007) is around a lack of detail “concerning the sequence of events” (p. xiv) as part of professional learning. They concluded
that while there is extensive evidence “relating to children’s learning, what promotes it and what limits it”, the “empirical evidence relating to professional learning of teachers is sparse” (p. 228). Providing evidence to help deepen understanding of the progress of change, and the sequence of events as experienced by a school and the teachers, is a prime focus of this research. There is also a lack of research articles that combine both the empirical evidence and the theoretical base in professional learning (Timperley, et al., 2007). The research reported on in this thesis aimed to bridge this gap by interweaving the practical, teacher-based evidence with theoretical models of teacher change within a socio-cultural theoretical framework.

Numerous researchers acknowledge the complexity of change and its inability to be easily captured, described, understood or resolved (Anderson, 2010; Fullan, 2007). Ongoing studies are needed to be woven into the tapestry that will map the shape of educational change. Although this study focuses on the teachers in one school, the findings should provide useful insights for schools, teachers, school leaders, professional development facilitators and pre-service educators who grapple with reforms in teaching and learning and curriculum change, not only within numeracy and Mathematics but within the broader school curriculum.

An outline of this thesis.

Chapter Two, The Framework for the Inquiry provides the theoretical framework structuring this research. It situates both the researcher and the research in terms of ontology, and epistemology and explores sociocultural theory. A sociocultural lens is then used to inform Chapter Three, The Literature Review. This chapter examines the research literature around the process of change, firstly considering models of school-wide change and secondly the change process from the perspective of the individual teacher. Finally in this third chapter the barriers and catalysts to change, and how these are managed by both schools and the teachers are explored. Chapter Four, The Design of the Study describes the specifics of the research process in the Intermediate School and introduces the reader to the participants in this study. Chapter Five, The School Story shares the change process the school and the teachers underwent during the three year of the INP professional development. The change journey, the catalyst and the barriers to change emerging from the story are discussed in light of the literature and the sociocultural framework presented in Chapter Two. Chapter Six, The Individual Teacher Stories presents in narrative form the ways individual teachers dealt with the reform process and highlights the diversity of teacher responsiveness to changing practices. Chapter Seven, Implications for Managing Change is presented within a
sociocultural framework. This chapter identifies the implications arising from this research for teachers, leaders, schools and in-service professional development providers in coping with the ever present change expected of teaching professionals as they strive to meet the diverse, continually shifting educational needs of students they teach.
Chapter Two - The Framework for the Inquiry

From my perspective, orientating our inquiry by focusing on how people participate in sociocultural activity and how they change their participation demystifies the process of learning and development.

Barbara Rogoff (1995, p.159)

Introduction

In their text on beginning qualitative research Pamela Maykut and Richard Morehouse (1994) suggested that how one sees reality is guided by interrelated assumptions about its nature, by your worldview and the set of beliefs that give cohesiveness to this vision. It is important to identify what paradigm, or way we view the world, that informs and guides our research process. In tracking the history of qualitative research from a personal perspective, Yvonna Lincoln (2010) wrote that, “Paradigms …do matter” because they talk of the “researcher[s] standpoint” and their “proposed relationship” (p. 7) to the participants in the study. She suggests that knowledge of the researcher’s paradigm can help the reader understand how the researcher views the construction of knowledge and who can present the most important parts of this knowledge. Paradigms also shed light on the ways a researcher plans to account for the numerous contrasting and opposing values that will emerge during the research process (Lincoln, 2010). In this chapter I will outline the paradigm –“basic set of beliefs that guide actions” (Guba, 1990a, p. 17) this inquiry is situated within, how I propose to view the participants, and their and my role in the process of knowledge formation in this inquiry.

Researchers, in attempting to understand and write about what has been observed, place themselves in a vulnerable position with regard to possible distortions or misinterpretations of the situation or experiences being studied (Jessie Goodman, 1992). Michael Crotty (1998) confirmed the importance of being aware that, “at every point in our research- in our observing, our interpreting, our reporting and everything else we do as researchers- we inject a host of assumptions” (p.17). This chapter will explore the theoretical framework that underlies this thesis and share the basic assumptions I held in undertaking this research thesis.
Who am I and how do I relate to the participants in this study?

American sociologist Shulamit Reinharz (2011) proposed three questions that must be asked when carrying out fieldwork: “Who exactly is this researcher who comes to this field? Who did she/he become in the field because of what kinds of relationships? What is the range of ways in which others see him/her?” (p. 9). In order that the reader can understand the phenomena being studied they need to know “what the researcher attributes mean to the people being studied” (p. 9). Rheinharz quotes the word of anthropologist Pat Caplan:

[A] number of factors… determines the kinds of data we collect, and our interpretation of them. One of the most important of these is our positionality-who are we for them? Who are they for us? Such questions have to be considered …in term of such factors as our gender, age and life experience, as well as our race and nationality. (Caplan, as cited in Rheinharz, 2011, p. 9)

This section will situate “I”, the writer of this thesis, in the research text.

I am from the South Island of New Zealand, ‘born and bred’ in Dunedin and have lived there all of my life, apart from some time travelling overseas in the 1980s. I am 54 years old, the principal of a girls’ state school, and previously a mathematics teacher educator, who is white, middle-class, heterosexual, energetic, and married with two adult children. But, Susan Sandretto (2004) reminded me that I need to do more than this in declaring who I am, when she identified that it is not as simple as locating oneself in, “…these socially constructed categories. My multiple positions and identities have shaped the entire research process” (p. 45). So, to explain further, when I started my master’s study I was a teacher educator at the Dunedin College of Education working in the field of both primary and secondary mathematics teacher training and facilitating in-school professional development as part of the NZNDP. Already I have revealed multiple “personal dispositions” (Peshkin, 1985, p. 270) in the differing professional roles that I undertook at this time. Previous to this, I worked as a secondary mathematics teacher in girls’ schools for seventeen years and for eleven of those years concurrently tutored secondary mathematics teacher trainees, whom I worked with in the school setting. I left the Dunedin College of Education to become a principal at the end of 2005. The contribution of these roles to this inquiry will emerge as I describe the research process and research journey embedded in this work.

Further scrutiny in relation to the interactions between ourselves and those with whom we work is necessary (Reinharz, 2011). So I will explain my relationship with the participants
in this study. The numeracy facilitator of the INP for KIS was Nina\(^2\), my colleague. She was an experienced, highly regarded, intermediate teacher who had worked for one year in teacher education at the College of Education. The decision to co-facilitate this project meant we were able to draw on each other’s strengths, Nina as a year 7-8 practitioner and myself as an experienced teacher educator and secondary teacher with a depth of background knowledge in mathematics. Nina and I co-led the workshops and Nina carried out most of the in-class modelling sessions. I was the researcher and also did some in-class modelling for Nina when she was unavailable due to her preservice teaching commitments. Nina had previously taught for five years at KIS and hence she already knew a number of the teachers at the start of the project. As a local mathematics teacher educator I was known by some of the teachers and I had taught one of them in a preservice mathematics course. The credibility this gave Nina and me enabled us to quickly establish relationships with the teachers.

Within these relationships I was aware that the participants’ input was interpreted through my eyes and my cultural being. Hence I needed to be alert to emerging ideas that were different to my own and scrutinise rather than marginalise these. Lincoln (2010) highlights this stating:

> We need to find something that does not ignore difference; that takes account of vast deviations, conflicts, and contradictions between individuals and their lifeways, and even within individuals themselves; and that gives rise to new, richer, more complex, more authentic representations of those with whom we work. (p. 5)

This led me to consider the framework within this research sits; the ontological and epistemological stances I took in undertaking this study.

**Ontology: What is the nature of the world?**

This section is informed by the work of Egon Guba (1990a) and Susan Sandretto (2004). Paradigms can be characterised by the form of their responses to three basic questions, the ontological, the epistemological and the methodological questions (I will address these in Chapter Four) (Guba, 1990a, p. 18). Ontological questions ask about the nature of the world and what is real (Maykut & Morehouse, 1994). This master’s thesis sits within relativist ontology. Reality is not a singular, constant entity made up of independent parts, but it is continually being constructed by the people who live it from multiple

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\(^2\) Nina was the pseudonym for the Numeracy Facilitator at KIS
perspectives, connections and realities. It is characterised by difficult to articulate, “tacit knowledge” (Polyani, as cited in Maykut & Morehouse, 1994, p. 30), based on experience and social interaction giving due credit to the ways of thinking and knowing of individuals or groups (Guba & Lincoln, 1994). Relativist ontology assumes all knowledge is tied to culture, theory and values, and is related to a specific historical context. Rogoff (2003) elaborated on the situated nature of individual development within social settings, claiming that individual development is interdependent with sociocultural activity:

people develop as participants in cultural communities. Their development can be understood only in the light of the cultural practices and circumstances of their communities-which also change. (p. 3-4)

Realities are negotiable; they can be built on, changed and reconstructed as the result of interactive discussion between the researcher and the research participants. Knowledge is co-constructed and moves towards some consensus of opinion as the basis for knowing about the world, while still maintaining an open mind toward others developing constructions and more sophisticated reconstructions (Guba & Lincoln, 1994). Realities are multiple, and “they exist in people’s minds” (Guba, 1990a, p. 26). Each of us has a uniquely constructed version of reality that is part of our daily experience, and two people looking at something together never actually see the same thing in the same way. In his explanation of social constructionism, Crotty (1998) noted that, from a relativist ontological standpoint, understandings will be held much more, “tentatively and far less dogmatically, seeing them as historically and culturally effected interpretations rather than eternal truths of some kind” (p.64). This relativist ontology, involving consensual knowledge construction through attention to personal and group idiosyncrasies, is linked in this research framework with constructionism as an epistemological stance.

**Epistemology: How do we come to know?**

Epistemological questions ask about “the relationship between the knower (the inquirer) and the known (or knowable)” (Guba, 1990a, p. 18) and the role that “values play in understanding” (Maykut & Morehouse, 1994, p. 4). Individuals create meaning through their interactions with one another and with the environment they live in. Crotty (1988) explained that:

Truth and meaning comes into existence in and out of our engagement with the realities in our world. … that different people may construct meaning in different
ways, even in relation to the same phenomenon. …In this view of things, subject and object emerge as partners in the generation of meaning. (1998, p. 8)

In the process of social research this means that the relationships between the inquirer and the inquired are closely interwoven and they learn from one another and together. Constructions are created, scrutinised and reformed as the investigation proceeds and “findings are literally the creation of the process of interaction between the two” (Guba, 1990a, p. 27). Rogoff (2003) extended this, seeing the individual as embedded in cultural communities and explained that sociocultural theorists assumed “people contribute to the creation of cultural processes and cultural processes contribute to the creation of people” and thus “individual and cultural processes are mutually constituting rather than separate from each other” (p. 51). Rogoff (2003) emphasized that “human development is a process of people’s changing participation in sociocultural activities of their communities” and that “as people develop through their shared use of cultural tools and practices, they simultaneously contribute to the transformation of cultural tools, practices and institutions” (p. 52, emphasis added). The epistemological stance in this thesis is based on social constructionism as a ‘way of knowing’ informed by sociocultural theory.

**Sociocultural Theory**

Sociocultural research focuses not only on individuals, but also on the interactions between them and on the wider contexts in which these interactions occur. The social context for teachers is their classroom, their interactions with their colleagues, with their students and the school systems and structures within which they operate. Barbara Rogoff (1995) stated that “it is incomplete to focus on only the relationship of individual development and social interaction without concern for the cultural activity in which personal and interpersonal actions take place” (p. 141). This is consistent with Vygotsky’s (1978) ‘socio-cultural’ learning that viewed the individual as situated within cultural and social settings where knowledge is socially constructed and justified. A sociocultural framework fitted with the inquiry in this thesis as it integrated the individual teacher and their social interactions with others and the school culture or “community of practice” (Wenger, 1998, p. 5) together giving consideration to all three aspects.

The change generated by implementing a new curriculum initiative involves changes in the way teachers do things and their ‘ways of being’ or identities (Graven, 2004). Teacher learning is enhanced by participation in a community of practice where teachers support one
another to make changes (Bishop, et al., 2010; Timperley, 2008). These assumptions are underpinned by the work of Jean Lave and Etienne Wenger (1991) and Wenger (1998). These two researchers are referred to by Stephen Lerman (2002) as instrumental in moving discourse in the educational community past a focus on cognitive issues towards recognition of a social practice perspective on learning incorporating the role of participation and identity. According to Lave and Wenger (1991), the acquisition of knowledge is seen as occurring through participation in a community as an apprentice. They see learning and a sense of identity as inseparable and that participation in the activities and practices of a community are fundamental to learning and hence the development of identity. Participation is at first just peripheral, but gradually increases in complexity and autonomy, with learning taking place through activity and social interaction within meaningful situations. Lave and Wenger (1991) described this process as “legitimate peripheral participation” (p. 14). This is a change process where knowledge and skills are not acquired abstractly, but rather developed through participation in activity which is situated within the context in which it would be authentically used. Experience and understanding interact and meanings are negotiated and renegotiated as part of the participation in an activity. In a similar way, Higgins (2006) noted that by speaking about activities, relationships, tools, knowledge and practice with others, newcomers to numeracy teaching became part of a community of practice. The process of “co-teaching and co-generative dialogues” (Higgins, 2006, p. 78) used by facilitators within the NZNDP was consistent with the process of legitimate peripheral participation. The teacher’s active participation with teaching their own class as part of the facilitator or lead teacher modelling sessions and the ongoing discussion and interactions that followed could be viewed as a process of legitimate peripheral participation. In a sense “the facilitator takes the ‘expert’ role and the teacher the ‘apprentice’ role” (Higgins, 2006, p. 74).

Lerman (2002) cited Lave and Wenger’s ‘person–in-practice’ approach as useful in highlighting the need to view the teacher as active and with the ability to take cognisance of and mediate their experiences. He expanded on this idea viewing not only the teacher in practice, but also the change that occurred as the practice becomes part of the way the teacher is and operates. Lerman used the term “person-in-practice-in-person” (p. 241) to shed light on the process of people’s differing developing identities emerging through the experience of practice. Teacher paths into and through the practice are transformed by: the nature of their prior experiences, the way they participate in the activity and the personal or programme-based goals they bring into the practice. Lerman described his “person-in-practice-in-person” approach as occurring through various levels of involvement in action and through interaction with other people’s developing identities:
In the different forms of participation, peripheral, central, and in the overlapping of that practice with other practices, people’s identities develop in different ways. The trajectories into and through the practice are modified by virtue of prior personal experiences, personal goals and the form of participation. (p. 241)

This approach assumes that teacher growth and the development of identity continues throughout practice and built on the work of Lave (1996) who saw “Teaching as Learning in Practice” (p. 149). Here teaching is synonymous with an apprenticeship model and viewed “as a social practice in which teachers are practitioners” (Jaworski, 2006, p. 189).

Etienne Wenger (1998) built further on Jean Lave’s ideas, seeing teacher identity developing through participation in a “community of practice” (p. 5) with learning presented as “a process of becoming” (p. 215). Wenger noted that “a community of practice is a living context that can give newcomers access to competence and also invite a personal experience of engagement by which to incorporate that competence into an identity of participation” (p. 214). He presented a social theory of learning that included four learning components. These are; community (linked with learning as belonging), practice (linked with learning as doing), meaning (linked with learning as experience) and identity (linked with learning as becoming). The four components are mutually defining and interconnected and as shown in the diagram (Figure 2) below:

![Diagram of components of a social theory of learning (Wenger, 1998, p. 5)](image)

**Figure 2 - Components of a social theory of learning (Wenger, 1998, p. 5)**

This model was useful to my study because it made connections between the individual’s experience of learning and the wider school community of teachers. Learning through experiences in the classroom and with colleagues, through doing activities with students, through belonging to a school community focused on changing practice and through developing a teaching identity or idiosyncratic way of implementing new initiatives resonated with my ideas about learning. How such learning impacted upon the change process or
provided catalysts or barriers to change would help inform my study. Wenger also notes that reflection on learning is integral to this model because it helps to “direct ..., [and] accelerate” (p. 9) learning. Not only did the INP in-class facilitation focus on reflective practice, but the interview process used in my research required the teachers to reflect on the changes they had undergone and their perception of what had hindered or promoted these changes.

**Challenges to Lave and Wenger.**

Communities of practice per se do not necessarily lead to change and there are challenges to an apprenticeship model in relationship to teacher learning. Firstly Graven (2004) proposes that Lave and Wenger’s (1991) apprenticeship model addresses learning but not teaching because within an apprenticeship model “teaching is more incidental than deliberate” (Graven, 2004, p. 184). There is a lack of insight into how teaching causes learning and how to translate Wenger’s (1998) ideas of learning on the job into “learning in more formal educational contexts where teachers (or facilitators, coordinators etc.) have a central role in ensuring that successful learning occurs and are, furthermore, held accountable for such learning” (pp.184-185). So will teacher learning within a school community generate sustainable change in their practice in the more formal setting of their classroom where certain expectations may exist? Successful teaching and the changes associated with this are dependent on successful student learning, but teaching does not necessarily result in learning. In this light, Timperley et al. (2007) warn that without challenging conversations and a focus on student achievement, communities of practice can cultivate complacency and become barriers rather than catalysts to teacher growth and change. The sociocultural framework that underpins my thesis needs to consider the impact of collegial interactions not only in promoting change, but also in inhibiting it.

Secondly at the individual level, Graven (2004) highlights the role of teacher “confidence as a product and a process of learning” (p. 208) which she identifies as lacking in Wenger’s (1998) model. Teacher confidence was important to my study when I explored the teachers’ perception of their ability to implement the changes consistent with the INP. I imagined this changing perception would be directly linked to the teacher’s personal experience of the process of change and it would also impact upon their emotional responses to change.
Conclusion

The consideration of a sociocultural perspective allowed me to appreciate the complex interaction between the individual, their actions, their social environment and the historical and temporal nature of a person’s learning. In research, a dilemma exists between analysis of the individual teacher and his or her learning and considering changes in the larger community of learners they are part of (Rogoff, 1995, 2003; L. Shulman & Shulman, 2004; Wenger, 1998). In my research the individual teachers’ stories were part of the whole school story which in turn impacted upon the teachers’ stories. Analysis on multiple levels was needed and this led me to the work of Barbara Rogoff (1995) who proposed a three-plane approach to the observation of sociocultural activity relating to personal, social and community interactions. This methodology is described in Chapter Four.

Having a theoretical framework in place provided a structure within which my research inquiry could now develop, but this did not preclude me, in fact it encouraged me, to uncover challenges to this stance. Barbara Jaworski (2006) warned that theoretical considerations, such as constructivism and sociocultural theories may help “analyse, or explain” change relationships in teaching, learning and practice “but they do not provide recipes for action: rarely do they provide direct guidance for practice” (p.188). She promoted a form of “critical alignment” within a community of practice where individuals are encouraged to question “the purposes and implications of aligning” themselves with the “conditions or characteristics of the practice” (p. 190); where teachers critically question the ways of doing things as part of the ongoing development of the practice they are aligning with. I concluded this chapter with no easy recipe to follow but equipped with my sociocultural lens and an awareness that it must not block out a reflective and critical eye on the world.
Chapter Three - The Literature Review

The recognition that the implementation of changes in the professional beliefs and knowledge, behaviours, organizational conditions, and outcomes of people working in schools and school systems takes place over time is a fundamental precept in educational change theory, research, and practice….Given the volume of published research on educational change over the past 50 years, it is perhaps surprising that our understanding of the process dimensions of educational change remains limited to a few core concepts that once articulated have assumed a taken-for-granted status.  

Stephen E. Anderson  (2010, p. 65)

Introduction

Change is both an individual and an organizational process (Bishop, et al., 2010; Cowie, et al., 2011; Fullan, 2001b; Kotter, 1995) and I acknowledge the need to pay attention to both the changing practice of individual teachers as well as the systems in which they work. Change for individuals needs to be supported by structures and systems within the whole school (Bishop, et al., 2010; Fullan, 2006b; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). As Stephen Anderson (2010) articulates in the quote above, our understanding of the process of educational change is limited. I hope this literature review will inform our thinking about the process of change.

This review is presented in three major sections, relating directly to the three research questions at the heart of this study. It attempts to map the field of change in relationship to: firstly the process of change at the school-wide level; and secondly, the change process as experienced by individual teachers. The third section outlines the barriers and catalysts to change and explores how these can be managed for both individual teachers and the school. Multi-dimensional connections exist between the individual change process and the school-wide experience and it is difficult to isolate one from the other. A new school wide initiative or professional development programme often provides the context and the initial impetus for individual teacher change. Hence I have presented the literature on school-wide change first. Initially I focus on models of educational change in order to highlight change as a process.
School-wide change process

There are numerous models that outline the process of educational change within organisations, but a smaller number of overarching ideas emerge as core to the discussion around educational change models. Stephen Anderson (2010) identifies four ideas as key to the process of change based on the work of a large number of researchers. These are:

(1) that change is an organizational process over time;

(2) that the process can be described and explained in terms of three broad phases;

(3) that activities associated with different phases are interactive, not necessarily sequential in time; and

(4) that change over time is less a process of direct replication [of newly presented practices] than one of mutual adaptation. (p. 71)

Research suggests teachers need three to five years (Bishop, et al., 2010; Hall & Hord, 2006; Higgins, 2003; Loucks-Horsley, et al., 2003; Stein, Schwan-Smith, & Silver, 1999) to implement a programme designed to make major changes to practice, supporting the claim that “change is a process not an event” (Fullan & Stegelbauer, 1991, p. 130). The ability of schools to sustain change is improved when the school’s culture is integrated with the objective of the change and professional development is not focused “on the quick fix of the day” but on “practices driven by results and continuous improvement” (Berends, Bodily & Nataraj Kirby, 2004, p.155, as cited in Bishop, et al., 2010, p. 86). The implementation of a new initiative is highly dependent upon relationships between the nature of the innovation and the school context (Higgins, 2004). This includes the school’s vision, goals, structures, systems, leadership, shared practices, knowledge base, motivation and, collegial support and relationships (Bishop, et al., 2010; Fullan, 2001b; L. Shulman & Shulman, 2004). Some examples of factors impacting on the progress and outcomes of innovations based on the school context are:

[the] perceived need and motives for change, innovation quality and complexity, fit with prior practices and beliefs, funding, resources and working conditions to enable change, quantity and quality of technical assistance, leadership stability and skill, participation in decision making by key stakeholder groups, competing priorities and expectation. (Anderson, 2010, p. 71)
The diverse interconnections between school culture and the form of the innovation along with the assumption of ongoing improvement, means that change is more a process occurring over time rather than a linear or short-term event (Hall & Hord, 2006). Numerous researchers connect this process to a model containing broad phases or stages (Anderson, 2010; Bishop, et al., 2010; Cowie, et al., 2011; Fullan, 2001c).

Michael Fullan’s (2001c) presents a three-phase model that I will use as a general framework to explore the change process. His model has the following components; **initiation** (or adoption or mobilisation), **implementation** (or initial use), and **institutionalisation** (related with incorporation, routinisation, or continuation) as shown in Figure 3.

![Figure 3- A simplified version of the process of change (Fullan, 2001c, p. 51).](image)

Some models have a greater number of stages, such as John Kotter’s (1995) Eight Steps to Transformational Change, based on American business organisations, or Bishop, O’Sullivan & Berryman’s (2010) seven-element model, based on their work with New Zealand schools in lifting the achievement of Māori students. A number of stages in these models have characteristics that align with the broader three aspects of Fullan’s model. Other models are similar to Fullan’s, with three stages, but with different names such as Leoni Degenhardt & Patrick Duignan’s (2010) school reinvention model used to make major changes in an Australian girls’ school to meet the needs of 21st century learners. Their model includes a strategy stage, a reinventing stage and a continually reinventing stage. Other models have different diagrammatic forms such as Eileen Piggott-Irvine’s three-cycle action research model (2000, as cited in Piggott-Irvine & Gratton, 2004, p. 4), based on her work with New Zealand teachers focusing on school improvement. An s-shaped curve or sigmoid
model (Cowie, et al., 2011; Fullan, 2004) was used as a metaphor for the overall shape of change in the New Zealand Curriculum Implementation Exploratory Studies (CIES) project (Cowie, et al., 2011) where ten schools were studied over three years 2008-2010 as they implemented the new national curriculum. The research reported on in this thesis is also carried out over a three-year period and I will look for similar patterns to those identified in the CIES project in KIS’s journey.

The sigmoid curve (Figure 4 below) used by Cowie et al. (2011) includes a growth phase, maturation phase and thirdly either a decline or new growth phase. This model was also drawn upon by Degenhardt and Duignan (2010). The idea comes from the growth of communities in the ecological sciences, and has also been used to explain ongoing patterns of growth and decline in organisations (Consulting, 2007; Degenhardt & Duignan, 2010). This curve maps ongoing changes over time and highlights the need to rejuvenate initiatives to avoid any regression in ongoing progress. The plateau at point A is a critical point for renewed efforts to avoid the slide into the decline phase at point B.

![Diagram of s-shaped or sigmoid growth curve](image)

**Figure 4 - Diagram of s-shaped or sigmoid growth curve (Cowie, et al., 2011, p. 2).**

Despite differences in stage names and form, I draw upon similar aspects of a number of models to enhance the understanding of the three key phases of the change process as identified by Fullan (1993).

The first phase of **initiation** involves decisions about the need for change and determining what programmes or practices to take on and how to engage people and resources towards implementing the envisaged changes (Fullan, 2001c, p. 65). Questions such as: Why do we need this change? What will it achieve? How will we know it’s successful? What resources do we need? Will this help our students? should be considered (Piggot-Irvine, 2005). A clear plan of action and strong advocacy is required at this initiation phase. Kotter
(1995) talks of establishing a “sense of urgency, forming a guiding group” and developing and communicating a “compelling vision” (p. 430) in the first stages of his model. Setting goals about improving student achievement based on a systematic identification of needs is part of the initial process of change (Bishop, et al., 2010; Parsons, 2001). The growth phase in the sigmoid curve is similar to this initiation phase. This is seen as a dynamic phase, linked with energy and new conversations about collective school and individual learning. The dip at the start of this phase identifies an initial awareness that “all is not well” (Cowie, et al., 2011, p. 3) as teachers are confronted with trying to use new approaches and tools and the need to change some things. This growth phase can be given a boost by starting the new initiative or supported by the arrival of a new school leader. The end of the growth phase is characterised by a rapid rise as a school enjoys short-term gains from their actions. These are described by Cowie et al, (2011) as “the fruits of change” (p. 5). These could include such things as improved student engagement and involvement in their learning, increased collective responsibility for student learning, a renewed sense of moral purpose, and benefits from engaging parents in discussions of student learning and developing a shared language and vision for learners and learning.

Exploration of the existing situation in the school is key at this first stage and may involve an iterative process as in the “plan, act, observe, reflect” cycle used in action research (Parsons, 2001; Piggot-Irvine & Gratton, 2004). Piggot-Irvine’s Problem Resolving Action Research Model (PSAR) model (Figure 5 below) encompasses this approach. This model was used by professional development facilitators to support collaborative problem solving to promote school-wide change in appraisal systems in New Zealand (Piggot-Irvine 2003, as cited in Piggot-Irvine & Gratton, 2004).
This cyclic process allows for ideas to be trialled and changed and new suggestions to be considered before moving to the next stage. Numerous small cycles or “spinoff cycles” (p. 4), with the focus on systematic, critical reflection of teaching practice in conjunction with other colleagues and the professional development facilitator, can promote and support the change process. For example there may be a need to find out what the teachers’ current views and classroom practices are around group work before moving to the implementation stage, especially if group work is to be part of the new initiative.

At the implementation stage teachers, often along with a professional development facilitator, are working to put the innovations into practice in the school. Implementation requires impetus to get the change going (often with momentum developing from a small starting group), positive pressure and support (Fullan, 2010), and changes in teacher practice and beliefs (Timperley, et al., 2007). Within the NZNDP, the implementation stage challenges teacher’s beliefs about how their students learn mathematics. Dissonance with their traditional approaches and beliefs emerge for the teachers as they hear the students explain their strategies for solving problems in the diagnostic interview, from observation of their students learning as they watch the facilitator teach, and from analysis of their student
achievement data (Higgins & Parsons, 2009). The principal’s leadership in managing the change is vital to successful implementation. Their effort in resourcing the initiative with materials and time, facilitating teacher collaboration, sharing leadership, encouraging challenges to be openly discussed and being an interested learner with the staff are key to this stage (Bishop, et al., 2010; Cowie, et al., 2011; Degenhardt & Duignan, 2010; Robinson, Hohepa, & Lloyd, 2009).

In the sigmoid model this second phase is presented as the maturation phase and is plateau-like, where “additional time and energy are required for the next adaptive breakthrough” (Fullan, 2004, p. 14). This phase is associated with “horizontal learning” (Gee, 2004, as cited in Cowie, et al., 2011, p. 7); exploring and getting familiar with the newly learnt approaches without making a lot of new vertical progress in terms of skill level. It also allows time to get all people up to date with the changes that have occurred. Cowie et al. (2011) stress the importance of supporting this work across all levels of the school saying it “entails interactive to and fro between whole-school, team and individual learning. Professional learning needs to be sustained at all three levels and to remain connected across them” (p. 7). All three aspects of Rogoff’s (1995) sociocultural theory, which I use as the framework for this research, are paralleled in the above description of activity at the maturation phase of the sigmoid model. The results from the CIES confirm this choice of approach where learning within the school takes place at all three levels; the individual (personal), the team (social) and the whole-school (community). Change enthusiasts who have taken the vision and put it into practice in their classrooms can take leadership roles with their colleagues (Cowie, et al., 2011). In doing this these leaders need good people skills to connect with and motivate others, and to integrate people together across different class, team or whole school groupings. Building leadership capacity in a number of teachers is important to sustain the initiative into any new growth phase. The ultimate aim at this stage is ownership of the initiative by the teachers. This tends to be a slow process emerging over time (Fullan, 2001c; Piggot-Irvine, 2005). To move past the plateau requires adaptations rather than just using any newly developed technical knowhow. This relates to Anderson’s (2010) fourth key change idea of “mutual adaption” and the ongoing rejuvenation of change discussed by Degenhardt & Duignan (2010) where new ways of thinking and connecting with others, that go beyond our current capacities, are needed.

Fullan’s final phase of institutionalisation, which is similar to “sustainability” as used in the NZNDP (Ell & Irwin, 2006; Higgins, 2004; Thomas & Ward, 2006) refers to the absorption of the innovation into ongoing school organisation, structures and teacher
practices. Throughout the change process the school and teachers not only make changes in line with the professional development programme or initiative, but also adapt the programme to meet the specific conditions in the school. Higgins (2004) confirms the importance of this adaptation within the NZNDP, stating: “Transformation of the structure over time appears to be a critical component in ensuring the sustainability of the project” (p. iii). New and adjusted roles may emerge for teachers, parents and students, different timetables, forms of assessment, student groupings and physical learning spaces can develop in this adaptation process (Bishop, et al., 2010; Degenhardt & Duignan, 2010). This may mean for example, working across classes using online collaborative group technology to adapt the structure modelled within the professional development project, or linking with neighbouring schools in creative ways to share planning or teaching. Constant analysis of student performance and reflection on evidence gathered about the goals of the initiative, in order to focus on improvements, is crucial to sustainability (Bishop, et al., 2010; Thomas & Ward, 2006). This can lead to a “reinventing school culture” (Degenhardt & Duignan, 2010, p. 51) similar to the new growth phase in the sigmoid model where constant self-review and subsequent new changes are evident. Cooperative efforts of a group of staff at school-wide level is needed to sustain these continual rejuvenating processes and collegiality is a key factor in supporting longer term changes (Higgins, 2004).

The central circle of Fullan’s model (Figure 3, p. 20) shows the overall outcomes of the change process, which are usually based on improved student learning, the development of new skills or attitudes and improved capacity of the school to solve its problems or meet the ongoing needs of the students (Fullan, 2001c). But the reality of the change process is not so straightforward. There are limitations as to what you can present in one general model of change and phase models like Fullan’s are criticised as being simplistic.

**Critique of phase or stage models.**

A limitation of Fullan’s and similar phase models is that they appear linear and stage-by-stage although Cowie et al (2011) warn that the phases they describe do not necessarily take place in a sequential manner. Anderson (2010) notes that change should be seen more as a change of state for the teachers and the school, in the sense that it is more than a passing phase but instead a reinvention. Ongoing growth and change is clearly evident in Piggot-Irvine’s (2004) “continued action” arrow at the top of her action research model and in the “continually reinventing culture” (p. 50) of Degenhardt & Duignan’s (2010) model. They describe this as a culture “whereby everyone expects change and seeks continual
improvement” (p. 50). This ongoing renewal and continual improvement focus is not obvious in Fullan’s model. However, there is a paradox that exists in use of the word culture in the term “continually reinventing culture”. Schein (1992, as cited in Degenhardt & Duignan, 2010) notes that culture is, “a stabilising conservative process, whereas a learning culture attempts to institutionalise and stabilise learning, innovation and change” (p. 50). This highlights the difficulty in having an ever changing aspect to culture and the need to avoid getting caught or “freezing” (p. 50) in any new paradigm of operating along the continually changing path. Further limitations to stage models include the lack of reflective, cyclic processes and inattention to the need for evidence-based data to drive this action (Bishop, et al., 2010). The dynamics of the change process are also less evident in Fullan’s model with its lack of recognition of the ups and down of the change experience (Piggot-Irvine, 2005).

In defence of Fullan (2001c), his model does however show some interactive relationships (signified by the arrows in Figure 3, p. 20) between the three phases, which signifies that the phases do not necessarily occur sequentially. This interactive, non-ordered dynamic is Anderson’s third key idea about the change process summarised earlier in this section (p. 19 this thesis). What happens at one phase may feed forward or back into the other phases. For example Piggot-Irvine’s (2005) initiation questions noted earlier could be reused at times during the implementation or institutionalisation phase to refocus on the ongoing purpose and outcomes of the initiative. Another point in Fullan’s (2001c) model’s favour is his suggestion that it can be used in a multi-dimensional way to describe the situation where a school may be involved in more than one initiative. A school may be at different phases in the model for each different initiative it is undertaking. This is the reality for New Zealand schools that may be involved in numerous new initiatives or professional development projects, simultaneously. Since 1993 schools have been involved in ongoing implementation of new curriculum and associated nationally, rolled-out, school-wide professional development programmes. These include for example, the Information and Communication Technology professional development programme (ICTPD), Assessment to Learn (AToL), Literacy programmes and NZNDP. KIS, for instance, had completed the ICTPD contract in 2001 then started the NZNDP initiative in 2002 and moved into the AToL contract in 2004, which was the last year in which the school is followed in this research.

Less evident in the above models of change are the school-wide structures within which a change process is situated. A professional learning community is an example of a holistic school-wide model that can facilitate the process of change. But professional learning
communities were in their infancy in New Zealand schools in the early 2000s when this study took place.

**Professional learning communities.**

A professional learning community involves a planned and organised school-wide system for teacher learning that focuses on improved classroom practice and outcomes for students (Timperley, et al., 2007). Recently the development of professional learning communities has been the focus of professional development programmes (Bishop, et al., 2010; DuFour, 2004; Parsons, 2005; Timperley, 2008). A professional learning community model involves a shift in focus from teaching to learning. More specifically; helping each individual student to learn rather than a broad focus on the learning of all students is paramount. Thus:

A professional learning community is one in which teachers update their professional knowledge and skills within the context of an organized, school-wide system for improving teaching practices. Teacher’s efforts, individually and collectively, are focused on the goal of improving student learning and achievement. (Timperley, 2003, p. 129)

Numerous researchers have summarised the characteristic of effective professional learning community (Bishop, et al., 2010; Parsons, 2005; Du Four, 2004; L. Shulman & Shulman, 2004; Timperley, 2003). I have précised the work of Bishop, et al. (2010, p. 83) who drew upon Timperley (2003), Stoll and Seashore (2007) and Nieto (2000, as cited in Bishop, et al., 2010) to summarise these as follows:

1. Communities engage in reflective dialogue and use this to evaluate and challenge their own assumptions and practices.
2. Communities keep a collective focus on student learning and achievement and data is used to make decisions about learning.
3. Teachers share expertise and critically examine practices and student achievement and participation to engage in joint planning and future goal setting.
4. Practices are de-privatised and teachers learn from peer coaching.
5. Values and expectations about learning and achievement are shared and there are agreed beliefs and vision about what is important and how this will be achieved.
Sitting alongside this list both Parsons (2005) and Bishop et al (2010) include the importance of professional leadership and supportive management structures. All of these processes are designed to improve outcomes for students and this is the key that links engagement in a professional learning community with teacher change.

Du Four (2004) identifies three components of learning in his description of a professional learning community, with inherent roles for both individual teachers and communities of teachers working together. These are: (1) ensuring that students learn, (2) a culture of collaboration and (3) a focus on improving student results. Each of these ideas also underpinned the NZNDP professional development within which my INP study was situated (Graham, Geddes, & Potter, 2004; Parsons, 2005). Du Four (2004) presents three key questions to be addressed by those working within a professional learning community to ensure that students do benefit from learning and change is precipitated. These are:

1. What do we want each student to learn?
2. How will we know when each student has learnt it?
3. How will we respond when a student experiences difficulty in learning? (p. 8)

He considers that attention to the third question is what distinguished a school operating as a learning community from a traditional school. Teachers need to identify the incongruity between their desire for each student to learn and the strategies they are presently using that have not allowed all students to progress. The school-wide implementation of systematic strategies to address these differences is part of operating as a learning community. These three questions are addressed within the NZNDP model of professional development (Higgins, Parsons, & Hyland, 2003b). The New Zealand Number Framework identifies progressions for students’ learning in number so that the teachers know what they want the students to learn. An initial and follow up one-on-one diagnostic interview, carried out by all the teachers with each student in their class, generates data about what each student has learnt. In line with the third question under-achieving students are identified and discussion between the teachers, numeracy facilitators and lead teachers on how to improve outcomes for these students is encouraged.

Developing school structures encourages the second component, a culture of collaboration. This collaboration is characterised by teachers working in teams, spending time in each other’s classrooms, analyzing and sharing practice in order to improve and engaging in ongoing reflection and questioning about their teaching and their students’ learning.
Schools may endorse the idea of collaboration, but “the staff’s willingness to collaborate often stops at the classroom door” (DuFour, 2004, p. 9). An inherent assumption in collaborative discussions is that team members feel comfortable to share views about their goals, strategies, resources, concerns, assessments and student results in a public way. A “critical colleagueship” develops within a community where a non-threatening, supportive environment of professional discourse and critique is fostered (Wilson & Berne, 1999, p. 195). Higgins comments on the importance of peer support in encouraging sustainable classroom practices within the NZNDP. These structures include teachers talking together, observation of each other’s practice, support from an ongoing ‘critical friend’ who gives feedback and suggestions on observed teaching sessions, and the sharing of videos of teacher’s practice (Higgins, 2004).

Thirdly, professional learning communities work together to improve student achievement by using data about students as a catalyst for improving teacher practice (Bishop, et al., 2010; DuFour, 2004; Goddard, Hoy, & Woddfolk, 2004) and this evidence of improved achievement is what supports the ongoing change. Research in New Zealand on quality teaching by Adrienne Alton-Lee (2003) identifies the importance of synthesizing the results of student achievement in order to improve outcomes for students. Thomas and Tagg (2005) carried out a three–year longitudinal study of 19 schools who had been involved in the NZNDP for a combination of 1 to 4 years. They researched the importance that schools placed on reflecting critically on their students’ achievement data as a way of improving student achievement. Students in the thirteen schools that set school-wide targets for numeracy and collated and used student achievement information to inform their practice performed better than the students in the other six schools that did not. Focusing on student achievement data had helped these schools improve outcomes for their students and change practice.

But professional learning communities in themselves do not generate change (Timperley, 2008). For teachers to change, learning activities need to be focused on teachers working together, with the support of school leaders and often initially external support, to become responsive to students, to process new information and to remain fixated on the goal of improving student achievement. Learning about new curricula or pedagogical practices can be “thwarted by the norms of politeness and absence of challenge” (Timperley, 2008, p. 19). Difficult conversations about, for example, specific results or student work samples are needed to break down complacency of practice. The norm of privacy and isolation in classrooms needs to transform into one of collegiality, peer coaching and community support
for inquiry into practice (Bishop, et al., 2010). Bishop et al. (2010) conclude that a professional learning community needs to sit within a structured, institution-based context where the community can develop their own means of sustaining ongoing improvement and not be dependent on the “outside expert” (p. 83). They promote school ownership of the change process.

In conclusion, a school-wide professional learning community as described above can provide a structure in which the change process can proceed. Organised reflection, through planned syndicate or whole school discussion time, allows for joint reflection and critical review encouraging teachers to think in new ways. Collective responsibility for goal setting and enacting together strategies that can lift the achievement of all the students enhances teacher confidence and helps motivate changing practices. Teacher’s ability to enquire into their own teaching and their awareness of the potential for learning is increased when “supported by membership in a learning community” (L. Shulman & Shulman, 2004, p. 267). But, Gene Hall and Shirley Hord (2006) suggest that, “an entire organization does not change until each member has changed” (p. 7) and hence the nature of individual change is explored in the next section.

**Change as a personal process**

This section will address questions about how individual teacher change occurs during the implementation of a reform agenda. Change in a teacher’s practice does not happen in one step, but it is a progressive process that takes time and persistence (Bishop, et al., 2010; Kotter, 1995; Loucks-Horsley, et al., 2003). Individuals who change their practice over time go through stages in how they feel about the change and how confident they are in using the changes (Claxton & Carr, 1991; Hall & Hord, 2006; Hall & Loucks, 1978; Loucks-Horsley, et al., 2003; Piggot-Irvine, 2005).

Over thirty years ago, Gene Hall and Susan Loucks (1978) presented a framework of change outlining a developmental process in both attitudes and behaviours when describing teachers’ efforts to put new approaches into practice. Stephen Anderson (2010) describes this work as a “seminal conceptualization” (p. 65) in his review of the evolutionary perspectives of educational change. Robert Marzano (1995) states that the Hall and Loucks’ model is “perhaps the most popular educational model” used to describe the “psychological phases with regard to innovation or change” (p. 162). Hall and Loucks (1978) proposed a Concerns-Based Adoption Model (CBAM) with two dimensions; one the development of dispositions
towards change called “Stages of Concern”, and the other a developmental progression in
behaviours as teachers use new professional development practices termed “Levels of Use”
(as cited in Anderson, 2010, p. 66). This model still underpins much of today’s research. Hall
and Hord (2006) have completed a comprehensive overview of research relating to CBAM.
In their work with experienced teachers, they identified seven stages (going from 0-6
inclusive) for each of these dimensions. These are summarised in the table below:

Table 1 - Stages of Concern and Levels of Use (Adapted from Halls and Hord, 2006,
pp. 140 & 160)

<table>
<thead>
<tr>
<th>Stage/Level</th>
<th>Stages of Concern (Attitudes towards change)</th>
<th>Levels of Use (Progression in knowledge and skills)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 UNRELATED FOCUS</td>
<td>Awareness</td>
<td>Non use</td>
</tr>
<tr>
<td></td>
<td>Aware of the change but little knowledge or interest in it</td>
<td>No use of innovation</td>
</tr>
<tr>
<td>1 SELF FOCUS</td>
<td>Informational</td>
<td>Preparation</td>
</tr>
<tr>
<td></td>
<td>An interest in gaining information about the change</td>
<td>Active planning to implement new approaches but at a later date</td>
</tr>
<tr>
<td>2 SELF FOCUS</td>
<td>Personal</td>
<td>Mechanical Use</td>
</tr>
<tr>
<td></td>
<td>Anxiety about implementing the change and how it will affect them personally</td>
<td>Using the innovations but in a teacher-focused way and struggling with mastery of new teaching skills</td>
</tr>
<tr>
<td>3 TASK FOCUS</td>
<td>Management</td>
<td>Consequence</td>
</tr>
<tr>
<td></td>
<td>Accepts the innovation as useful but has concerns about implementing it into teacher practice</td>
<td>Considers the consequence of the change on the outcomes for the students</td>
</tr>
<tr>
<td>4 IMPACT FOCUS</td>
<td>Consequence</td>
<td>4A) Routine Use</td>
</tr>
<tr>
<td></td>
<td>New approaches are integrated into teaching strategies but with few adaptations to the regular programme</td>
<td>Adjustments to the programme based on the impact on students</td>
</tr>
<tr>
<td>5 IMPACT FOCUS</td>
<td>Collaboration</td>
<td>4B) Refinement Use</td>
</tr>
<tr>
<td></td>
<td>Focuses on working collaboratively with others to improve the benefits for the students</td>
<td>Adjustments to the programme based on the impact on students</td>
</tr>
<tr>
<td>6 IMPACT FOCUS</td>
<td>Refocusing</td>
<td>Renewal</td>
</tr>
<tr>
<td></td>
<td>Modifications to the innovation or new approaches are developed.</td>
<td>Active exploration of changes to the innovation and seeking out alternative practices</td>
</tr>
</tbody>
</table>
During the first three progressions of this model teachers move from an initial disinterest in the innovation to a focus on wanting to know more and then worrying about how this might affect them. At progression 3 the teacher focus is on getting all the material ready to use with the students and figuring out how to use and manage the new resources in their classroom. The focus then moves to the students and thinking about how the new initiative affects their learning. At progression 5 the concerns relate to working with colleagues in the interests of improving student achievement. At the final progression 6, teachers are able to adapt the newly developed approaches to use in different ways to meet the needs of their students and are exploring other ideas that they think may work even better.

The CBAM is useful in helping to understand teachers’ reactions to change during the process of innovation (Degenhardt & Duignan, 2010). Degenhardt and Duignan identify teachers in their case study school as ranging across all seven stages, at particular points in time. This diversity of teachers’ responses to new learning is also highlighted by Timperley et al. (2007) who identify six “responses of diverse teacher learners” (p. 14). These are similar to the concerns identified in the CBAM, but Timperley et al. suggest that various combinations of these responses may be evident in a community of learners rather than offering any progression. Their six responses are:

- reject/ignore new theory and practice and continue with prior practice;
- continue with prior practice, believing it is new practice;
- select parts of new theory and practice and adapt to new practice;
- implement as required;
- actively engage with, own, and apply new theory and practice and change practice substantively;
- demonstrate enhanced regulation of own and others’ learning. (p. 14)

A stage model, similar to CBAM, called The Five Ages of a Numeracy Teacher (FANT) scale was developed by a number of facilitators as part of the NZNDP (D. Carter, 2002; Hughes, 2003; Moody, 2003). This model identifies specific behaviours in relationship to numeracy teaching practice and was used by the researcher with the teachers who were participants in the research reported in this thesis. The FANT scale focuses on teacher behaviour and classroom practice and is similar to stages 2-5 in the CBAM above. It is based on the work of Peter Kugel (1993) and was used to gain an understanding of teachers’
journeys within the NZNDP (D. Carter, 2002; Hughes, 2003; Moody, 2003). The five stages are summarised in the table below, with reference to the similar stage on the CBAM: Stages of Use progressions.

*Table 2 - Five Ages of a Numeracy Teacher Scale (Adapted from the work of D. Carter, 2002; Hughes, 2003; Moody, 2003)*

<table>
<thead>
<tr>
<th>STAGE (Similarity to CBAM stage)</th>
<th>AIM</th>
<th>CONCERN</th>
<th>FOCUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ORGANISATION (CBMA: Stage of Use 2)</td>
<td>Change from whole-class to group teaching</td>
<td>Management of students</td>
<td>Setting behaviour expectations and ensuring these are met</td>
</tr>
<tr>
<td>2. SUBJECT (CBMA: Stage of Use 3)</td>
<td>Identify and try out the new tools</td>
<td>Finding and learning how to use the new tools as a teacher</td>
<td>Matching resources and activities to the numeracy framework stages</td>
</tr>
<tr>
<td>3. STUDENT (CBMA: Stage of Use 4A)</td>
<td>Understand how the tools will be used to promote learning.</td>
<td>Understanding what students are doing and saying</td>
<td>Matching the resources and activities to the students’ learning</td>
</tr>
<tr>
<td>4. LEARNING (CBMA: Stage of Use 4B)</td>
<td>Interpret the students responses and adjust planned teaching activities</td>
<td>Learning to be flexible</td>
<td>Using feedback to manage changes in the difficulty or direction of a task or question</td>
</tr>
<tr>
<td>5. OTHERS (CBMA: Stage of Use 5)</td>
<td>Support colleagues in their teaching</td>
<td>Learning what help is appropriate to support others</td>
<td>Modelling and explaining what you are doing to students and other teachers</td>
</tr>
</tbody>
</table>

It is acknowledged that the stages did not occur in isolation, but rather teachers focus on a mix of these aspects. Concern for student behaviour and planning appropriate tasks was ongoing but key foci shifted over time as identified by the progressive stages. Although simplistic, the FANT model was designed to explain changing teacher practices over time and was useful in helping individual teachers identify their current situation and plan their next steps (Hughes, 2003). This along with the frameworks described above helped me identify the changes over the three-year period for the teachers in this study. However there are limitations to the FANT and CBAM models of teacher change.
Challenges to stage models.

Images of a step-by-step process identifying the ‘concerns’ or ‘behaviours’ stages that individuals pass through seems a simplistic approach (Anderson, 2010, p. 66) and this ideal evolution may not always occur (Hall & Hord, 2006). Connections, or jumps, between and around certain, identified stages over time, give more credence to the complexity of the individual change process. Sense-making, as described by Piggot-Irvine & Gratton (2004) and Timperley, et al (2007), involves cycles of exploring and understanding new theories, new practices and seeing changed results for students. This presents the change process more as a journey than any ordered sequence of proceedings. Anderson (2010) surmises that researchers using the CBAM model note discrepancies with the stage process, such as that some teachers did not get to the final stages of refining the innovation based on student observation, or struggled with the collaborative stage. The shift to CBAM stages 4 or 5 may be more a product of the organizational culture of the school than on a “teachers’ individual mastery” (p. 67) in the use of the new practices. Whether the school places an emphasis on “improvement in student learning through shared goals, teacher collaboration, and ongoing teacher learning activities” (p. 67) is important in facilitating individual teacher growth (Dufour, Eaker, & Dufour, 2005; Little, 1982; Rosenholtz, 1989, as cited in Anderson, 2010, p. 67). The wider issues surrounding school culture are not considered as part of the FANT model, but they are crucial to teachers interpreting and internalising the ideas of the numeracy project in their own classroom and school (Higgins, 2004).

Sociocultural factors situating the individual as part of the wider school culture need to be considered alongside any models of change. There is a relationship between changes in teaching practice and school culture and structural changes such as “grouping students for instruction; creating opportunities for teacher to share knowledge collaboratively; taking greater responsibility for budget …and making professional development part of regular responsibilities” (Bishop, et al., 2010, p. 78). But in considering the work of Elmore (1996, 2004, as cited in Bishop, et al, p. 78-79), Bishop et al. conclude that simply developing “new structures will not necessarily cause teachers to change their practice” (p. 79). Teaching decisions are related to complex, internalised conversations connecting past and present practices, decisions about what to teach, familiar practices and personal and peer thoughts on how one should teach rather than pre-empted by the nature of any structures teachers are placed within. In order to change practice you “start with the practice and modify school structures to accommodate it” (Elmore, 2004, p. 4, as cited in Bishop, et al., 2010, p. 79). This
can include structures that promote collegial support and reflection on student achievement issues that are discussed previously in this chapter, under professional learning communities.

A further social dimension not directly obvious in these stage models is the impact of any external support from professional development facilitators. What teachers do, and the successes they have, are influenced by the quality of any external facilitation they receive (Hall & Hord, 2006; Higgins, 2004). Quality facilitation is cognisant of the specific context within which each teacher operates. The ability of the facilitator to access this context and provide appropriate modelling and observation of practice, and give structured feedback to the teacher in ways that promote their individual growth is important (Higgins, 2004). Facilitators need to consider teachers’ personal beliefs, values and self confidence in teaching (Graven, 2004) as these may also inhibit teachers from moving through these stages.

Affective factors such as beliefs, attitudes values and emotions underlie responses to change and this affective domain can have a pervasive impact on teaching and learning (Fullan, 2010; James, 2010; McLeod & McLeod, 2002). In making explicit the importance of teacher beliefs, Robert Marzano (1995) suggests that the CBAM Stages of Concern progression assumes some acceptance of a certain framework of beliefs and principles aligned with the specific innovation. If these beliefs are not integrated into the teachers’ practice at the management stage 3, then the innovation may never move beyond the personal concerns evident at stage 2. A person’s existing set of perceptions and beliefs, and how these are repositioned or transformed during the change process are critical to how one interacts with proposed changes (Franke, Carpenter, Fennema, Ansell, & Behrend, 1998; Fullan & Stegelbauer, 1991; Handal & Herrington, 2003). In particular, Mathematics Education literature confirms that changing teacher practice is directly related to changing teacher beliefs (Chapman, 2002; Hart, 2002; Lloyd, 2002; McDonough & Clarke, 2005; Philippou & Christou, 2002; Wilson & Conney, 2002). But there is difficulty in determining the nature of this relationship. Different emphases exist about what comes first the changing beliefs or the changing practice and there are limitations in identifying either in isolation from the other (Wilson & Conney, 2002). The interaction between teacher beliefs and practice, and the change process needs to be considered as a further complexity alongside any stage model of growth. Such an exploration is beyond the scope of this study.

A further challenge to stage models is that teachers may experience related emotions or characteristics of numerous stages at one time and with different intensity. A metaphor of “stages as notes in a musical chord that can be played in ways that give emphasis to different feelings depending on the teachers’ progress in context” (Anderson, 2010, p. 67) provides an
image rich in dimensions and connections depicting the inherent complexity of emotional responses to change. The unique, situated and emotive responses of individuals to the change process presents a challenge to any change model considered so far in this literature review.

The affective domain needs greater emphasis in reflections on change and it is importance in capturing the emotional aspects of individual teacher change (Fullan, 2010; James, 2010). Schools are “places with a high level of affective intensity” and “the work of teaching and organising in schools can call up a whole range of feelings. Learning requires motivation, which has an affective component” (James, 2010, p. 48).

**Emotions-based models.**

Numerous researchers acknowledge grief and the associated emotions as a vital part of change (Edwards, 2008; Fullan, 2001b; Hall & Hord, 2006; James, 2010; Piggot-Irvine, 2005). To learn something new you have to unlearn and “in educational change significant objects and aspects of educational work may be discarded, deemed redundant and lost” (James, 2010, p. 49). Responses such as loss, anxiety and struggle are common to all change both imposed and voluntary (Fullan, 1993) and should be regarded as normal (Fullan, 2001b; Kotter, 1995; Piggot-Irvine, 2005). Teacher change involves loss; loss of a teacher’s usual ways of doing things and their beliefs about what comprises effective practice. Their standard seating plan, their management techniques, the nature of their relationships with students, how the power is distributed in the classroom, and a teacher’s views on how students best learn can all be, if not quite lost, at least transformed, by the change process initiated by professional development programmes (Claxton & Carr, 1991). Restructuring of meaning and of our ways of thinking is required and this can “generate conflicting feelings, which can influence behaviour” (James, 2010, p. 49). We cannot return to the situation before the loss, or forget the past and move on, but rather we struggle to resolve the dilemma and restore equilibrium. This struggle for equilibrium can take energy and time, draining “people’s vitality” (p. 50). John Edwards (2008) proposes that in choosing to action new ways of thinking “you must get worse before you get better” (p. 6). He represents this pictorial with a pit-like graph (Figure 6) that shows a transformation from negative learning (L-) and confusion to a positive position (L+) where the new learning is clearly understood.
Figure 6 - John Edwards’ Transformational Learning (2008, p. 6)

Similar patterns are proposed by Michael Fullan (2001b) in his reference to the “implementation dip” (p. 34). These pits or “chasms” (Fullan, 2001b, p. 40) may be cyclic and reoccur over time and different individuals may move in and out of ‘the pit’ at different times (Edwards, 2008; Piggot-Irvine, 2005). Grappling with the ‘pit’ is fundamental in the process of change and although “very difficult to deal with, …[is] essential in helping to motivate actions” (James, 2010, p. 61). Teachers may be anxious, feel overwhelmed or angry about what they perceive is expected of them and this can lead to a lack of motivation or a perceived inability to enact the changes promoted by the professional development (Edwards, 2008). They may perceive they are unable to do what the professional development facilitator or lead teacher can do. The nature or timing of in-class support may foster a teacher’s feeling of inadequacy.

To be asked to do things, or take on jobs, that we do not know how to do with little time or support to learn, and to be criticised (or criticise ourselves) for not being able to respond immediately, to be asked to behave in a way that conflicts with our values, attitudes or self-image can, and does, lead to overload and stress. (Claxton & Carr, 1991, p. 4)

All the above factors may contribute to the downward cycle into the ‘pit’. But not everyone goes into the pit or comes out of it. Chris James (2010) notes that some people never accept change and that “the conservative impulse in educational practice can be strong and overwhelm adaptive capacity, which is the readiness and capacity to learn and change” (p. 49). This emotional dip is further explored by Eileen Piggot-Irvine (2005), where she represents possible phases of personal change over time with a “Change Grief Cycle” (p. 3) shown in Figure 7.

Piggot-Irvine assumes the reactions encountered in everyday situations of grief and loss (death or separation) are similar to those encountered in situations of change, concluding that
“in any grief there is a reasonably consistent pattern of behaviour that follows a cycle” (p. 3). The reactions to change shown on the left hand side in Figure 7 do not necessarily represent an ordered process, but rather just a list of possible responses.

### Figure 7 - Change Grief Cycle (Piggot-Irvine, 2005, p. 3)

Comparable terms to the Change Grief Cycle model are outlined by Guy Claxton and Malcolm Carr (1991) in their framework of teacher’s responses to professional development based on the New Zealand Learning in Science Project. They outlined a sequence of changes that a teacher may go through, in no strict order, when making major changes to their philosophy of teaching. Initial responses of entrenchment and opposition associated with “it’s nothing to do with me” (p. 7) comments are similar to Piggot-Irvine’s (2005) denial and rejection. Claxton & Carr identified further responses including starting to think the change is a possibility and dabbling with some of the ideas presented in the project, agreeing with the merits of the idea but unsure about how practicable it is. Teachers may show commitment and
enthusiasm deciding to “go for it” (p. 7), although still holding some private misgivings. Along with commitment teachers may seek clarification, (striving for meaning in Piggot-Irvine’s (2005) model) by further reading or discussing ideas with others, introspection in which they reflect on their previous teaching and become aware of the limitations it presents, and planning where exploration and initiative is involved in the search for new ideas and advice on how to change. Claxton & Carr depict the experimentation stage as a struggle to implement the new approaches; where teachers are constantly subverted by “old habits” (p. 8). Teachers may accommodate the new ideas and approaches to fit in with what they already know and feel comfortable with, rather than shift their practices and beliefs to one of acceptance of the new philosophies and practices (Anderson, 2010; Clarke, 1997; Claxton & Carr, 1991; Hall & Loucks, 1978). This is similar to Piggot-Irvine’s (2005) contextualisation response. Teachers may feel deflation when things do not work out as they used to, planning takes longer or the students do not behave as well as before. Anger at the people who instigated the project and dropping out is possible at this stage and this is consistent with the low point in Piggot-Irvine’s cycle. Claxton & Carr (1991) continued their model to include recuperation and reappraisal characterised by new commitment and extension of the new ideas into other parts of their teaching. They suggested that some teachers can become evangelistic and “adopt the role of preacher in the classroom” (p. 8). Others may move to a more positive stage of seeing the limitations in an approach while still being committed to the change and ultimately the new approach permeates all of their teaching. If the change works well, then Fullan (1993) suggests that a sense of mastery, accomplishment and professional growth should replace the initial feelings of inadequacy. The specific barriers and catalysts to change that precipitate such feelings of inadequacy or mastery and determine the nature of any movements in and out of the pit are outlined in the following final section of this literature review.

Catalysts and barriers to change

This section addresses the actions that support teachers during the change process; what helps get a school through the implementation dip and moving beyond any plateaus or maturation phases to further growth and development as well as what hinders and frustrates their path. The barriers are often implicit in the catalysts. A catalyst may pre-empt a barrier in that the lack of that catalyst could have led to a barrier or a catalyst may emerge in response to the development of a barrier. A barrier for one person may be end up being a catalyst for another as they take up the challenge the barrier presents. Or the catalyst of, for example,
external support to one person may generate fear and apathy in another, making it a barrier for them. A specific, unique mix of barriers to change can lead to a slide into apathy and inaction on the part of individuals or larger numbers within the school as the combination of issues becomes overwhelming. The challenge and discomfort of overcoming the barriers is often a necessary prerequisite to further growth and progress (Edwards, 2008; James, 2010). These catalyst and barriers are relevant to the experience of both the individuals and the collective group of teachers that make up a school.

**Catalysts to change.**

From his considerable experience in change research, Michael Fullan (2010) identifies five forms of “positive pressure” that he suggests provide motivation to “hordes of people” (p. 122). He identifies a sense of urgency motivated by moral purpose, partnerships and peers, transparency of data, non punitive accountability and irresistible synergy as providing “positive pressure” (p. 122) for change. I have extended my review to include eight broad catalysts to change that are prevalent in the literature and relevant to the context of this study. Fullan’s five factors are referred to within these categories.

**Moral purpose and its link to improved student outcomes.**

Appealing to a sense of moral purpose is a way of engaging educators in the reform process. Without staff dedication and support any initiative is unlikely to succeed. Hence lack of moral purpose, or the means to pursue it, is a barrier to change, but having moral purpose is a catalyst. Staff commitment to a reform initiative is often linked with moral purpose (Fullan, 2001b) or maanakitanga (Bishop, et al., 2010) which refers to “the building and nurturing of a supportive environment” (p. 19) and a commitment to social justice and improving the achievement of all students (Fullan, 2006a). Fullan (2010) describes moral purpose as, “a confident but humble sense of real hope that this can be done” and a “can-do attitude” (p. 122) associated with a whole team approach. He stresses the importance of a “sense of urgency” linked with the means to help it happen, rather than just blind passion (Fullan, 2010). At the forefront of teacher thinking is an awareness of their input into the success of any innovation. Promoting a sense of moral purpose can be enhanced by sharing agreed school values possible through telling stories of school life that have values inherent in them. Teachers can be “reheartened” by this process and reclaim “their sense of power, moral purpose and professionalism [which] is a powerful lever for change” (Degenhardt & Duignan, 2010, p. 175). Teachers, by nature of their profession, want to improve the achievement of
their students. Engaging in new teaching practices that can be seen by teachers to have a positive impact on student engagement and achievement leads to higher teacher motivation and higher teacher expectations of students (Timperley, 2008). In contrast, a barrier can emerge if teachers are expected to address student learning difficulties without support to develop effective approaches (Fullan, 2010; Timperley, 2008). Learning how to effectively use new pedagogical tools can provide the means to promote the enactment of striving for a moral purpose associated with improved outcomes for students.

**NZNDP structure as a catalyst for change.**

The NZNDP uses “three pedagogical tools” (Higgins & Parsons, 2009, p. 233) to provide structure to the programme of teacher learning. These are the number framework, the diagnostic interview and the strategy teaching model. These tools act as a catalyst for change as teachers engage with their individual students in the diagnostic interview, discover what they know and do not know and can and cannot do, and determine the next steps in learning based on the number framework. The items in the diagnostic interview are aligned with the number framework. Joanna Higgins and Ro Parsons (2009) concluded that in carrying out the interview with students, the teachers not only identify the stages of their students knowledge and strategy use, but further develop their personal understandings of the number framework and “the types of questions they might use in teaching students strategies” (p.234). “Increased teacher responsiveness” (p.234) to the diverse learning needs of their students is sought as an outcome of the diagnostic interview process.

The strategy teaching model (p. 5 this thesis) is designed to be used by the teachers to help learners bridge the gap between concrete material and abstract number properties when promoting the use of problem solving strategies. The power of the number framework, the diagnostic interview and the strategy teaching model in precipitating teacher change is related to their interconnectedness, where each tool informs and supports the other (Higgins & Parsons, 2009). Once the teachers have personally identified where students are at in their learning with the diagnostic interview, and they are aware of what future learning trajectories there are from the number framework, and how they might promote this learning using the strategy model, then high motivation to do something can emerge.

**Leadership.**

The principal’s participation in, and promotion of, teacher learning and development as part of her role as a pedagogical leader is critical to enhancing student outcomes and teacher
support for change. This is confirmed by Viviane Robertson, Margie Hohepa and Claire Lloyd (2009) who, in their meta-analysis of leadership studies, found this dimension of leadership has at least twice as much effect on improving student outcomes as other aspects. This includes the principal ensuring a focus on the relationship between teaching and learning, promoting “collective responsibility and accountability for student achievement and well-being” (Robinson, et al., 2009, p. 42) and giving advice to help resolve teaching issues. The principal was expected to engage fully and support the teachers within the NZNDP and participate in the teacher workshops. Cowie et al (2009) found that principals who showed a commitment to their personal professional learning helped motivated teachers to do likewise. Principal modelling of ongoing learning became a catalyst to change and heightened staff expectations about the provision of professional development.

Although principal leadership is required for curriculum reform, distributed leadership is vital to sustaining change. Input from lead teachers and other staff within a school is vital to supporting and refreshing on-going change (Chrisman, 2005; Degenhardt & Duignan, 2010; Thomas & Ward, 2006). “Teachers …say …they get their best ideas from peers and effective principals exploit that confidence while building shared practice” (Cowie, et al., 2009, p. 29). Principals need to be present in the school, generate discussion and networks amongst the staff, make resources available to encourage collaborative teacher learning and build connections within the school community (Cowie, et al., 2009). Such leadership that spreads responsibility throughout the school “enhancing [the] decision-making capabilities of others” (Mintzberg, 2004, as cited in Fullan, 2006a, p. 16) is central to sustainable change in a school.

Leaders need to have a clear vision and plan for their participation in the reform (Piggot-Irvine, 2005). The way things are organised (e.g. meeting times, teaching times, leadership roles) and the infrastructure (e.g. room use, furniture, computer access) may need to change (Bishop, et al., 2010). Fullan (2006a) uses the term “capacity-building” which may involve adjusting resources, strategies and policies to align the innovation and “to increase the collective power of the people to move the system forward” (p. 6). Unfortunately a clear vision can work against change, immobilising people as they can clearly see the ways they will look stupid or incompetent in the future scenario (Black & Gregeresen, 2002, as cited in Fullan, 2006a). Hence understanding the change process, planning for the pace of change (Cowie, et al., 2009) and building trusting relationships with staff is needed to support changes (Notman & Henry, 2009; Robinson, et al., 2009).

Leaders, who can consider different people’s perspectives, treat others with respect, have integrity and are capable, can earn peoples’ trust. These trusting relationships are needed
to encourage “the levels of inquiry, risk-taking, and collaborative effort that school improvement requires” (Robinson, et al., 2009, p. 47). Daniel Golman (1996) uses the term “emotional intelligence” (p. 268) related to recognising feelings and identifying the links between feelings, thoughts and reactions. Leadership that is catalytic to change needs to draw upon emotional intelligence and show empathy for others. Golman outlines that this involves acknowledging others’ feelings and perspectives, managing the diversity of teacher views, accepting different, shared understanding and divergence from one’s own view, resolving conflict and mediating compromise. This also involves reflection on the personal values that guide a leader’s decision-making (Notman & Henry, 2009). Effective leaders require emotional maturity to manage the anxieties that learning can produce (Robinson, et al., 2009). Such maturity also assists principals in drawing peers together and forming partnerships that will support teacher growth and student learning.

**Peer collaboration.**

Collegial activity where peers support each other in planning, understanding new ideas, the use of new resources and tools, reviewing student achievement and spending time in each other’s classrooms provides a major catalyst to change. This is most powerful because engaged peers, in increasing numbers, can generate positive pressure and momentum to implement the changes (Fullan, 2010). Within the NZNDP, the teachers identify “collaboration between teachers about numeracy practices as the most helpful factor for sustaining numeracy” (Thomas & Ward, 2006, p. 124). Fullan (2010) uses the term “horizontal peer learning strategies” (p. 122) to highlight the importance of teacher participation where teachers learn about strategies from peers as they work together to implement the new initiative. This can include such activities as teachers observing each other’s practice, teachers acting as “critical friends” or buddy teachers where teachers are provided with practical advice and a discussion forum within the context of their everyday classroom practice (Higgins, 2004). Higgins (2004) concludes that:

Innovation in teaching practices amongst a small group of staff provides a foundation for individuals to internalise changes to their practice. A collective internalised effort creates a dynamic from which change can be sustained at the school level. (p. 59)

This learning in action process is consistent with the apprentice model within a sociocultural framework (Jaworski, 2006; Lave, 1996; Lave & Wenger, 1991; Wenger, 1998) and was the process underpinning the in-class modelling component of the INP (Higgins,
By positioning teacher learning within the classroom the teachers become “the enactors and interpreters of the fundamental ideas of the project” (Higgins, 2004, p. 51) within their own context. Higgins (2004, 2006) notes that this helps not only build teacher efficacy and authenticate the new teaching approaches, but allows the facilitator or observing colleague to take cognisance of the individual teacher’s situation. In-class modelling was confirmed as a catalyst to change in the NZNDP (Higgins, 2002; Thomas & Ward, 2002).

Learning that parallels the expectations of the classroom was further confirmed as building teacher confidence by Mellony Graven (2004), in her work on teacher learning within mathematics teaching in South Africa. Graven (2004) confirmed the value of a community of practice (Wenger, 1998) in building self-efficacy, confidence and ownership of new learning. She found that reflection on progress as well as frustrations is supported by teacher collaboration. Similarly Piggot-Irvine & Gratton (2004) note that collaboration within an action-research model can “enhance ownership and commitment to change” and leverage the change to a level frequently unattainable through individual reflection alone” (p. 9). Openness that is developed out of trusting collegial relationships where problems can be discussed and resolved and collective responsibility for progress assumed can assist a school to take responsibility for an initiative.

**School and teacher-initiated ownership of the changes.**

Schools that successfully sustain new programmes are those that take ownership of their ongoing professional learning. In this situation change is sustained through cooperative relationships between the facilitators, principals, lead teachers and teachers that transform as the programme progresses (Le Fevre, 2010; Thomas & Ward, 2006). The school develops autonomy and ownership of the project and the teachers develop a sense of efficacy based on evidence of improved student learning (Bishop, et al., 2010; Higgins, 2004). In numerous research studies teachers identify that teacher-initiated changes in teaching and learning contributed to sustained teacher learning and improvement in student achievement (Chrisman, 2005; Higgins, 2004; Timperley, et al., 2007). Chrisman (2005) explained that teacher ownership of decision making around teaching and learning including for example internal leadership structures, school policy, mentoring and student intervention programs are evident in schools that sustain ongoing students’ success and teacher motivation for change. But teacher developed reflection processes that focus on reviewing student work and discussing how to strengthen classroom practices in response to student achievement are a fundamental
catalyst in helping teachers integrate new learning into classroom practice (Chrisman, 2005; Thomas & Ward, 2006; Timperley, 2008; Timperley, et al., 2007).

*Teaching practices linked to assessment data and transparency.*

The importance of evidence-driven data as a catalyst to change is well covered in recent educational literature (Bishop, et al., 2010; Fullan, 2010; Ministry of Education, 2004, 2007b, 2010; Timperley, 2008; Timperley, et al., 2007). Fullan (2010) pinpoints transparency about the practices that produce the results including “specific, precise, visually clear images of what works” (p. 123). He talks of a relentless focus on “non-punitive accountability”, which promotes high expectations, rather than judgementalism, as a “powerful strategy for improvement” (p. 123). This links with the need for de-privatisation (Louis, Kruse, & Raywid, 1996), not only of teaching practice in the classroom, but specifically about the impact teaching has on learning as measured by targeted student outcomes that are carefully scrutinised with an improvement focus in mind. This is ‘easier said than done’ and external expertise is often required to assist schools in making such transparency of practice and scrutiny of data an everyday and ongoing part of changes that teachers need to make.

*External expertise.*

The use of external expertise is often a necessary catalyst to change because of the level and amount of new learning expected as part of the change process. The presence of an external facilitator is not sufficient for change, but rather what is important is the strategies they employ “to make the content meaningful for teachers and manageable within the [ir] context of teaching practice” (Timperley, et al., 2007, p. xxix). Their input is enhanced when facilitators work in ongoing “iterative ways” (p. xxix) involving discussion and feedback in the teacher’s own classroom. Facilitator visits to the school where classroom activities, teacher beliefs and issues were discussed were highly valued by teachers, lead teachers and principals in NZNDP (Thomas & Ward, 2006). Thomas and Ward (2006) further confirmed that schools and teachers identified ongoing facilitator support, as central to sustaining numeracy developments in schools.

Workshops and the introduction to new resources provide motivation to explore new initiatives. Thomas and Ward (2006) found both the teachers and the lead teachers in the NZNDP valued these aspects of the professional development most highly. The workshops provided exposure to new mathematical content knowledge and pedagogical content knowledge. Teachers gained confidence by using the specific activities that they would use in
their classroom with the students. Engaging with these activities in the workshop not only supported the teachers’ content development, but also their pedagogical content knowledge as they experimented with how to use the activity with others. It is easier to build contextual understanding by participating in the learning rather than observing it (Higgins, 2006; Lave & Wenger, 1991). Expertly run workshops can provide teacher learning that mirrors the expectations of their classroom context and this plays a role in developing teacher confidence (Graven, 2004) and provides a catalyst to try new ideas. But ultimately the experts leave and the teacher needs to take responsibility for the strategic planning and cohesion that will sustain the initiative.

**Synergy.**

Alignment and coherence between the goals of new initiatives, teaching and assessment practices, school-wide policies and strategic decisions helps provide an integrated and focused approach that facilitates change. Such cohesion, along with a clear purpose and a relentless focus on positive support for change can generate “irresistible synergy” (Fullan, 2010, p. 128). This, when based on partnerships with others, can pull people along with the changes. Fullan (2010) outlines a process where people become more skilled through purposeful, collegial action, this increases their understanding and together this helps generate shared ownership of new initiatives. This was supported by studies of schools working to implement the New Zealand Curriculum (Cowie, et al., 2009; Cowie, et al., 2011). Developing and enacting a shared vision around curriculum linked to teaching and assessment practices provided positive motivation to the schools and “created a stronger sense of shared purpose amongst staff” (Cowie, et al., 2011, p. 5).

This synergy needs to extend to different initiatives or professional development projects that schools undertake (Le Fevre, 2010). Fullan (2006a) notes the importance of focussing intently on how innovations connect, while the CIES talks of this as “de-cluttering” (Cowie, et al., 2011, p. 5) to ensure greater integration between different practices. It is important, for example, that the numeracy contract work is integrated with assessment contract activities if both activities are going on simultaneously in a school. New Zealand teachers and schools have been inundated with Ministry of Education professional development initiatives linked to curriculum change over the last twenty year (Cowie, et al., 2009). If too much is expected of teachers too quickly, negativity and inaction can result (Fullan, 2010), and this becomes a barrier to change. This was a major concern of the facilitators and only somewhat for the principals and the teachers within the NZNDP (Thomas
& Ward, 2006). New initiatives usually bring with them increased resourcing: money, facilitator time, and physical resource provision. These can be difficult for a principal to turn down but expecting the teachers to focus their learning into new areas, where there is no obvious synergy, each time a newly funded project is offered, creates tension (Cowie, et al., 2009; Fullan, 2001b). Hence strategic selection of initiatives closely aligned with a set of school-wide goals and strategic vision is vital to maintain teacher engagement and motivation to change (Willis & Bourke, 1998).

Barriers to change.

Lack of curriculum content knowledge, knowledge of how to teach a specific subject (pedagogical content knowledge) (J. Shulman, 1986), and knowledge of how students learn, are barriers to change. Teachers need help in building relationships between their own understanding, their students’ thinking and research-based models of students’ thinking within their own classroom context (Fennema & Franke, 1992; Higgins, 2004; Rhine, 1998). Teachers are supposed to know what they are teaching and “confronting one’s own uncertainties in understanding can make a teacher feel inadequate and ashamed” (Ball, 1996, p. 505). The importance of underlying content knowledge in order to effectively integrate teaching strategies, especially in mathematics teaching was highlighted by Timperley et al. (2007) in their research synthesis on teacher professional learning. Professional learning may overcome these barriers initially, but they may challenge the teacher again as the students’ advance in their learning. Within the NZNDP, Fiona Ell and Kay Irwin (2006) concluded that teachers may be able to sustain the organisational aspect of the programme but lack “the depth of insight and interaction [needed] as the students progress” (p. 136). This demands not only content and pedagogical knowledge, but also the teacher’s ability to access their student mathematical understanding and how they are learning (Timperley, et al., 2007). Deborah Ball (1996) confirms the discomfort generated by a lack of teacher understanding, “If student understanding becomes problematic, one’s own understanding becomes problematic... And this is at least unsettling” (p. 505). Undertaking professional learning to manage this complex interplay between content knowledge, pedagogical content knowledge, knowledge of student learning and the ability to assess student understanding can be overwhelming for teachers and presents a major barrier to change (Timperley, 2008). This, along with uncertainty about the worth of new approaches for the student’s learning can generate resistance to new ideas.

Entrenched viewpoints, fear and mistrust, or a lack of motivation can lead to teacher resistance to implementing new agenda’s creating a barrier to change. Resistance to new
ideas, or lack of motivation was identified by the lead teachers and facilitators in the NZNDP but less so by the teachers and principals (Thomas & Ward, 2006). Thomas and Ward (2006) suggested that the lead teacher was working directly with the classroom teachers and was more directly exposed to the feelings and actions of her colleagues. She had a greater understanding of the teachers’ situation and greater empathy for the struggle being part of the process herself. Fear, resistance, and unwillingness to change also hindering the teachers’ adoption of the reinvention process at Loreto Normanhurst School in Australia (Degenhardt & Duignan, 2010). Between 20-30% of the teachers in this school identified these three barriers. This resistance can emerge out of disharmony between present and new approaches and whether or not the new ways are compatible with the assumptions that underlie current practices. If teachers’ personal beliefs and theories about students’ learning and appropriate teacher practices are different from those being promoted, then new learning becomes more challenging (Timperley, 2008). This can be “profoundly uncomfortable” even for teachers who are “confident in their professional role” (Timperley, et al., 2007, p. viii). It requires teachers to be prepared to not only explore the new ways, but to consider the limitations of their previous approach and reframe their ways of determining “what knowledge is valued” (Timperley, 2008, p. 17). This is hard because “specific and tangible” losses, in term of familiar practices and tool use, are easily identified at the start of the change process while the gains in terms of student understanding and achievement are more “theoretical and distant” (Fullan, 2006a, p. 9).“Many prefer to be competent at the [old] wrong thing than incompetent at the [new] right thing” (Black & Gregerson, 2002, as cited in Fullan, 2006a, p. 9). Resistance can also be related to feeling overworked and lacking in time for class preparation, assessment and professional learning.

The pace of change and the associated lack of time is a barrier that is omnipresent in the literature (Bishop, et al., 2010; Cowie, et al., 2009; Degenhardt & Duignan, 2010; Hall & Hord, 2006; Thomas & Ward, 2006). Within the NZNDP, one third of the teachers in Thomas and Ward’s (2006) study reported that a lack of “teacher time to plan, teach, and assess numeracy was… a barrier” (p. 125). The lack of funding for release time to work with other teachers was also a constraint identified in the NZNDP by principal, teachers, facilitators and lead teachers (Thomas & Ward, 2006). Time to prepare resource material inhibits teacher implementation of new initiatives as does availability of resources and the ease with which these can be used by the teachers (Degenhardt & Duignan, 2010; Thomas & Ward, 2006). Teacher support in terms of extra release time, or help with the use of new resources or in-class facilitator assistance usually reduces over the time of professional development projects.
This lack of lack of ongoing professional development following initial support is seen as a barrier by schools (Thomas & Ward, 2006).

The learning and implementation of a new teaching agenda seems to be an iterative, cyclic process rather than a linear one (Cowie, et al., 2009; Cowie, et al., 2011; Timperley, et al., 2007). Thus a lack of timely and ongoing professional development can be a barrier to further growth. Timperley et al (2007) found that professional development offered over longer timeframes and with regular contact was necessary, although “how the time was used was more important than the amount of time” (p. xxviii). The need to build capacity, through a leadership team or peer support, that can provide ongoing guidance within the school is critical to overcoming this barrier (Degenhardt & Duignan, 2010; Thomas & Ward, 2006; Timperley, et al., 2007). A further role of this in-school leadership group needs to be the training of teachers new to the school. Difficulties in employing a teacher, who was not familiar with the new initiative was identified as the foremost barrier to sustainability in the NZNDP, by lead teachers and principals (Thomas & Ward, 2006).

Conclusion

This literature review discusses and critiques models of both school-wide and individual change processes that schools and teachers undergo when implementing a new initiative that requires a major change in current practice. At the school-wide level, the issue of change as a process over time, with the need for collaborative efforts and the rejuvenation of school systems and direction along the way emerged (Anderson, 2010; Degenhardt & Duignan, 2010; Thomas & Ward, 2006). The importance of synergies within the school including distributive leadership practices and a common focus on evidence-driven improvement in student achievement was clear (Timperley, et al., 2007). Professional learning communities can provide a structure for such focus. At the individual level, models of individual teacher change reveal changes in both knowledge and skills enhancing classroom practice as well as changes in attitude and emotional responses to the expectations of change (Halls & Hord, 2006; James, 2010). The interaction of these factors is complex and idiosyncratic and when overlaid with a specific personal, classroom and school context create unique responses to change.

There a number of common catalysts and barriers to change (Fullan, 2010) and teachers may experience these at different times, with different intensity. Lack of knowledge about subject content, learning and learners is a major on-going barrier to changing practice.
(Ell & Irwin, 2006; Timperley, et al., 2007). The need for, or fear of, new learning can generate resistance to change and interplay with the challenges of time and resourcing to create multiple hurdles to overcome during the change process. These barriers can be overcome by developing structures and systems in the school that generate collaborative ownership of the changes and support for individuals to implement. Such catalysts to change need to be complemented by teaching practices that focus on student achievement data and shared responsibility for student improvement (Bishop, et al., 2010; Fullan, 2010; Timperley, 2008). The initial role of external experts and the continuing role of school leaders in facilitating teacher confidence (Robinson, et al., 2009) and a self-reflective school culture (Cowie, et al., 2009) is a crucial catalyst for sustainable change.
Chapter Four - The Design of the Study

Interpretivist inquiry, consequently, pleads for a metaphor that is “thick”—replete with multiple levels of understanding; assembled from many “ingredients”;... perhaps the metaphor is a quilt. Or a poem. Or a double helix. Whatever it is, it is intensely organic, many layered, what T. S. Eliot called the multifoliate rose. Yvonna Lincoln (2010, p. 6)

Introduction

All qualitative research is interpretative and guided by the researcher’s values and beliefs about the world and how to understand and study it (Denzin & Lincoln, 2005). Interpretivist inquiry gives credence to the joint construction of meaning and focuses on a discovery approach to research where insights emerge from the data rather than being pre-determined and validated. Interpretive research assumes; “an interactive process, shaped by his or her (the researcher’s) personal history, biography, gender, social class, race, and ethnicity, and those of the people in the setting” (Denzin & Lincoln, 1994, p. 4). Interpretivism acknowledges the complexity of the human condition and attempts to understand the host of interconnected, interdependent phenomena that comprise particular situations. Yvonna Lincoln’s quote above highlights the need for multiple, ever-developing methods of inquiry that are carefully woven together as in quilt, poem, double helix or multifoliate rose in order to assist our understanding of this complexity.

The “organic” nature of research inquiry, noted by Lincoln above, was reflected in the data gathering and data analysis in this inquiry. I used an emergent research design in order to allow data collection and data analysis to become simultaneous, ongoing tasks. This meant that key understandings could be discovered during the research process and then explored further by the collection of additional data. An example of this extra data gathering was in the form of a written survey, prepared by the participants, in response to a perception that a number of teachers were struggling with implementing the INP initiative. This was initiated and compiled by the lead numeracy teacher in the school independent from any researcher input. However, the survey results were shared with the researcher and thus became part of the data gathering. Qualitative inquiry methods of interview and narrative were part of the original design, but the change journey graphs and written survey emerged during the research process.
In the first section of this chapter I discuss feminist theory because I became aware in writing up this thesis that it had influenced the way I carried out the research process surrounding this study. Section Two focuses on the methods of data gathering including the sampling methods that I used. The processes surrounding the transcription and analysis of the data are discussed in Section Three. This includes the use of three plane analysis (Rogoff, 1995) as a tool to highlight the sociocultural nature of the school context.

**Feminist Theory and Research Methods**

Rather than setting out to undertake feminist research, I wanted to acknowledge a feminist perspective complementing the “act of knowing” (Crotty, 1998, p. 141) in this study. In particular the importance of the affective component in research (the world of emotions and caring), which was identified by Crotty as part of feminist epistemology. Secondly feminist theory prompted me to consider the issues of power and identity in carrying out this research within a community of teachers. My desire to form a relationship with the participants and to avoid being directive or controlling in the research process aligned with feminist research methodologies. The methodologies and methods feminist researchers use act as tools to enhance equity and social justice and free them from “the limiting of human possibility through culturally imposed stereotypes, lifestyles, roles and relationships” (Crotty, 1998, p. 182).

Feminist researchers may use a variety of methods, for example; interviewing, oral history, action research, case study, narrative and collaborative research. This flexibility in the methods use can help them “to link past and present ‘data gathering’ and action” and to acknowledge the changes “that occur to them and others in a project of long duration” (Reinharz, 1992, p. 197) A desire “to be responsive to the people studied” (Reinharz, 1992, p. 197) is also an aspect of feminist research that I embraced. These methods, and their flexibility, were consistent with my approach to the participants in this longitudinal study. I wanted to develop a non-threatening, comfortable but responsive relationship with my research participants that allowed them to share their change journey. My role as a co-facilitator of the INP where I was directly involved in helping the teachers in the school helped foster this responsiveness.

The feminist researcher “means many things to many people” including “a researcher, a gendered individual, and a person whose race/class/nationality/education denotes a particular power relation with others” (Reinharz, 2011, p. 8). I had numerous different roles and
relationships with the teacher participants in this research setting. I was a researcher, a professional development facilitator, a College of Education lecturer, an ex-teacher, and ex-lecturer of one of the participants, a woman, a mother, white middle-class and middle-aged. All these roles had varied power positions associated with them and how I carried out my roles, and how the participants viewed me in these various roles, needed to be acknowledged.

Reinharz (2011) further identified feminist theory as sensitive to “hidden voices and identities” (p.13). The “hidden voices” in the school setting may be the less confident teachers, the new teachers, the female teachers, the older teachers or any one feeling oppressed by the power or confidence of others. Crotty (1998) explained this “abiding sense of oppression in a man-made world” (p.182) as a commonality in differing feminist research stances. Different power relations exist within school, between teachers, between students and teachers, between teachers and the principal and also in this inquiry between the researcher and the participants. So I needed to ensure I listened to all the voices of the participants in the study.

Feminist theory has also impacted upon the way I have written this thesis. By using a narrative approach based on the voices of the participants, I wanted the reader of this thesis to connect directly with the teachers in this study. This style is a characteristic of feminist research described by Rheinharz (1992) as “a desire on the part of the researcher to address the reader directly and to forge a connection through her between the reader and the people studied” (p. 267).

**Ethics of Research**

In undertaking research there is a need to consider ethical issues such as informed consent, deception, privacy and confidentiality and accuracy (Denzin & Lincoln, 2002). Permission was sought and granted by the University of Otago Ethics Committee at the commencement of this study. Because the study was situated within the NZNDP, permission was also gained from the Curriculum Facilitator at the Ministry of Education. The nature of the research project was discussed with the numeracy facilitator, principal, teachers and the Board of Trustees of the school. A voluntary consent form was then completed by all the participants and the Board of Trustees. A copy of the consent form for participants is included in Appendix 1. But, researchers need to aware of the ethical dilemmas and tensions that emerge as they carry out qualitative research and this sheds doubt on the validity of informed consent (Malone, 2003). The participants and the researcher cannot know in advance what
direction the study may take, thus the participants’ ability to give consent to a process that is still to unfold is questionable. Hence I needed to be self–critical about the limitations of the consent process. I also needed to be sensitive to any maternalistic assumption or misrepresentation in my reporting of this research (Pendelbury & Enslin, 2001). I did not intend to deceive the participants or the readers of this research in anyway and I hope the descriptions of my research process in this chapter will confirm my methodology as trustworthy. Confidentiality and anonymity of both the individual teachers and the school was paramount in undertaking and writing up this study. All the names of the teachers, the principal, the facilitator and the school are pseudonyms and the participants had the right to withdraw from the project at any time without disadvantage. Shirley Pendelbury and Penny Enslin (2001) promote the importance of participant “agency and choice” (p. 369) as an imperative for ethical research. Hence the participants had the opportunity to comment on and make changes to the final school and individual narratives to ensure the accuracy of the reported results. Their comfort with the process and product of this research was of key importance.

Data Collection Methods

Narrative methods.

In this research project I used narrative as an approach to the interpretation of the data and in presenting the summarised results. Over twenty years ago, Michael Connelly and Jean Clandinin (1990) noted the value of narrative in educational settings stating:

Humans are storytelling organisms who, individually and socially, lead storied lives. The study of narrative, therefore, is the study of the ways humans experience the world. This general concept is refined into the view that education is the construction and reconstruction of personal and social stories; teachers and learners are storytellers and characters in their own and others’ stories. (p. 2)

Narrative, or storytelling, is the way we share our life experiences with others and ourselves. As a process it is embedded in the social life we live. The study of narrative is the study of the way people experience the world: “One’s personal history, the traditions of which one has been a part, and the social and community relations in which one engages form the plot outlines of day to day life” (Clandinin & Connelly, 1991, p. 259). Our experiences reflect the tide of thoughts and meanings we bring to the situations we live in and when we present these to others they “assume the shape of a story, or narrative” (Denzin & Lincoln, 1994
The deliberate telling and retelling of life’s story is a method of “personal (and social) growth” (Clandinin & Connelly, 1991, p. 259) which aligns with educational goals. Understanding what is meaningful in a person’s history can help us understand their classroom actions (Connelly & Clandinin, 1987). Clandinin and Connelly (1994) refer to the work of Dewey who saw education, experience and life as “inextricably intertwined” (1994, p. 415) and they proposed narrative inquiry as a vehicle to move Dewey’s notion of education as a “form of social life” into “practical methods of educational research and reform” (p. 259). Narrative research bases itself on a process of growth through storytelling.

The use of the term ‘narrative inquiry’ refers to both phenomenon and method. ‘Narrative’ refers to the form and nature of the experiences studied (phenomenon) as well as being the name given to the methods of inquiry used. Clandinin and Connelly (1994) distinguish this by calling the phenomenon the ‘story’ and the method of inquiry the ‘narrative’. Narrative inquiry can relate to a diverse range of approaches and methods (Chase, 2005) including field notes, interview transcripts, journal records, and other material such as classroom plans, newsletters and drawings (Clandinin & Connelly, 1991). The reported research story can be considered the outcome of the narrative inquiry.

Narrative inquiry involves making meaning out of past experiences. Susan Chase (2005) described it as “a way of understanding one’s own and others’ actions, of organizing events and objects into a meaningful whole, and of connecting and seeing the consequences of actions and events over time” (p. 656). This process was relevant to both the researcher and the participants in my project. I chose to organise the teachers’ experiences of the change process and the events surrounding this into a meaningful whole school story and consider the catalysts and barriers to this change process over time. From the teachers’ perspective, the use of ongoing interviews facilitated storytelling of past experiences as they reflected on how things had changed over the three years in the study. Narrative methods need to view the overall picture and consider the change from beginning to the end, rather than get lost in the small details. Connelly and Clandinin (1990) noted that narrative inquiry is “driven by a sense of the whole and it is this sense that needs to drive the writing (and the reading) of the narrative” (p. 2). How to negotiate between the big and the small picture creates a challenge in writing narratives (Stake, 2005). This was especially relevant to my project where I developed the whole school narrative from the details of the participant and their interpretations of their experience.

Stories allow for multiple interpretations to emerge with different versions of the truth developing from different stories (Bishop & Glynn, 1999). It allows each storyteller to hold
the “power and control” (p. 178) and to decide the story and its meaning for them. Narrative stories are put together by the researcher. The texts are peopled by characters who are in some measure the creations of the author, and the events reported are particular constructions (Coffey, 1996). Robert Stake (2005) concluded that; “even when empathetic and respectful of each person’s realities, the researcher decides what the case’s “own story” is, or at least what will be included in the report” (p. 456). Even if the research is based on the researcher’s first-hand, personal experience the interpretative process that allows the story to be told distorts and removes aspects of the lived experience. The actual experience cannot speak for itself and some researchers claim that any record of it, is in effect, a personal interpreted story about the experience (Chase, 2005; Clandinin & Connelly, 1994).

Stories are “powerful research tools” (Witherell & Noddings, 1991, p. 280) that allow us to see real people and their problems. They portray the richness, nuances, ambiguity and dilemmas of experience (Carter, 1993). Listening to and telling stories is a communal process and as such implies a social construction of meaning framing research as a social activity. Narrative accounts can help promote caring attitudes to other people as well as share insights that may prompt readers or tellers to action. Narrative, set within the context of caring conversations, can support the “co-construction of knowledge by the researcher and participant” (Freidus, 2002, p. 171) that involves greater inclusiveness and meaning making. “It helps teachers to know more ... and know that they know more” (Freidus, 2002, p. 171) as well as making what they know accessible to others (Lyons & Kubler LaBoskey, 2002). Teachers need “safe spaces” (Craig & Olson, 2002, p. 115) to discuss and share their stories in order “to reflect upon their bases for their professional practice and decision-making” (p.116). This restorying process can help teachers “construct and reconstruct their personal practical knowledge” (Lyons & Kubler LaBoskey, 2002, p. 192) in order to make sense of the complexity of teaching. The four teacher interviews in this project facilitated the narrative process which led to the narrative findings presented in this thesis.

Interviewing.

In this research project semi-structured and open-ended interviews were used as the major form of data gathering. An open questioning technique was employed, where the precise nature of the questions that were asked was not fixed in advance. Focus questions were prepared for each interview stage and the researcher was committed to giving the subjects the opportunity to pursue individual lines of reflection and to suggest other areas for discussion (Bishop & Glynn, 1999). Structured interviewing provides little flexibility in the
way the questions are asked and few opportunities for interpretation of meaning to be
explored or personal views to be expressed (Fontana & Frey, 2005). Because of these
limitations, a structured interview method was not employed. I wanted a method that was
responsive to my participants’ stories of their experience and one that provided opportunities
for reciprocal input (Oakley, 1986).

Semi-structured and unstructured interviews offer access to peoples’ ideas, memories
and thoughts in their own words (Reinharz, 1992). In this mode, discovering patterns through
listening rather than asking a question is the purpose of an interview. The interviewer hopes to
hear the voice of another through a range of “conversational interactions” (Gilchrist, 1992, p.
80) that focus on listening to, rather than talking to, the informant (Beer, 1997; Chase, 2005;
Gilchrist, 1992; Kvale, 1996; Reinharz, 1992). Many researchers have argued that the
interviewing process of question and answer is not just an impartial exchange, but rather an
interactive, collaborative effort between the interviewer and the interviewee (Fontana & Frey,
2005). The interviewer is seen as a partner engaged in an active process with the participant
“that leads to a contextually bound and mutually created story” (Fontana & Frey, 2005, p.
696). This is consistent with a feminist research ethic where the interviewer and the
interviewee are viewed to be on equal terms. Reinhardt (1992) noted that the interview may
be guided by the participant and thus close attention to detail on behalf of the researcher, and
an amount of trust that the interviewee will head the interview into useful directions, is
required. The ongoing in-school work that was part of the three-year professional
development programme in this study gave an opportunity for the researcher and the teachers
to develop a mutually supportive and trusting relationship. As the co-facilitator I had a
responsibility for, and was in fact part of the making of the overall INP experience; it was a
joint activity. This helped the teachers develop greater confidence in sharing with me
knowing that to an extent I was also accountable for their progress. In having ‘a stake’ in the
outcome I was certainly not a neutral observer.

Researchers have highlighted this lack of neutrality as problematic in the interviewing
noted that interviewers bring “unavoidable conscious and unconscious motives, desires,
feelings and biases” (p. 696) into the interactions in the interview. One solution to this
promoted by Douglas (1995, as cited in Fontana & Frey, 2005) concerns the interviewer
revealing their personal feelings and situations to the interviewee in a show of ‘good faith’.
But Fontana & Frey (2005) warned that these techniques could be seen as a means to elicit
further revelations from the interviewee, rather than develop a greater bond with them.
Soul searching around motives, data interpretations and contradictions evident in the data is needed by the research interviewer. Multiple interpretations are linked with “perspective subjectivity” where researchers take different perspectives and ask different questions of the same text and elicit “different interpretations of the meaning” (Kvale, 1996, p. 212). Kvale views this as a strength of interview research and warns against a “biased subjectivity” (p. 212) where researchers only notice evidence that concurs with their own ideas. The influence of the researcher as the interpreter and author of the study is problematic (Fontana & Frey, 2005) and this needs to come under scrutiny.

What is represented and reported on from the interview, usually, ultimately is decided by the researcher (Stake, 2005). Reflectivity in acknowledging what we learn about ourselves, in trying to understand the participants and our impact on the phenomena we study, can help reveal researcher influence (Fontana & Frey, 2005). An awareness of situational differences can enable the researcher to perceive anomalies and differences between their world and the world of the interviewee. Recognition of this “discontinuity” (Beer, 1997, p. 122) allows interviewers to change the intent and direction of the questioning to encourage the interviewees to explain how they view their own situation. Beer (1997) uses a “shift in the slant of light” (p. 125) metaphor to describe this opportunity for changing understandings which requires the researcher to reconfigure their assumptions and theories based on the new vision.

**Sampling methods**

The people, events, places and situations that produce social phenomenon involve variability and difference (Maykut & Morehouse, 1994). This means that in selecting a research sample, within a qualitative research design, careful consideration should be given to the inclusion of participants or settings that may give rise to greater variability. This is called “purposive sampling” (Maykut & Morehouse, 1994, p. 45) and contrasts with random sampling, that uses random selection and large sample sizes and is associated with quantitative research design.

The selection of the Intermediate School involved in this study, was not done using purposive sampling but rather KIS was the only Intermediate School in my geographic region that qualified for funding from the Ministry of Education to support the implement of the INP
in 2002. KIS was a decile\(^3\) 4 school of around 300 students, in a densely populated, low socio-economic area. The school was predominantly European (75%), but included a significant number of Māori students (15%), Pacific Islanders (8%) and other ethnic groups (2%). The specific, predetermined characteristics of KIS, and the restricted nature of the way in which this school became my research setting, is an overall limitation of this study. But my selection of the teacher participants was purposive and did produce a greater variation. I choose to include all of the twelve classroom teachers at KIS in 2002 in my study. This did not include the specialist teachers such as the Art or Technology teacher. In the subsequent two years of the INP all of the new classroom teachers who came to the school were included as participants in the study. Initially I was unsure of the need to interview all twelve classroom teachers in order to give a picture of the whole school and felt that a cross section would be sufficient, but the difficulty of how to choose the teachers in order to generate such a cross section created a dilemma. How would I know at the start from which factors or type of teachers, rich, diverse data would emerge? Hence all the classroom teachers were interviewed during the three years of the project although some were unavailable at various times. The nature and resultant variability in the participants as well as the number of times each was interviewed is outlined below.

**The participants and the interview process.**

All participant names have been changed so they are not individually identifiable in the presented results. Although from one school, the diversity of ages (ranging from 25 to 63 years), teaching experience (between 3 and 40 years) and level of mathematical background (completed year 10 through to gaining 200 level university statistics papers) of the teachers was marked. Only three of the twelve starting teachers had received any professional development in mathematics over the five years previous to the start of the INP. The principal and the numeracy facilitator were also interviewed. Collecting data from the teachers, the principal and the facilitator allowed for a more integrated picture of the personal challenges and advances made by individual teachers and contributed richly to the documentation of the whole school change journey.

I decided to interview each of the twelve classroom teachers individually and record the conversations on audiotape. This option allowed me to “get to know” all the teachers involved

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\(^3\) The decile rating of a school is a measure of the socioeconomic status of its parent body and is rated on a 1-10 (low to high) scale within the NZ school system.
and meant if some were unavailable or chose not to be interviewed in the future, I would still have a spread of teachers involved to portray the individual and whole school progress with an amount of depth and diversity. Interviewing all the teachers at each data collection point allowed me to gain a better understanding of the changing nature of the school where teachers leave and new ones arrive. The flow of teacher interviews over the three-year period is shown below in Table 3.

**Table 3 - Teacher Interviews (x denotes not employed at the school)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Year 1 2002 Initial Interview 1</th>
<th>Year 1 2002 End Interview 2</th>
<th>Year 2 2003 End Interview 3</th>
<th>Year 3 2004 End Interview 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbara</td>
<td>Yes</td>
<td>On leave</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Dawn *</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sally</td>
<td>Yes</td>
<td>On leave</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Stuart *</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Kevin</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No class</td>
</tr>
<tr>
<td>Todd</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>x</td>
</tr>
<tr>
<td>Jan *</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Warren</td>
<td>Yes</td>
<td>Yes (tape unusable)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Campbell *</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>May</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Eve</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>David *</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Tania</td>
<td>On leave</td>
<td>On leave</td>
<td>Yes</td>
<td>x</td>
</tr>
<tr>
<td>Frank</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Eight teachers (bolded in Table 3 above) experienced the full three years of the project and their stories drive the narratives in this thesis. Of these eight teachers, six (four females and two males) completed all four interviews and the remaining two teachers completed three interviews. The differing change journeys of the five teachers denoted with a * in the table above comprise the specific teacher stories reported on in Chapter Six. The overall professional development programme and data collection points are outlined in Table Four.
<table>
<thead>
<tr>
<th>Date</th>
<th>INP Implementation Model</th>
<th>Research Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>January 2002</td>
<td>Workshop 1: Number Framework</td>
<td></td>
</tr>
<tr>
<td>February 2002</td>
<td>Workshop 2: Diagnostic Tool</td>
<td></td>
</tr>
<tr>
<td>March 2002</td>
<td>Workshop 3: Video sharing in preparation for interviewing</td>
<td></td>
</tr>
<tr>
<td>April 2002</td>
<td>Workshop 4: Analysis of interviews and grouping</td>
<td>Ethics Approval-University Of Otago Ministry of Education Approval</td>
</tr>
<tr>
<td>May 2002</td>
<td>Workshop 5: Knowledge teaching</td>
<td>Principal Interview 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teacher Interview 1</td>
</tr>
<tr>
<td>June 2002</td>
<td>Workshop 6: Addition and subtraction strategy teaching</td>
<td>Teacher Interview 1 continued</td>
</tr>
<tr>
<td></td>
<td>Workshop 7: Multiplication and division strategy teaching</td>
<td>(12 teachers in total)</td>
</tr>
<tr>
<td></td>
<td>Workshop 8: Fractions and decimals In class facilitator modelling knowledge lesson (one per teacher-delivered by researcher and facilitator)</td>
<td></td>
</tr>
<tr>
<td>July 2002</td>
<td>In class facilitator modelling strategy lessons with groups</td>
<td></td>
</tr>
<tr>
<td>August 2002</td>
<td>In class facilitator modelling strategy lessons with groups (two per teacher in total)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observation lesson and feedback by facilitator (one per teacher)</td>
<td></td>
</tr>
<tr>
<td>October 2002</td>
<td></td>
<td>Teacher Interview 2</td>
</tr>
<tr>
<td>November 2002</td>
<td>Workshop 9: Debrief Forward</td>
<td>Teacher Interview 2 continued</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9 original teachers in total, 1 tape unusable)</td>
</tr>
<tr>
<td>December 2002</td>
<td></td>
<td>Principal Interview 2</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>January 2003</td>
<td>In School Numeracy Team meeting with facilitator and researcher</td>
<td></td>
</tr>
<tr>
<td>February 2003</td>
<td>Syndicate planning meeting Year 7 and Year 8 teachers separately</td>
<td></td>
</tr>
<tr>
<td>March 2003</td>
<td>Programme planning meeting with lead teacher</td>
<td></td>
</tr>
<tr>
<td>April 2003</td>
<td>Facilitator modelling of four linked lessons Year 7 class (facilitator only)</td>
<td>School Initiated Questionnaire</td>
</tr>
<tr>
<td>May 2003</td>
<td>Facilitator modelling of four linked lessons Year 8 class (facilitator only)</td>
<td></td>
</tr>
<tr>
<td>July 2003</td>
<td>Workshop 10: Integers</td>
<td></td>
</tr>
<tr>
<td>October 2003</td>
<td>Workshop 11: Approaches to Algebra</td>
<td></td>
</tr>
<tr>
<td>November 2003</td>
<td>Workshop 12: Debrief Forward Planning</td>
<td></td>
</tr>
<tr>
<td>December 2003</td>
<td></td>
<td>Teacher Interview 3 (10 teachers in total, including 9 original teachers and one teacher new to the INP in 2003)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Principal Interview 3</td>
</tr>
<tr>
<td>Date</td>
<td>INP Implementation Model</td>
<td>Research Data Collection</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Facilitator Interview 1</td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February 2004</td>
<td>Meeting with two lead teachers</td>
<td></td>
</tr>
<tr>
<td>June 2004</td>
<td>Meeting with two lead teachers</td>
<td></td>
</tr>
<tr>
<td>August 2004</td>
<td>Planning and resource day with the two lead teachers only</td>
<td></td>
</tr>
<tr>
<td>November 2004</td>
<td>School initiated resource day run on a Saturday (teacher only, no facilitator or researcher present)</td>
<td></td>
</tr>
<tr>
<td>December 2004</td>
<td></td>
<td>Teacher Interview 4 (9 teachers including 8 original teachers and one teacher new to INP in 2004)</td>
</tr>
</tbody>
</table>

The first teacher interview generated a baseline picture of the state of classroom practice as perceived by the participant teachers. Interviews two, three and four were completed at the end of each of the first, second and third years of the INP respectively. Broad open-ended questions that gave the teachers the opportunity to share the changes they perceived they had made were used. I also designed a series of prompts that considered a range of aspects of their practice and these were used only if needed to generate greater discussion (See Appendix 2). Four key topics were repeatedly covered in interviews two, three and four. These were centred on changing teacher confidence and knowledge, classroom practices, school culture and structure and the nature of the professional development programme. The final two interviews added a focus on the teacher’s perception of their personal change journeys reflecting on their years in the INP. Each subsequent interview was determined to some degree by the previous one and the direction the interview took emerged from the personal reality of each of the participants.

The school principal and the numeracy project facilitator were also research participants, adding their different perspectives on the change made by the school and the teachers. The principal, Andrew, was interviewed during the first three interviews, but retired from the school at the end of the third year, (2003) and was unavailable for the final interview in December. The three principal interviews focused on the developing school structures and the changing professional culture of the school (see Appendix 3).

The Numeracy facilitator, Nina, was interviewed once at the end of the two year period. This interview provided an overview of the first two years of the INP with specific reference to critical activities that she perceived had impacted on the whole school professional development journey (see Appendix 4). Opportunity was provided for her to share case
studies of particular teachers and lessons in order to highlight factors determining the different levels of adoption of the project by the classroom teachers. For ethical reasons, I did not use the facilitator’s comments in relationship to any particular teacher’s progress, but rather to add depth to the whole school picture. I did not want there to be any perception from the teachers that the facilitator was judging or reporting on them. For a similar reason, I chose not to interview the facilitator at the end of the first year because I did not want her role as support and mentor to the teachers to be jeopardised. This was especially important during the first year of the project when trial and experimentation was expected and this was associated sometimes with classroom havoc and disaster, but also with good learning opportunities! I did not want the facilitator’s role or the implementation of the project to be impeded in any way by my research. The final year, 2004, did not involve in-school facilitator support, but only two resource preparation days with the lead teachers outside of the school setting. Hence because Nina had had little direct contact with the school, she was not interviewed at the end of the third year.

Journey graphs.

At the end of interviews three and four the teachers drew graphs of their perceived changes in their ability to implement the approaches consistent with the numeracy project in their classroom over the previous years in the project. School-wide change graphs were drawn by the lead teacher (2003, 2004), the principal (2003) and the facilitator (2003). This idea was developed from Piggot-Irvine’s work (2005) on grief cycles. The pictorial graphs allowed the participants to readily show the peaks and troughs of their change journey over the longer time period. This strategy provided a way of enriching the data with the oral interview and the ongoing researcher observations giving greater trustworthiness (Chase, 2005) to the interpretations. An example is shown in Figure 8 below:
Drawing each graph prompted the participants to talk about its meaning, which became a restorying opportunity. This was furthered when revisiting the graphs at the end of 2004 and is consistent with Bishop and Glynn’s (1999) notion of narrative discourse. When extending the journey graphs at the end of 2004 many of the participants asked to change what they had drawn the previous year in the light of where they perceived themselves to be a year later. This is shown by the solid line which included the extension from the 2003 dotted graph. In a similar vein, Clandinin and Connelly (1990) noted that, “we restory earlier experiences as we reflect on later experiences so the stories and their meaning shift and change over time” (p.9).

The teachers also self-assessed themselves against the FANT scale (p.32 this thesis) at the end of 2003 and 2004, complementing the drawing of their journey graphs.

Doubt has been cast on the reality of teacher’s self-assessment of change (Timperley, et al., 2007) where the depth of the change is difficult for the teachers to envisage. This weakness was addressed in this study by the facilitator’s week-long modelling and numerous in-class sessions with individual teachers which meant the teachers had an understanding of 

Figure 8 - Personal Journey Graph
what that change looked like in comparison with their present practice. Observation of class lessons by the facilitators and ongoing school interactions over the three-year period helped to confirm the reality of their placements.

School questionnaire.

In April 2003, in response to frustration over the planning and teaching of a Numeracy unit and a perceived lack of progress on the part of some teachers, the school Numeracy Lead Teacher initiated a school-developed questionnaire. The questionnaire, including the summarized results for each question, is included in Appendix 5. It focused specifically on the extent of teacher progress at integrating the Numeracy Project approaches into their classroom mathematics lessons. An opportunity for the teachers to air any concerns by listing advantages and disadvantages of the Numeracy Project, for both the teachers and the students, was also included. Nine of the ten teachers completed the anonymous survey and this provided “a non-judgmental opportunity” (Lead teacher, personal communication, December 10, 2003) to obtain data around individual teachers’ progress. This data informed the school-wide narrative story.

Data Analysis and Reporting of Results

There is a structure or a strategy involved in research. It is a planned process, although many spontaneous actions occur, and the methods used link to the particular ontological and epistemological stance that the research aligns with (Sandretto, 2004). In this inquiry a methodology based on Barbara Rogoff’s (1995) three-plane analysis was used to explore knowledge that was created through participation in the setting of a school. This methodology is underpinned by sociocultural theory and takes account of three interconnected planes of social activity and meaning making. These planes correlate to the personal, the social and the cultural aspects of being in a school community. I have aligned these with the individual teachers, their interaction with their others (colleagues, students, facilitators, researcher), and with the wider school culture and systems respectively.

Three plane analysis.

Rogoff (1995) proposed a method of observation based on three planes of analysis corresponding to “personal, interpersonal and community processes” (p. 139) and linked
participatory appropriation, guided participation and apprenticeship as developmental processes corresponding to these three planes. The personal plane focuses on how individuals change through their involvement in an activity, and how such participation prepares them for future engagement in connected activities. The interpersonal plane focuses on how activities are communicated and organised between individuals in order to facilitate or restrict particular ways of participation and the community plane focuses on institutional practices and cultural values which have developed over time.

These planes are inseparable and “mutually constituting”, but in order to analyse them Rogoff (1995) suggested that the planes could be considered separately by foregrounding one “without losing track of their inherent interdependence in the whole” (p. 139). As an example of this Rogoff suggested that we could consider “a single person thinking or the functioning of a whole community in the foreground without assuming they are actually separate elements” (p. 140). But understanding the processes within each plane of analysis means we need to understand “the processes in the background as well as those in the foreground” (p. 146). Rogoff (1995) used the analogy of parts in the body where individual organs can be studied separately, but you cannot understand their operation fully without considering them as integral to the rest of the body. Kimberley Pressick-Kilborn, Erica Sainsbury and Richard Walker (2005) suggested that “meaning is lost” when different planes are fore-grounded and argued that there were obvious distinctions and boundaries between the planes. They used the term “inclusive separation” (p. 39) as a way of advancing Rogoff’s model. This allowed a specific focus on each plane while still accepting the planes were mutually constituted. Based on this approach I have presented the narratives in this thesis in two parts. Chapter Five, the whole school story, is focused on the community (cultural) plane backgrounding the interpersonal (social) and personal planes. In Chapter Six, the individual stories are focused on the personal plane, while still being cognisant of the impact of the interpersonal and community planes. Pressick-Kilborn et al. (2005) warned that the interpersonal plane was easiest to access because it was communicated through verbal and non-verbal modes and thus one should be alert to the need for balance in the degree to which we focus on any one of the three planes. They proposed that, “consideration of the social, cultural and historical situation is critical, but not at the expense of the particular nature of the learning environment which is created by the interactions of unique individuals” (p. 39).

Apprenticeship is used as a metaphor within the community plane referring to a process where less experienced practitioners advance their skills by engaging with others in “culturally organised activity, such as …schooling” (p. 142). In this light, research examines
the institutional organisation and community practices. This includes such things as resource use, how relationships support the achieving of goals, the purposes of endeavours, cultural constraints, classroom protocols such as equipment, modelling book use and seating arrangements and linguistic and mathematical systems. An apprenticeship model was evident in the interactions within the NZNDP. Whole class and strategy group modelling by the facilitator promoted a “mimicking or imitating of one another” (Higgins, 2006, p. 74). This could be seen as “the facilitator takes the ‘expert’ role and the teacher the ‘apprentice’ role” (p. 74). Subsequent to this, the lead and other teachers played the expert role in working with teachers in their own school. The apprenticeship metaphor was useful to this inquiry as it allowed the researcher to explore how teachers are enculturated into particular school practices and how they develop new competencies by participating within a school community.

Guided participation is linked to the interpersonal plane of sociocultural analysis and describes how to look at events as individuals engage with “others and with materials and arrangements collaboratively managed by themselves and others” (Rogoff, 1995, p. 147). Communication and the coordination of efforts are central to the notion of guided participation and this “includes direct interaction with others as well as engaging in or avoiding activities assigned” (p. 147). Guided participation aligned with the structure of the INP where the facilitator “modelled recommended teaching approaches and observed lessons, in individual teachers’ classrooms” (Timperley, et al., 2007, p. 251), followed up with discussions with the teacher. Guided participation was also used between teachers, where reciprocal observations and coaching occurred. Teachers learnt from feedback and discussion with each other and this approach was integral to professional learning within the INP.

Participatory appropriation where individuals change “their understanding of and responsibility for activities through their own participation” (Rogoff, 1995, p. 150) treats cognition as a dynamic process rather than “a collection of stored possessions (such as thoughts, representations, memories [and] plans” (p. 151). Thinking, planning, remembering and re-presenting are active processes and the focus in participatory appropriation is on the changes inherent in the “unfolding of an event or activity” (p. 151). The INP workshops had a major practical component which facilitated teacher participation in the activities and strategies that they could use in their classrooms. This allowed them to experiment together in order to further their individual understanding of the material and its use. In shared endeavours, communication between people involves adjustments between participants which help to “stretch their common understanding to fit with new perspectives” (Rogoff, 1995, p.
Within the NZNDP, the ability of individual teachers to internalise new practices, and then have these supported through the collaborative efforts of a group was a key factor in helping sustain the project (Higgins, 2004). Rogoff (1995) stressed the mutual, dynamic processes involved in people’s participation rather than aligning it with any view of development as static, bounded, acquired or transmitted.

In summary, three plane analysis acknowledges multiple dimensions in teacher learning within a community of practice and in Chapter Seven the implications for managing change generated from this research are presented using each of the three planes as a different lens.

**Transcription and data analysis.**

All of the interviews were audio-recorded and transcribed verbatim. I interviewed the participants in the school library, which was a quiet setting, and the tapes produced were of good quality. They were able to be transcribed with only a few phrases or words unclear. On one occasion the battery in the recorder went flat and this tape was unable to be transcribed. I did not re-interview this participant because they left the school at the end of the year following this interview.

I transcribed the first two interviews and collated the personal biographical data from the first interview. A competent typist completed the transcription of the later two interviews. The transcriptions were then reviewed by me to check that they were a true and accurate description of the words on the tape. I rechecked specific inconsistencies in transcriptions a number of times to ensure the correct wording was used.

In order to check the accuracy of my descriptions of the participants experience I used the following process of “member checking” (Lincoln & Guba, 1985, as cited in Maykut & Morehouse, 1994). I returned each of the first three transcripts to the participants, but they all chose to accept them as written. This may have been a product of their busy lives and/or their acceptance of the process that was undertaken. In response to this, in the interviews at the end of 2003 and 2004 I took the transcript of the previous interview to the subsequent interview. This allowed for discussion of the previous year’s comments and clarification of any meanings. I returned a number of copies of a draft chronology of the first year to the school so they were aware of the process I was undertaking and to confirm their comfort with the quotes I had used, and the meanings I had made. They were satisfied with this process and requested no alterations at this point. Rather than returning the final fourth interview to the participants I sent them a copy of the final school narrative and their personal story narrative and gave them
the opportunity to identify any omissions, make deletions and add any further comments they wished to make. I thought it most important to ensure the final product was a “‘recognisable reality’ in their view” (Maykut & Morehouse, 1994, p. 147) rather than overload them with copious quantities of data.

Coding the data.

Due to the number of individual transcripts, each was read at least twice and formally analysed once. I used a coloured highlighter to identify each new key comment or idea (Bogdan & Biklen, 1998). The process I used was based on the method of constant comparison as described by Maykut and Morehouse (1994). Constant comparative analysis is an inductive method of analysis where the categories of interest are not pre-determined but rather emerge from the data. “Smaller units of meaning” (Maykut & Morehouse, 1994, p. 128) are firstly identified in the data and these may be used later to define larger categories of meaning. As each new unit of meaning is analysed it is compared with previous units and identified as either belonging to an already defined category or, generating the need for a new category. The categories may be refined in the light of subsequent analysis of data and some of the initial categories may no longer be used. Similar categories are considered together and then a rule for inclusion in a category and a category name and code is developed. There may be instances of both positive and negative aspect of the category as was the case in this study where I identified some categories as being both a barrier and a catalyst to change. At the next stage of analysis patterns and relationships across the categories are explored. Finally the analysed data is collated together in a way that helps the researcher understand the people and the setting being studied.

In this study specific emerging themes were coded under changes related to each of the four interview topic headings of content knowledge, classroom practices, school culture and professional development. To help me identify units of meaning or themes I used questions such as: What are the recurring words, ideas or notions in the data? What are the concepts the interviewees are trying to explain? Can I see any patterns in the conversations? What are the similarities and differences in what the interviewees are saying? (adapted from Maykut & Morehouse, 1994). Some examples of the coding used under each category are:

• Changes linked to content knowledge: strategies as new learning, confidence linked to increased personal content knowledge and confidence linked to observed student progress
• Changes linked to classroom practices: use of equipment, use of groups, use of games and fitting old approaches with new

• Changes linked to school culture: collegial planning, motivation provided by others, time in others’ classrooms and actions of numeracy lead teacher

• Changes linked to professional development: time, facilitator modelling, workshops, and feedback on planning supporting sustainability.

These codes were further refined to identify actions as either catalysts or barriers to the change. This coding process followed the suggestions of Robert Bogdan and Sari Biklen (1998) where the codes were written in the margins beside the highlighted quotes (see Appendix 6). For example a quote coded SC: MO meant linked to changes in school culture and secondly about motivation or support provided by other colleagues. The rule for inclusion in this category was: Other teachers provide support to colleagues that is viewed by them as helpful. Units of meaning were further coded as a catalyst or barrier (e.g. Cat: collegial support) if they fitted the criteria for the particular catalyst code. The catalyst and barrier codes were written on the left hand side of the transcript page.

Further categories and modifications of categories developed as the process continued and subsequent interviews revealed new and changing aspects of the codes. For example, a category called emotional responses to change was developed as these became evident in the data. In particular, Denial and Avoidance (DA) became a code with an inclusion rule of: Teachers avoid engaging with the numeracy material and/or the facilitator. I did not set out to focus this research on ‘emotional responses to change’ and this could be seen as a gap in the research design. But, even though I did not ask pointed questions about the impact of emotions on the change process the data clearly spoke to this and hence emotional responses to change became part of the results reported in this thesis.

I argue that the initial semi-structured nature of the focus questions in the interview framework in this study allowed the intent of the participant to be more transparent and as such enabled common issues and individual practices to be identified from the transcribed interviews (Bishop, 1995). The individual teacher’s coded transcripts were rechecked against the interviews of the other participants to ensure consistency of classification and intent of the emerging patterns. The participants’ transcribed comments were collated into a draft summary document under each of the codes for each of the four interviews. This allowed me to follow the changes in particular categories over the three year period. Specific individual teacher differences that allowed the continuum of adoption of the project to be revealed were noted.
Key perceptions of individual teachers were recorded as part of each draft interview summary document. Later I produced a personal journey document largely in chronological order (Connelly & Clandinin, 1990) with comments that illustrated the process of change over the three-year period for each individual teacher. These were viewed alongside the teachers’ personal journey graphs and their self-evaluation of their positions on the FANT scale in constructing the individual teacher narratives.

**Constructing the narratives.**

There is no set formula or mechanical way to go about storytelling as a means of interpretation of experience (Clandinin & Connelly, 1994). Rather the narratives presented in this thesis are the outcomes of responding to the methodological issues as outlined in this chapter and the sociocultural framework discussed in Chapter Two.

The narrative represents my “interpretive perspective” and when I “talk about or for others” I am “taking over their voice” (Denzin, 1994, p. 503). Hence when constructing the text of the narratives I paraphrased as little as possible and used extensive quotations in order to maximise the voice of the participants. I wove the participants’ quotes directly into the narrative in order to respect the integrity of the constructions as spoken by the interviewees. Feminist researchers use quotations from the interviews in the research product in order to give the reader a sense of the participants (Reinharz, 1992). Reinharz (1992) noted “when the interviewees “speak for themselves” or “use their own voice” the reader is better able to understand” (p. 267). Using quotations also helped reduce latent errors in communicating the ideas and meanings of others (Bishop, 1995). Numerous participant voices were represented in the whole school narrative to add richness to the developing picture of the school and help dilute the omnipresence of my interpretative voice. Denzin (1994) suggested that “multivoiced as opposed to a single-voiced text can partially overcome” (p. 503) the issue of the researcher talking for the participants. To create a readable narrative and include multiple voices I have not put each direct quote in quotation marks in the school story, but rather integrated the quotes into the narrative. Later in the discussion I give a full citation for direct quotes. Within the individual teacher stories direct quotations have been used with quotation marks.

Initially I wrote a draft chronology (Clandinin & Connelly, 1991) of the events, mainly in the participants’ words without a real storyline. It included the main themes as they developed over time, and the catalysts and barriers to the change process. I identified these
from the coded data compiled from each of the four interviews. Drawing the four interviews together helped me understand the teachers’ experience of the professional development initiative in a holistic way. Patterns and the processes surrounding the changes became clearer in viewing the three-year progression. How particular ideas and actions reappeared and transformed over the time period were noted. These transformations gave directions to the form of the narrative as I wove them into the journey-based story.

**Trustworthiness.**

The ways of determining the ‘validity’ of a research study are attached to the methodology used, which I have discussed in this chapter. The term ‘validity’ in qualitative research is controversial and instead words like ‘authenticity’ or ‘trustworthiness’ are used (Guba & Lincoln, 2005). Guba and Lincoln (2005) suggest asking the following question of the research process: “Are these findings sufficiently authentic… that I may trust myself in acting on their implications?” (p. 205). I have used the term trustworthiness from Maykut and Morehouse (1994). They pose the questions “To what extent can we place trust in the outcomes of the study? Do we believe what the researcher has reported?” (p. 145). I have used research processes to increase trustworthiness as recommended by Maykut and Morehouse. I have described the participants and the events that took place and the timing of research activities. My explanations of the interview process, the member checks, the data collection and analysis methods I used and the narrative written to report the results of this thesis, are part of the wider story that gives this text a claim for trustworthiness. I have tried to present “thick descriptions” that help give “the context of the experience, states the intentions and meaning that organized the experience, and reveals the experience as a process” (Guba & Lincoln, 2005, p. 205). Guba and Lincoln (2005) also focus on “validity as an ethical relationship” stating, “The way in which we know is most assuredly tied up with both what we know and our relationships with our research participants” (p. 209). I have reported on my ways of knowing (epistemology) in Chapter Two and discussed my relationship with the research participants in Chapter One. I have attempted to be fair and balanced in representing the “views, perspectives, claims, concerns and voices” (Guba & Lincoln, 2005, p. 207) of the stakeholders in the text.

Some researchers use triangulation as a means to enhance validity (Willis, 2007). This involves researchers using multiple data collection methods or multiple data sources in an attempt to confirm the conclusions they wish to draw. One data gathering method may have certain flaws and strengths compared to another and combining methods or sources can help
overcome the imperfections evident in any one approach (Willis, 2007). Jerry Willis (2007) noted that triangulation is often used in studies that seek to find generalisations or truths, which was not the aim of this qualitative study. Nevertheless, I did use multiple data collection methods including interviews, the school-initiated survey and the change journey graphs as well as a variety of participants including the principal, the facilitator and the teachers. I also used restorying (Bishop, et al., 2010) over the three-year period as a further research method which allowed the teachers to reflect on their stories from previous interviews and to confirm or reframe their perception of their progress. This was especially evident in the individual teacher journey graphs where a number of the participants adjusted the shape of their graph as they reflected on their progress a year later. Using multiple methods and sources allowed similarities and differences to emerge and helped me to gain a deeper understanding of the change process in the school. Rather than use triangulation and any associated ideas of validity or truth-seeking, I prefer to relate my research process to a more recent metaphor of crystallisation (Richardson, 1997, as cited in Guba & Lincoln, 2005). This highlights “the interweaving of process in the research: discovery, seeing, telling, storying, representation” (Guba & Lincoln, 2005, p. 208) and sheds light on the complexity, and multi-dimensional nature of developing understandings within a qualitative research study.

Generalisability

The narratives in this thesis are stories based on the experience of teachers in one school, and although we can learn valuable lessons from individual events and situations these cannot be generalised to a wider population (Chase, 2005). The stories emerged at a particular time, in a particular place and were influence by a particular set of circumstances and these events and this situation is unique. The ability to learn from this research is not based on the positivist notion of large representative samples from which to generalise or objective knowledge construction, but rather on the readers’ personal experience, on what they can relate to, on how transferable they find the results to their own situation (Chase, 2005). How similar or dissimilar the stories are to others the reader is familiar with, and how the reader engages with these issues will determine the worth of the narratives in this thesis to the reader (Stake, 2005).
Summary

In this chapter I have outlined the methods of data collection and data analysis that I employed in the design of this study. I have discussed how feminist theory has impacted on the ways I undertook this research process with particular reference to the development of the researcher/participant relationship. Three plane analysis (Rogoff, 1995) was explored to show how this tool helped me focus the study within the sociocultural context of the school. The processes surrounding the coding and transcription of the data, as well as how I produced the narratives texts are described. I concluded by discussing ‘trustworthiness’ as a measure of the quality of my research process as revealed through my descriptions of the methodologies used in this thesis.
Chapter Five - The School Story

Nothing succeeds like success, especially when it emerges from changes driven by a shared sense of moral purpose and of the power of working collaboratively to build both individual and collective capacity in a school.

Cowie, Hipkins, Keown & Boyd (2011, p. 6)

Introduction

In this story I share the perceived experiences of the teachers at KIS as they undertake a professional development project to implement school-wide changes to the teaching of numeracy. This story tells of a three-year journey of school change including common issues, successes, pitfalls and the responses the teachers and the school made to the challenges presented by their involvement in the project.

The changing nature of the school’s journey from the start of the project in 2002 until the end of 2004 is depicted in the graph below (Figure 9). The dotted line was drawn by Dawn, the lead teacher in December 2003, and the solid line when she revisited the school’s progress at the end of 2004. Her graph of the school’s journey represents her overall view of the progress of the teachers and the collective ability of the school to implement the approaches consistent with the INP. The changes illustrated in the graph are evident in the school story.
School Journey Graph

Ability of the school to implement the approaches consistent with the Numeracy Project

Figure 9 - School Journey Graph: 2002-2004

School Story

Year 1: 2002.

Andrew, the principal of KIS, was delighted that the school was invited to participate in the INP and his enthusiasm and commitment to the project was evident from the beginning. He explained that the staff had started rewriting the school’s mathematics programme the previous year with a focus on numeracy and the proposal fitted in really well with this initiative. The school appreciated the generous level of funding for resourcing and the teacher release days provided by the project. All the teachers were expected to be involved in the professional development and Andrew thought this was important. He hoped to see significant changes in teacher practice; in the way they organised their maths lessons, what they were teaching and how they were teaching. Andrew perceived that the hardest thing with
any kind of staff development was actually getting teachers to change from their usual habits and making them realise that there may be a better way of doing something.

The first INP workshop both excited and challenged the teachers as they shared strategies for solving number problems. They enjoyed watching the children on the video and were fascinated by the number of different strategies they saw them using to solve the number problems presented. The second workshop, two weeks later in February, focused on how to interview their students to find out what number strategies they used and what knowledge they had about numbers. Questions about what strategies people were using and how it could be recorded abounded. The teachers were pleased to hear that they got to do their initial interview in pairs but they were concerned about practical issues such as how much time it would take to interview all their students and who would do the relief for their class.

The student interview process took place during March and April and this provided the major impetus for the first upward shift as shown in the journey graph (Figure 9) above. Following facilitator modelling, the teachers then worked in pairs (one questioning and one recording), so they could help each other, discuss the student’s responses and give feedback on their decisions. Many of the teachers were surprised by the range of strategies which the students produced, as well as the number of children who were still using counting strategies. Andrew noted that the teachers’ awareness of the gaps in the children’s knowledge and strategies that had developed out of the diagnostic interviewing had helped focus their teaching.

Staffroom discussion now focused on how to use the new resources and how to manage group work. Andrew thought that one of the real strengths of INP was the business of working together and the discussion and thinking that goes on. He thought some people had changed their views about some things already. But he was realistic about the variable response of teachers and the time needed to make real change in classrooms.

A number of the schools’ philosophies and procedures changed to encourage the teachers to implement the INP. Timetabling set blocks for each mathematical topic and how much time was spend on mathematics, compared to other subjects, changed. Teachers were given more autonomy and flexibility, with less pressure on them to finish something off and get onto the next topic. In this way time class time was freed up to experiment with the new teaching strategies. Todd explained that sometimes he did not teach music, but that it did not matter as long as he was doing the numeracy stuff. There was now criteria for reporting to the School Board of Trustees at regular intervals and nationally benchmarked Assessment
Resource Bank (ARB) assessments were used as part of this process. These tasks reflected the approaches in the INP more than the assessments used previously.

The provision of new resources and more ready access to these also motivated the teachers to try out the new approaches. Before the INP, there was variable access to mathematics equipment with some staff suggesting they had very little, while others thought there was plenty, but they were not sure about how to best go about using it. May said the teachers were pleased that they were going to have the new equipment in their classroom instead of having to run all over the school trying to track it down the day before.

Over the first term, some of the teachers experimented with the INP approaches, but others identified the integration of the ideas presented in the first workshops as problematic, in relationship to their usual classroom practice. How to group students for instruction based on the diagnostic assessment data, how to develop different levels of conceptual thinking and use different learning materials, possible ways to manage group work, and systems for rotating groups between activities were concerns that confronted the teachers. This was especially difficult for those teachers who were teaching mathematics using a whole class approach. Some had previously felt very confident at teaching in the number strand but now wondered if they were doing such a great job. Although the teachers appeared motivated to take on the new practices they were unsure about what they actually needed to do and how much time and effort this would involve.

During Term 2 there was a compulsory workshop at school every two weeks between 3.15- 5.15pm. Most thought the workshops were well worth it, but a number obviously felt tired at the end of the day. Some willingly engaged while others quietly watched. Quite a jovial atmosphere developed as the teachers experimented with the equipment and the activities. A certain collegiality and an appreciation of other people’s approaches to problems also emerged.

The materials used at this workshop were unfamiliar to the teachers, which meant they all became new learners to some extent. Because of this I detected some uncertainty and a reorientation of the usual hierarchy of mathematical authority within the group. David, unlike the others, had completed university level statistics papers and had greater mathematical background knowledge. He often asked questions about the place of algorithms because he relied heavily on them and he believed that it gave the children the structure and the rules that they needed to follow. Todd thought that the equipment thing was still the big issue and was worried about the reality of looking after the stuff. Sally, a younger teacher who had taught in
a school in England that was part of the British Numeracy Initiative, was able to confidently share strategies explaining that she already knew some of them from having taught a similar sort of programme in England. Dawn was immediately enthusiastic about using a range of strategies and using concrete materials to support children’s learning. She had already been using the numeracy resources and approaches in her classroom because she had learnt about them previously through her involvement as a parent at her daughter’s primary school.

At the start of Term Two, Nina led in–class modelling lessons of knowledge activities that showed the teachers how to use the new resources with the students. But this did not really challenge the teachers’ usual teaching practice as these were one-off lessons and often based on whole class work, at least at the start of the lesson. By the middle of the year, the teachers were expected to plan a series of lessons implementing some of the activities they had explored in the workshops and in the numeracy books. They were encouraged to try grouping their students for instruction in order to cater to the range of different strategy stages as identified from the individual diagnostic interview. Initially in Term Two they attempted this in their own way or in discussion with a colleague, but the nature and complexity of the task became overwhelming for many. Warren voiced a reality for a number of teachers when he reflected that he probably should push himself more, but he felt tired and just wanted to go home and sleep.

In response to this, syndicate planning for mathematics was initiated. All the teachers commented on the positive impact of collegial planning and preparation of resource material, especially in terms of reducing the workload, and in the sharing of approaches and ideas. This collaborative planning corresponded with the increasing confidence in the school’s ability to implement the new initiative as show by the upward curve (Figure 9) through to August 2002. The principal believed that there was a lot of support within the syndicates and that the teachers would use this to help them cope with the planning needed to cater to the mixed ability groups of students in each class. Kevin identified this as a major change because people had planned in a syndicate for social studies and science, but never bothered about maths. He discussed the comprehensiveness of the syndicate planning, which involved not just writing it all down and making a plan, but sorting out the gear and who is using what and when it is being used. Eve explained that it was much better and they did not waste so much time because they were not going and doing something that somebody else has already done, they were sharing everything around, which made it a lot easier. May valued the joint ownership of the planning and thought the unit had flowed well because they all had input into it, they could all ask about it and everything was shared. Todd, a Year 8 syndicate leader,
explained the process of dividing up the unit preparation and how this co-operative, interdependency meant teachers were less likely to ‘opt out’. Some people did find it difficult planning, but Dawn, the numeracy leader, encouraged them to realise that they were not actually doing anything different. The collaborative planning was a catalyst for Dawn who then organised folders for each strategy stage and topic. She felt the syndicate planning process had been a ‘good learning curve’ for all the teachers.

Discussion about mathematics teaching had now extended from the workshops and syndicate planning sessions to a regular slot in the staff meeting. Here teachers shared good lessons or explained about equipment use or ideas they had tried. Andrew felt the discussion between staff, both in the workshops, at syndicate level, and at staff meeting had helped clarify people’s points of view. He identified the ongoing discussion as one of the big positives coming out of the project.

There was some pressure on the teachers at the end of Term Two because Nina was planning the in-class group strategy teaching for Term Three. In order to prepare for Nina’s in-class modelling the teachers had to have strategy stage groups organised and a suggested topic for Nina to teach as part of a unit. This was followed up with Nina observing them teach a lesson. The in-class modelling sessions were followed by a reflective discussion with the teacher and Nina. For most teachers having another teacher from outside the school (other than a teacher trainee) work in their classroom was unusual and this created some uncertainty. There was pressure to be prepared for the facilitator. This prompted the teachers to get organised, but also generated an amount of both tacit and explicit resistance. One teacher cancelled the facilitator’s visit a number of times and two others postponed them until a later date; most were somewhat flustered by the prospect. Along with this the principal had decided to incorporate a mathematics focus within the appraisal system during the second half of the year, using peer appraisal and looking at what was happening in the maths class.

Although the teachers enjoyed and valued having Nina in their classroom, for a number of them this was just a starting point to changing their usual practice. They were experimenting with ‘one-off’ lessons from the Numeracy Books and some were trying a form of strategy group teaching, but regular linked lessons and group-based programmes were not in place in many classrooms. The enormity of the effort needed to understand how to develop the students’ mathematical understanding and to use the new pedagogies and equipment as part of an ongoing programme led to a decline in teacher motivation and confidence. This is reflected in the declining section of the journey graph (August 2002- April 2003). The school was heading into a ‘pit’ (Edwards, 2008; Piggot-Irvine, 2005).
Towards the end of the first year numeracy was put on the back burner because teacher workload was too huge; it was just something they struggled to take on board. It became evident that a number of teachers lacked any real engagement with the teaching strategies promoted in the project. Dawn noted that a few teachers were taking it on, but they felt hesitant and the implementation of it seemed a bit overwhelming, especially the terminology and the new names. A general feeling was that if they left it like this then in two years it would no longer be around The school really needed to buy into it a lot more and plan for “Who is leading it? Who is checking that it is being done?” Todd identified the need for “personal responsibility” because the Ministry of Education and the teachers had invested time and money into it. He suggested that there was no point in doing this if you were not willing to give it a go. Todd surmised that if you force people to do things they will find ways around it, but if they see real benefits in doing it themselves they will do it. Eve, a Lead Teacher, felt the teachers had, at least, identified the student’s need for numeracy learning and thought that this acknowledgement may help motivate them next year.

The Debrief Workshop 9 held in early November focused on planning for 2003. A key outcome from this workshop was a whole school decision to share the planning for 2003 in order to reduce the workload, but in a different way to how they had organised it before. Although syndicate planning had been used this year for the numeracy units it had not carried over to the rest of the year’s mathematics planning for all syndicates. It was not seen as a well-established support structure and some of the teachers suggested that they had not done it before and had not done it since. Others had been frustrated by the time required to coordinate the syndicate planning and perceived it offered them less flexibility. Hence the planning pairs for 2003 were self-organised and it was hoped this would enable two compatible people to consult and work together more easily than in the full syndicate group usually comprising of four teachers.

Nina’s observation visits and the peer appraisal system had been aimed at developing a school culture that encouraged teachers to spend time in each others’ classrooms. Although the teachers thought this was a good idea, they felt uncomfortable with it. Classroom visits were still viewed as a critique rather than a learning experience. They also raised concerns over how you shared the power and who was in charge when other people were teaching in your classroom.

Despite the teachers’ concerns, Andrew perceived a growing independence of the teachers from the facilitators. The staff had owned the project and it had not just been something that happened when the facilitators appeared. Andrew was aware that it was
critical to keep the momentum going; to plan a course of action for 2003, to pick the right people to lead the programme, to allocate time for lesson observations, to provide opportunities at staff meeting to talk about numeracy and to continue to plan co-operatively, so the burden on everyone was reduced. Andrew stressed the long term nature of changing professional practice. He warned against being judgemental and promoted an empathetic approach towards differing rates of teacher change.

Both Nina and Eve confirmed the teachers’ open-mindedness at trying new strategies despite their different levels of experience. Nina’s highlight from the first year was the questions the teachers were asking and the depth of perception and reflection they exhibited in her conversations with them about teaching and learning.

**Year 2: 2003.**

A Numeracy Group consisting of Eve, Dawn, May and Sally was set up to drive the project for 2003. This group was very enthusiastic; setting up the year’s programme, developing unit plan formats, finding resource material and planning for the purchase of more equipment. But in the first syndicate meetings it became evident that the teachers had struggled with preparing the units they were allocated at the end of 2002. As the year progressed through to April some teachers had reverted back to their usual teaching programme, and others had not started any teaching based on the Numeracy Project material or approaches. This concerned the Numeracy Group who contacted Nina and me about how to encourage the teachers to feel more confident about their numeracy teaching and take more individual responsibility within their own classroom. They suggested undertaking an anonymous staff questionnaire in order to find out what the teachers were actually doing in their classroom and how they felt about the Numeracy Project.

The questionnaire was completed by nine of the ten teachers and the results summarised (see Appendix 4) to share at a staff meeting attended only by the teachers. The principal, Nina and I were not involved at any stage in this process. It was teacher-initiated and driven; compiled, summarised and discussed by them. This forum provided a non-threatening way for the teachers to look at themselves and evaluate their part in the Numeracy Project.
1. How do you feel about the numeracy project? (Tick the continuum appropriately)

- How do you feel about the numeracy project? (Tick the continuum appropriately)

2. Do you feel comfortable with the seven stages of development of the Numeracy Project?

- How comfortable do you feel with the stages of development of the Numeracy Project?

3. Do you feel comfortable with the strategies for each developmental level?

- How comfortable do you feel with the strategies for each developmental level?

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**Figure 10 - School Generated Numeracy Questionnaire: Results of the Continuum Questions 1, 2 and 3.**

The questionnaire identified that there were two staff members who had not used the INP approaches that year. The revelations in the questionnaire and the open discussion generated from this were probably the turning point for KIS. The teachers reflected on what they were doing and it became OK to admit you had not done, or did not know how to do, something, because other people were also having difficulties. Spending time in other people’s classrooms or getting another teacher in to help seemed more acceptable now. Everyone knew where people were at and how they felt.

In May, at the same time as the completion of the questionnaire, Nina started her in-class modelling work. Most of the teachers had been doing some one-off lessons, but they wanted to see how a series of linked lessons worked in the classroom. They were dubious about the reality of maintaining a numeracy programme over an extended time period. In response to the teachers’ request, Nina had decided to use her class modelling time in 2003 differently to the usual one lesson per teacher. She taught a whole week’s programme in Dawn’s Year 7 class with all the Year 7 teachers observing and similarly later with May’s Year 8 class with all the Year 8 teachers observing. This idea had emerged from the teachers out of the final meeting with the staff at the end of previous year.

Nina felt that the week-long modelling met everyone’s needs no matter where they were on the journey model. She perceived that teachers who were at the stage of changing the structure of their classroom (FANT: Stage 1) through to those who were at that stage of
listening to students and making decisions about their progress (FANT: Stage 4) were all able to learn from the observation of the week’s programme. It appeared to help the teachers see the reality of teaching an ongoing unit of work and appreciate what was involved in the planning and decision making as part of connected teaching. May recalled that the teachers had appreciated Nina’s unit planning tips, seeing the equipment use and organisation, her layout of materials and activity sheets, and her focused teaching using grouping structures. Nina’s demonstration of how to use modelling books was a strategy that had really helped some teachers.

The teachers’ confidence in their ability to implement the innovation improved rapidly over the second half of 2003. Student achievement was closely monitored as part of the project and teachers were able to see the students progressing. Andrew commented that in the end of year student achievement data every student had progressed. He felt the students obvious progress helped those doubting the new approaches to see the value in what they were doing. The teachers commented on the children’s developing confidence in explaining their strategies, and their independent use of the equipment as motivational to change. Andrew noted the practical and relevant nature of the delivery of the professional development as contributing to the success. It related to both the teachers and the kids, it was not ‘airy-fairy stuff’ and the facilitators understood that there was also a lot of other demands placed upon the teachers.

In reflecting on the second year, Nina thought as a school they now had the knowledge and expertise as well as good leaders to help them move into the next year where very little facilitator support was available. They had the experience from the day-to-day implementation of the project that we, as facilitators, did not have. They were the only ones who could take ownership now and they needed the space to do so. Nina’s major concern lay with whether the school would take on a new professional development focus thinking they ‘had done numeracy’ and the emphasis and gains could be lost.

At the end of 2003 Dawn described them as ‘humming along’, having moved on from the low patch. The syndicates were now planning together and sharing some ideas, and as a school they felt more confident in their ability to implement the programme. But she explained that the end of year activities and tiredness contributed to a drop off in implementation ability. This was shown as a wiggly line on the school journey graph by Dawn who described things as a bit bumpy towards the end of the year.
It appeared that Andrew was not as aware of the ups and downs of the teachers’ experience as Dawn. In his school journey graph (Figure 11), Andrew presented a more holistic overview of the school’s progress over the first two years, but placed the school at a similar point to Dawn at the end of 2003. Nina and Dawn were working closely with the teachers in their classrooms and as such were likely to be more in touch with the constraints along the way, whereas Andrew reflected more on overall progress.

![School Journey Graph](image)

*Figure 11 - Andrew’s School Journey Graph 2002-2003*

While Nina’s school journey graph (Figure 12) provides a different view to Andrew’s I will use it to summarise the first two years of the school’s story. Her graph, drawn at the end of 2003, had a very similar shape to that drawn by Dawn (Figure 15) representing the first two years. Both clearly reflect the initial confidence they had in the school’s ability to implement the INP, shown by the peak around July 2002. This followed the diagnostic interviewing and initial workshops, both of which provided positive motivation at the start of the INP. As the magnitude of the changes, the amount of work and time needed, the confusion around the new approaches, the need to learn new ways of doing things and the stress this placed on the
teachers became evident, their combined capacity to cope as a school, decreased. This was reflected in the dip over the second half of 2003 to the low point in early 2003.

Figure 12 - Nina’s School Journey Graph 2002-2003

The school-initiated survey, where the teachers together took ownership of their problems, the one week in-class modelling, the collegial planning and support, the workshops and evidence of improved student achievement in the end of 2003 data, were the key enablers assisting the teachers to move out of the implementation dip and develop more confidence in their ability to implement the programme over the second half of 2003. An end of year drop off in implementation ability was identified by both Nina and Dawn.


In 2004, KIS took on another whole-school project, Assessment to Learn (AToL). This had a focus on formative assessment and involved sharing student learning outcomes and developing student-based success criteria for the learning outcomes across a range of
More staff became involved in numeracy leadership over 2004 and a committee was formed to overview the continuation of the initiative. Syndicate group and whole staff planning sessions occurred. Issues were raised and discussed at professional development staff meetings. David and Dawn rewrote material to fit in with the resources available in the school. The committee considered how best to group the students at each year level across the whole school and this supported the syndicate groups. Collegial responsibility for the progress of all the students, not just those in their own class emerged.

In November 2004 all the teachers attended a Saturday resource day organised by the school numeracy committee. This was to prepare and label material for use in all the classes in 2005. This was at the weekend and there was no compulsion for teachers to attend. But, all the teachers did attend and this was an indication of the collegial commitment, whole-school ownership as well as the motivation and support provided by the numeracy leadership committee. The final upward curving section of the school journey graph is testament to the confidence the teachers had in the school and themselves to use the INP initiatives as an integral part of their numeracy teaching programme.

**Discussion of the School Story**

In this section I discuss the process of change for KIS and link this with the specific catalysts and barriers to change for this school. The findings that emerged in the narrative are discussed in relationship to the literature on school change as presented in Chapter Three of this thesis. Direct quotations from the participants are also used to highlight aspects of the findings. This approach is designed to incorporate aspects of the personal, interpersonal and community planes (Rogoff, 1995) in this analysis of the school story. How the individuals changed (the personal plane) and how activities were communicated and organised between individuals (the interpersonal plane) became dimensions of the school change as represented by the practices and values within the community plane.

The change story for KIS confirmed the complex ongoing nature of the change process as presented in the literature (Anderson, 2010; Bishop, et al., 2010; Hall & Hord, 2006; Higgins, 2003). But, in order to focus on change as a process over time (Anderson, 2010;
Catalysts and barriers emerged as drivers (Fullan, 2006a) or impediments to change at different times throughout the three year change process. Barriers, for example the implementation dip (Fullan, 2001a), resourcing issues, or lack of pedagogical knowledge about group teaching once overcome, transformed into catalysts for change as solutions to the challenges allowed the school to move forward (Fullan, 2006a). A number of the barriers to change and the time these emerged were specific to the individual teacher stories and are discussed in Chapter Six. Some barriers were common to a number of teachers at one time, or relate to the whole school setting, such as: dissonance with traditional beliefs and approaches, a lack of joint ownership of the initiative and the privatisation of classroom practice. The barriers and catalysts are often interconnected and hence, they are woven together throughout the discussion in this chapter. Other obvious barriers such as workload issues and the lack of time for planning and reading, the management of group teaching and the appropriate use of new resources and equipment, although evident at KIS, are omnipresent in the literature (Degenhardt & Duignan, 2010; Hall & Hord, 2006; Higgins, 2003; Ministry of Education, 2007a; Thomas & Ward, 2006; Timperley, et al., 2007) and I have not focused further on these.

As the catalysts and barriers are explored, references to developments over the whole three-year time frame are included where relevant. I grouped the catalysts to change within seven broad categories, based on the data and narrative story. They are presented in this order in the discussion along with relevant barriers and linked to the literature.

**Moral purpose linked to teacher discussions and identified student need.**

The initial catalyst to change for KIS emerged from the discussions and questioning generated out of the first workshops and the diagnostic interviewing. These activities allowed the existing situation in the school to be explored (Pigott-Irvine & Gratton, 2004) which is key to Fullan’s (2001b) initiation phase. For example, Nina highlighted discussions about initial teacher content knowledge saying that the workshops “create an environment where teachers are a bit more open about their limited content knowledge”. These discussions alerted the teachers to the need for change. Eve confirmed this saying, “we [the teachers] have talked about it and this [numeracy learning] is just so important for kids and that is basically what we are here for”. But the imperative, or moral purpose (Fullan, 2010), surrounding this
developed as the student needs were identified from the diagnostic interviews (Bishop, et al., 2010; Higgins & Parsons, 2009). Andrew confirmed the motivation and focus that this data had given the teachers compared to previous approaches:

That kind of malaise that you have had in maths over the last few years where you seem to teach them things and there are still heaps of kids that still don’t understand what you are talking about. I think this [the diagnostic interviewing] has given them [the teachers] a much sharper focus. (December 2002)

Identified student needs promoted the “sense of urgency” (Fullan, 2010, p. 120) noted in the initiation phase. Staffroom discussions around how present teaching practice could met these needs (Piggot-Irvine & Gratton, 2004), helped mobilise the teachers towards change (Fullan, 2001c; Piggot-Irvine & Gratton, 2004). In particular, talk about whole class teaching and equipment use was the initial focus. Consideration of these specific issues by the teachers and in discussion with the facilitators was similar to the action research “spinoff cycle” (Piggot-Irvine & Gratton, 2004, p. 4) process, and assisted the teachers to prepare for the implementation phase.

But these discussions and new learning also created a barrier, as dissonance with traditional beliefs and approaches emerged and teachers questioned their usual ways of doing things. Todd said that “after seeing the project I don’t know if I do feel that I am doing such a great job anymore.” In a similar vein Jan remarked:

I would have said in the past that there is one way to do it and … they need to have the basic knowledge first. And I guess what I am saying now is that maybe you don’t. (December 2002)

In response to these questioning thoughts, uncertainty and resistance emerged (Cowie, et al., 2011) and remerged at different times for different teachers. Andrew noticed this, but also showed his understanding of this process as part of a long term change:

We have been in staff meetings and we talk about changes … and we go back to the classroom and close the door and carry on with what we are comfortable with. But you put people into zones where they are not actually 100% comfortable … they are still struggling with the knowledge…. So you have got to be patient and see it as a long-term gain. (December 2002)

This highlighted the non-linear nature of the change process and the complex interaction between Fullan’s (2001c) phases as identified by Anderson (2010). The school and individual teachers reverted to the initiation phase after starting the implementation phase and there were a number of slumps in implementation activity over the three year period.
Leadership in managing the change by both the principal and the lead teachers.

At the growth (Cowie, et al., 2011), or implementation, phase Andrew’s leadership in managing the change was a critical catalyst. Cowie, Hipkins, Keown, and Boyd, (2011) confirm the importance of the behaviours of the principal in supporting teacher learning and building school wide capacity. Andrew provided physical resources, extra teacher release time, facilitated teacher collaboration in syndicates, encouraged challenging discussions in professional development meetings, set up teacher leadership teams, and participated as a learner in the workshop sessions. These key actions of the principal in supporting the implementation phase resonate with those identified in the literature (Bishop, et al., 2010; Cowie, et al., 2011; Degenhardt & Duignan, 2010; Robinson, et al., 2009). But I have chosen to focus on the importance of the emotional intelligence (Goleman, 1996) of leaders in relationship to change because this is less prevalent in the literature (Beatty, 2007) and important to the context of this school.

As a change manager, Andrew exhibited emotional intelligence including empathy and social deftness (Goleman, 1996). He had an understanding of differing paces and acceptance levels of change for individual teachers within the whole-school context. Andrew commented:

I think we have to be really careful that we are not too judgemental about some people who have moved a little bit and some people who have moved big bits. People are people and some people are open to change and some people find it difficult to change. But I think if we can continue that kind of support within the school, then hopefully we continue to see that change evolve. (December, 2002)

This accepting attitude created a more supportive environment for his teachers. Andrew’s positive approach to individual change focused on building capacity rather than on punitive accountability or criticism (Fullan, 2010). He encouraged leadership in others and facilitated the development of teacher partnerships and peer support (Fullan, 2010).

The role of the lead teachers working in partnerships with each other and their syndicate groups was vital in motivating ongoing change (Thomas & Ward, 2006) and the spread (Bishop, et al., 2010) of the reform for KIS. After the first year, four lead teachers were established, two at year 7 and two at year 8. These teachers each led a syndicate group, spreading the available support, the responsibility and the enthusiasm for change. The
facilitators in Thomas & Ward’s (2006) lead teacher initiative study confirmed that lead teacher leadership was the most beneficial factor to developing and sustaining numeracy, but the teachers in their study believed collaboration between teachers was more important. KIS contrasted with this because the wider spread of leadership meant that for them leadership and teacher collaboration were interwoven, especially in the syndicate groupings. Having a range of people take on responsibility seemed to inspire the other teachers to get involved. May commented on the teachers she led wanting to develop material themselves rather than being given it saying “my syndicate, they said, ‘no, no, don’t hand it to us, we’ll do it ourselves’… They actually worked together and then came and sort of saw me and asked me questions”. The lead teachers were the change enthusiasts (Cowie, et al., 2011). They questioned, challenged and encouraged one another, growing their understandings and enthusiasm. They were then able to spread this type of interaction and discussion into their syndicates and wider year level groupings. The way the leadership was spread and the positive pressure (Fullan, 2010) this generated at KIS was a factor in helping the school take ownership (Bishop, et al., 2010) of the initiative.

By the third year, the syndicate leaders were working with the teachers and the student data across the whole year level to ensure activities and resources fitted the achievement level of the groups. Dawn explained that: “We would take those syndicates and we would identify our groups and our classes, we knew where we were at and we would try planning together”. Chrisman (2005) confirmed the importance of lead teachers developing their own internal leadership structures that allowed them and the teachers to make decisions around the student learning programmes. These unique and context–based leadership models developed at KIS and helped to generate a more collaborative, non-threatening form of teacher learning.

**Collegial support for learning and the positive pressure this generated.**

Learning about implementation from peers during the process and the pressure that came from working alongside engaged colleagues (Fullan, 2010) was another major overall catalyst to change throughout the implementation stage. This included learning about the use of new resources and equipment. The group syndicate planning was a significant example of this, where a balance between support and pressure was developed. Everyone felt obliged to be involved, but the real motivation grew out of the benefits gained from the process. Todd commented that the shared planning, “was worth it, because it gave everyone in the syndicate something to take away and to go with, there were no excuses.” This was evidence of the powerful pressure that engaged peers can exert, encouraging a wider flow of knowledge
consistent with Fullan (2010) who suggested peers “learn about implementation from peers during implementation” (p. 122). Dawn noted: “It isn’t always successful but we could share activities and … kept a finger on the pulse of what was happening it certainly has made people do it as well, which has been good”. The positive way the teachers engaged with the syndicate planning and with each other in the workshops activities, highlighted the importance of teacher learning in context (Higgins, 2006). Teachers working in other’s classrooms supported the enactment of new learning and built teacher confidence based on seeing outcomes for the student. Dawn shared a story of a lesson she was observing “turning to custard” and how she worked together with the teacher to try a different approach and the consequential student understanding and teacher confidence this built.

... the children were having difficulty grasping the concept and I didn’t myself, I didn’t have any answers but I remembered… the Hills and Dales [numeracy activity]…we ran through it together and he used it for the class and probably has a better understanding of it now than I do…. It worked brilliantly. And then he took it to the staffroom and said, “This is what I tried…” which was really good. (December 2003)

This example confirmed the power of Fullan’s (2010) ‘horizontal learning’ or ‘learning in practice’ consistent with the Lave and Wenger’s (1991) apprenticeship model. But, although the lead teachers did spend some time in other teachers’ classrooms, this was not a common practice for the teachers in general.

Identifying and overcoming the lack of ownership of the project was initially inhibited by the norm of privatised practice, where teachers worked in isolation in their classrooms. The insights prompted by the workshop learning and the collegial planning were sufficient motivation for some teachers to self–initiated integration of INP practices, while others implemented the common planning but felt unable or, unconvinced of the need, to continue after the initial planning support. The school had not overtly identified who was really implementing the initiative in their classroom and who was paying lip service or felt overwhelmed by the process. Andrew noted that, “we know that teachers are good [at] nodding heads in agreement at staff meeting and going on and closing their doors and getting on with what they normally do.” DuFour (2004) confirmed that this willingness to engage and collaborate may be endorsed by the teachers, but still is not translated into action behind the classroom door. The lead teachers at KIS identified the need to explicitly explore why the teachers were struggling to take ownership of the initiative, as evidenced by the lack of action in their classrooms.
Collegial ownership of the barriers to implementation and a reflective approach to overcoming these.

Lack of ownership was a barrier to change, but making this explicit in a non-threatening, collegial environment subsequently became a crucial catalyst for change. The lead teacher-initiated survey and the subsequent discussions that surrounded this allowed the teachers and the school to confront specific barriers to change. A space was created, without the principal or facilitators present, where the teachers felt confident enough to share their progress and emotions with their colleagues. The teachers were able to off-load their concerns and no longer had to hide their lack of progress or feel they alone were not coping. This process was very cathartic and generated support and acknowledgement for one another rather than being judgmental:

…people could put themselves onto a continuum and they saw themselves and where they were, and from there the discussion just rolled. And we did that without any management being present, and without yourselves [the facilitators], and I think that was just, for them, ‘oh my goodness, I do need to do something’ or ‘I had no idea.’ One of the questions was as blatant as ‘have you read the new Getting Started [Numeracy Book 3]’ and many had put no, and as soon as you put that, I think the ownership of the issues were with them. (Dawn, December 2003)

Identification and ownership of the problems led to the identification and ownership of some of the solutions. This resounds with Fullan’s (2010) comment that openness and transparency of practice will work “if people do not run away” (p. 123). This reflective process was a turning point for the school. The openness it created allowed teachers to acknowledge the progress they had made and feel an affinity with the progress of others, as well as seek help. The major barrier the teachers identified from the survey was how to maintain the planning and enactment of a linked, group-based programme.

Teacher learning that paralleled classroom practice and allowed teachers to make meaning within their own classroom context.

In response to the survey, conducted by the teachers, Nina modelled a linked, week-long programme in both a year 7 and year 8 classroom, with all the year level teachers observing. Graven (2004) confirms the importance of teacher learning that parallels the expectations of the classroom context in developing teacher confidence that can provide the catalyst for
change. Being a school-generated professional development activity tailored to meet the specific identified needs of the teachers led to its success. The impetus developing from this modelling, including the discussion sessions about the children’s learning and the teacher’s decision making, provided a way out of the implementation dip that had stifled a number of individuals before this point. Being able to interpret the modelling in relationship to their own teaching was a crucial precursor to the teacher’s internalising and feeling confidence with the new teaching practices (Higgins, 2004). Jan commented: “So what I’ve found helpful about Nina’s stuff was seeing how she used things, then I would take it away and translate and use in my own way”.

Although this modelling was in one teacher’s classroom, the other teachers were able to relate it to their own teaching experiences. Following this, they clearly articulated what they had learned and needed to do next in their own classrooms. It was not until the teachers saw evidence of how INP-based planning could be transformed into every day ongoing classroom practice that they became more convinced of the need, and of their own capacity, to change.

**Teacher motivation and rewards from seeing student engagement and progress linked with teacher confidence in the use of assessment practices.**

Teachers now had a workable model for sustained teaching using the NZNDP pedagogical tools (Higgins & Parsons, 2009) within the framework of the INP. They had observed and discussed the children developing understanding and the next step progressions in learning. They started to see the benefits for the students and as the literature confirms (Higgins, 2003; Timperley, 2008; Timperley, et al., 2007) this provided high motivation for sustained long-term teacher action. May explained:

I just feel a lot more positive generally and I feel that the children have actually done a lot better this year… the top-end ones converted the boxes into algebraic format straight away, whereas the bottom ones worked with the boxes until they felt comfortable, and yeah, it worked really well. …they got it really… they could see it. (December 2003)

The extra effort in the last half of 2003 was rewarded by improved student results across the whole school and this was a major catalyst for sustained practice during 2004.
External experts who scaffold ongoing, iterative learning and promote within-school ownership of the initiative.

The nature and timing of the week-long classroom modelling professional development activity exemplified the importance of the role of external specialist support as a catalyst to change (Timperley, et al., 2007). The external facilitators developed a relationship with the teachers and the school that allowed for honest and open discussion of teacher needs developing directly out of observations and modelling in classrooms. Andrew commented about the facilitators and the programme delivered:

you guys [the facilitators] have allowed the discussion, and you know, we did have people who were ‘doubting Thomas’s’ at the beginning… it [the professional development programme] relates to the kids and it relates to the teachers, and it’s not just airy-fairy stuff, and you [the facilitators] understand that there are a whole lot of other things that impinge upon teachers. (December 2003)

Nina’s willingness to negotiate with the teachers, respond flexibly to specific emerging needs and tailor her programme firmly within the school context helped boost teacher confidence and ability to enact the changes. She was able to help the teachers make their content meaningful and manageable within the context of their own classrooms (Higgins, 2004; Thomas & Ward, 2006). This aligns with the literature that concludes that the strategies used by the external experts, and not just their presence, makes the difference in precipitating change (Timperley, 2008; Timperley, et al., 2007). Nina’s acknowledgment of the embeddedness of teaching within the school and classroom context and the need to build within school capacity is exemplified in the following quote:

As facilitators we need more of a hands-off role in the third year to allow them to move forward as a school, underpinned by their new knowledge and their superior knowledge of their own kids and school environment. We’ve given them the wind and direction to help them fly. (December 2003)

Although the lead teachers continued to work in classrooms in a similar role to the outside facilitator and natural collegial pairing for in-class support developed, this practice did not spread throughout the school in the following final year. More structures needed to be developed that allowed deprivitisation of practice and inside-classroom collaboration as well as alongside-classroom learning to occur in order to sustain ongoing change. Teachers sharing mentoring and advising roles and giving and receiving help as part of making classroom practice more public is a central characteristic of a professional learning community (Louis, et al., 1996). Peer observation had been incorporated in the appraisal system, but had not yet
moved into more sustained classroom observations and feedback. The teachers thought it was good to spend more time in each other’s classrooms, but still by the end of the project some had reservations about the pressure this could generate. David noted:

> to be perfectly honest I don’t think we are at a stage where we could do that [spend time in other’s classes] … I think people would feel threatened … people are teaching it and doing it, but I think it would just add a little bit too much pressure. (December 2004)

This highlighted the importance of maintaining the momentum for change as identified at the continuation or sustainability phase in the literature (Degenhardt & Duignan, 2010; Higgins, 2004). By 2004, KIS was at the point of needing to develop ongoing renewable practices in order to move into further growth phases (Cowie, et al., 2011) and avoid any “freezing” (Degenhardt & Duignan, 2010, p. 50) in the operating paradigm. The development of coordinated teacher coaching and mentoring structures was needed to build school-wide sustainable collaboration and overcome barriers around privatised classroom practice that still existed.

**Summary: School Journey Compared to Models of School-wide Change**

KIS’s change journey exhibited similar patterns to those shown by the sigmoid growth curve used to discuss the implementation of the New Zealand Curriculum in the CIES project (Cowie, et al., 2011). The curve for the school (Figure 9) showed the initial boost associated with new conversations and learning that followed the diagnostic interviewing and initial workshops. This was reflective of the initiation phase (Fullan, 2001c) and the examination of the existing situation as described by Piggott-Irvine & Gratton (2004). This initial energy and enthusiasm for implementation is not clearly shown in the sigmoid curve model (p. 20 this thesis) which appears to start with the implementation dip (Fullan, 2001b) entered at about six months into the project for KIS. As the magnitude of the changes, the amount of work and time needed, the confusion around the new approaches, the need to learn new ways of doing things and the stress this created for the teachers became evident, the teachers’ and the school’s capacity to cope decreased. This was reflected in the dip over the second half of 2003 to the low point around March 2003, which is consistent with the sigmoid curve and is widely discussed in the literature (Cowie, et al., 2011; Edwards, 2008; Fullan, 2004; Piggot-Irvine, 2005). School-wide ownership of the barriers to change, facilitator modelling and interactions that built confidence in the manageability of the initiative, collegial planning and support, complemented by evidence of improved student achievement during 2003, were the key
enablers assisting the teachers to move out of the implementation dip. Over the second half of the second year in the project KIS mirrored the rapid rise at the end of the growth phase and experienced some of the “fruits of change” (Cowie, et al., 2011, p. 5): improved student engagement, increased collective responsibility for planning and student learning, along with a common vision and renewed moral purpose about the importance of the initiative. After three-years the school sat around point B on the sigmoid curve (Cowie, et al., 2011), moving into the institutionalisation phase (Fullan, 2001c) where further impetus and school-wide strategies to support ongoing change were needed to avoid any stagnation or movement into a decline phase. The efforts and experiences of individual teachers in the school would be a major determinant of the direction the school took from here and their journeys are explored in the next chapter.
Chapter Six - Individual Teacher Stories

When we are learning something new, we can feel awkward, incompetent, and even foolish. It is easy to convince ourselves that it’s really not so important after all to incorporate the new and so we give up ... When you consider the risks involved ... you begin to appreciate not only the courage required, but the personal work.

Senge, Scharmer, Jaworski & Flowers (2005, p.35-37)

Introduction

In this chapter I present individual stories outlining the teachers’ perception of their ability to implement the changes consistent with the INP. Change occurs at both the whole school level and the individual level, and leaders tasked with managing change need to be cognisance of both.

Firstly, I will tell the teachers’ stories to give a sense of the individuality of each person. Although they were part of the same change programme in the school they each experienced it very differently. In trying to implement the INP, most teachers talked of feeling the incompetence noted by Senge, Scharmer, Jaworski, & Flowers (2005), but at different times and for different reasons. Others struggled for a long time to “incorporate the new” and felt overwhelmed by the “personal work” involved, as mentioned in the quote above. I have used the teachers’ personal journey graphs to show how they experienced the changes over the three-year period. Some of the teacher’s graphs were very different to others; hence I have chosen to write five stories that exemplify the diversity of individual experience of the teachers. Two of the journey graphs presented are similar, reflecting a longer initial period of lack of confidence in implementing the change. But the reasons for this were quite different, which is why I have included both stories.

Secondly, I discuss the narratives in light of the literature on change as a personal process as presented in Chapter Three of this thesis. Here links will be made to stage models and the change grief cycle and the role of emotions. Next, I present the specific barriers to implementation that contrast between individuals. The common catalysts and barriers to change have been discussed in Chapter Five, but a number of barriers were specific to the journeys of individual teachers and these are discussed in this chapter. The readers of these stories will see other dimensions in them, but I have chosen to focus on stage models, the role of emotions and the barriers to change because contrasts between the different teachers’ implementation ability over the period of the project emerged in these areas. This is designed
to alert the reader to the vital need to consider the diverse human experiences of individual teachers within any school-wide change process. In presenting both the school story and the individual teacher stories I want to illustrate the complexity and importance of balancing both levels of change.

**Jan’s Story**

At the start of the INP Jan was in her mid-twenties and had been teaching for three years, all at KIS. In the first year of the INP she taught part-time (every morning), having responsibility for teaching her year 8 class mathematics each day. Jan was teaching full time at year 8 in 2003 and 2004. Jan “absolutely hated” mathematics at school and identified a gap in her knowledge of progressions in mathematics teaching saying, “you have gotta have some idea where the approach is going and I don’t always”. But she liked teaching mathematics because “it is more black and white than other areas” and her class time was “almost a controlled session” and her students “worked quietly”. Jan started her change journey positive about mathematics teaching, but aware of her limited content knowledge.

Jan’s low placement on her journey graph (Figure 13) reflected her initial lack of confidence in her mathematical content knowledge. The small increase in her perceived implementation ability coincided with the student diagnostic interviews and the learning from the first workshops. But by June 2002 the preparation needed, and her ability to understand the strategies the children were being encouraged to share, led to a drop off in motivation to implement the new approaches:

You can do as much preparation as you like …and think you have gone through it and some kid who’s well and truly above your level, makes some suggestion and you are floored already cause it’s different to the solution I worked out and I haven’t got a clue whether that makes any sense or not. (June 2002)
Jan struggled to engage with the project over the next year. She talked of her “failing” to cope with differing student responses and was wondering if someone else would be better teaching this than her. She did, however, identify the possibility that improving her content knowledge would lead to better outcomes for her students:

I have enough maths to get by for my own personal needs in life and after that trying to... work out how you do it. ... I’m sort of like the kids that go: “poof” [who cares]. So I think the most help to me would be if we could teach to our strengths where somebody else [teaches mathematics] – I am a great believer in if you are passionate about something or you really enjoy it then you do better by the kids. So maybe up-skilling myself would actually do that for me. (December 2002)

Despite the articulation of this possibility, looking back on the second year of the INP Jan acknowledged that at the start of the year she was “still pretty negative” about it. She admitted to initially teaching her usual units rather than the new numeracy units developed by the syndicate groups because she did not know what she needed the students to understand. Jan got “quite sort of grumpy about it” and only when she thought “that it might actually
become curriculum” did she decide to give it another go. Once she decided to “do it her own way” after trying three times to “follow the suggested plan” she felt more in control:

People have their own way of doing things and I don’t feel like I have got any ownership over it. So what I’ve found helpful about Nina’s stuff was seeing how she used the things that I would then take and translate and use in my own way anyway. (December 2003)

It was not until the latter half of 2003 that she felt she had developed a greater ability to implement INP approaches in her mathematics classroom. At the end of 2003 when discussing her perception of her content knowledge development she said: “I feel much more secure in teaching the units myself because it’s not magic about how … I came across the answers”. Jan commented, that she thought she would have been “more rebellious about it”, but now felt that it made sense and was “quite achievable”. She identified a rapid rise in her confidence over the latter half of 2003 as shown in her December 2003 graph. Interestingly, she decreased this slope when given the opportunity to make changes to her graph at the end of the following year, as shown by the solid line in Figure 13, claiming she had been over-ambitious about her ability at the end of 2003.

During the third year of the INP there was a ‘whole school’ focus on formative assessment in the classroom. This involved sharing student learning outcomes and developing student-based success criteria for the learning outcomes across a range of curriculum areas. Jan felt this emphasis developed easily out of her work in the INP where she was used to identifying learning outcomes for each activity with her students and stated, “We just modelled it off the maths”. She explained her perceived value in making the students more aware of their own learning:

Making the kids aware of what the learning intention is, what we’re covering and success criteria so that it’s not just me who’s aware of what I’m wanting them to do but they are too and they can verbalise [it]. (December 2004)

Jan felt her planning was much more responsive to her students, and rather than just “reading the books [Numeracy booklets] word for word” and using the activities “regardless of whether that’s where my lesson had gone” she expressed more confidence in setting her follow-up activities based on the students’ progress during the lesson. Instead of trying to plan whole units in advance she found it “more relevant and easier” planning on a day by day basis. She talked of her shift from her lack of “basic knowledge” and her one way, procedural-based approach, to a focus on her student’s learning.
Jan identified herself as being at Stage 2 on the FANT scale at the end of the second year and moving to Stage 4 by the end of the third year. She expressed surprise and pleasure at her own growth, commenting that “I wouldn’t have said that I’d moved that far on, so there”.

David’s Story

David was in his forties and came into teaching following work in the police force. He had completed a Bachelor of Commerce and a Bachelor of Arts in psychology before doing a one year graduate course to become a primary teacher. At the time of the research, David was studying for a Masters degree based on work in Experiential Learning. He had been teaching for five years, all at KIS and worked with Year 8 classes during 2002-2004. During the first two years of the INP David worked two days a week with a small group of ‘at risk’ students in an experiential based programme called Adventure Challenge. The programme included mathematics sessions with this less able group and his usual class was taken by another teacher at that time.

Mathematics was David’s “forte”, and he commented that he devoted “more time to maths in a day than any other subject”. He was the most qualified teacher in the school with regard to his personal mathematical content knowledge, having completed university statistics papers at the 200 level. The importance of personal content knowledge and personal mathematical learning experience as a basis for teaching mathematics was valued by David and he appreciated that other teachers did not feel as confident as he did.

David saw knowing the rules and structure of mathematics as vital to effective teaching. He felt if you were aware of the children’s stage then you “can talk to them and they will pick up concepts”. David linked his liking of maths to the orderly approach it offered him. He suggested a parallel with following rules in mathematics and rules in society, which was interesting due to his background in policing:

I think the rules and structure of maths is the most important thing at this age. ... And I think in society rules and morals are sort of sliding away and I think that is why I like maths it is the structure and you have got to have the rules and you have got to know how to apply the rules to get the right answer. (June 2002)

During the first few workshops David was unsettled by the multiplicities inherent in both the strategy and knowledge framework and its stages. He questioned the visualisation and multiple strategy approaches presented, especially when he thought about the “at risk”
children he worked with. He felt they were unable to perform even basic procedures like “which side to start adding from” and expecting them to approach thing in another way like “visualise or to image stuff” was too much:

To be honest with you I am having a lot of trouble, not understanding, but seeing the point of having so many different structures ... It is all new and I certainly am not against it, but I did get the feeling after our last workshop that I came across as if I was against [the INP]. (June 2002)

David was not available to be interviewed at the end of the first year and had struggled to come to terms with some of the in-class expectation of the INP professional development. Times for Nina to teach model lessons in David’s class had not been suitable with his timetable, although I was able to take one model lesson in David’s class during 2002. When reflecting on 2002 at the end of 2003, David described himself as having a “long period of non-acceptance” and suggested that he had played “the devil’s advocate” in some of the workshops. During workshops he had stimulated debate by presenting opposing, often traditional viewpoints, and challenged the workability of new practices. David sought justification for making a change; he wanted evidence that it would work.

But by the end of the second year, David identified a transformation that had taken place in his approach to the INP and his mathematics teaching. A successful series of three whole class lessons based on using equipment and visualisation had been a turning point for him. He described it as “the first time it felt really good, because ... everyone progressed with each lesson” and that the “visual aspect, it made sense to them and ... they could pick up that concept.” Also his changing approach to valuing the students’ explanations and strategies had empowered his students and he’d seen a change in the culture of his classroom:

I think it does change the whole culture because ... they [the students] learn that their voice is valued even if it is just through the maths groups and that just comes through everything and I think they now feel a lot more confident about being able to voice their own voice. (December 2004)

David was “reluctant to throw everything out” and “was trying to make the new approach, fit into what I used to do”. In discussing what he had done differently, he talked of changing his approach around to incorporate the old with the new rather than the new with the old:

Completely reorganised things, restructured things ... I’m still struggling with the way I used to teach it ... I’m still trying to find a happy medium with what I used
to do ... Rather than make this new stuff fit into what I used to do, just reverse it around I think. (December 2003)

David said that he had become more reflective about his teaching and now had to “sit back and think about what I’m going to do a lot of times”.

At the start of 2004 David’s new found enthusiasm for the INP led him to volunteer as a numeracy leader, working with Dawn. David assisted Dawn in “raising issues at staff meetings” and justifying to other staff the ongoing need for time to be spend on the whole school numeracy work. By this third year David had become a convert, he had seen the approaches of the INP as “such a leap” from where he’d “traditionally taught maths” and there were a lot of things he “overlooked in the past”, but now he saw how it all fitted together. This is reflected in the rapidly rising curve from late 2003 in his personal journey graph (Figure 14).

![Personal Journey Graph](image)

*Figure 14 - David's Personal Journey Graph: December 2004.*

David completed his personal journey graph (Figure 14) only once, at the end of 2004 reflecting back on the full three-year period of the INP implementation. He did not perceive himself as having an initial period of confidence in his ability to implement the Numeracy
Project approaches as most other teachers did. Rather, David openly acknowledged his “long period of non-acceptance” over the first two years with a shallow starting slope and a flat graph up till the last few months of 2003. His upward section finished with a rapid rise around November 2004. The final rise reflected the confidence David felt in moving forward following the whole staff cohesion after the November weekend resourcing workshop.

At the end of 2004 David placed himself at Stage 4 or 5 on the FANT scale but noted, “if you had have asked me even perhaps six months ago I would have been thinking 2 to 3”. This showed the massive transformation he perceived he had undergone in his ability to implement the INP in his classroom over the last half year of his third year in the Project.

**Dawn’s Story**

Dawn was in her mid-thirties and had been teaching at the Intermediate level for ten years, two of which had been at KIS. Dawn became the Lead Teacher in the second and third years of the INP. Right from the start of the INP Dawn expressed enthusiasm about her mathematics teaching, saying, “I love maths, it’s my favourite subject” and she was keen to integrate ideas from the Numeracy Project into her classroom practice. But as a student, Dawn had “hated maths” “especially from the onslaught of high school”. On deciding to become a teacher she was determined to improve her own mathematical content knowledge and learn about a range of pedagogical approaches to teaching, so she majored in mathematics in her teacher training degree. She did not want her students having the same experiences she had as a high school mathematics learner.

At the start of the INP Dawn was already familiar with some of the Numeracy Project ideas and her main concern centred on “coming to terms with the terminology and so forth”. She had “always tried to be a good maths teacher” and felt “pretty secure” in her approach to her mathematics teaching. Dawn considered she did not “have to change a lot” in her present practice to incorporate the numeracy work, but rather just become “more aware of a few issues”. In her teaching, Dawn already tried to cater to the different ways children learned, managed flexible groupings and used equipment and materials to support children’s learning:

To have those different learning styles available in the classroom, and to be constantly evaluating and assessing where the kids are at … we have a magnetic board and kids might change groups three times in a week based on what has been going on that day in a classroom. (June 2002)
At the start of her journey graph, Dawn placed herself at the Medium level feeling confident about her ability to implement the programme. The initial “injection of resources and equipment and teaching ideas” had buoyed her. She felt “really high about it’ towards the end of 2002.

![Personal Journey Graph](image)

**Figure 15 - Dawn’s Personal Journey Graph: December 2003, revisited December 2004.**

Dawn started preparing resources for the second year to help overcome her concern about not being “conversant enough with the new terminology”. But she found that other staff had not made a similar effort and she felt stifled with the lack of whole school progress. The workload to put everything in place overwhelmed her and she became “very frustrated at the start of the year [2003] believing, “I just can’t do this, I’ve got a new class to get to know, [I] can’t put it together’”. This corresponded to the downward slide in her graph. Following the staff questionnaire with the subsequent acknowledgement of everyone’s ‘real progress’ and the in-class whole week modelling by Nina, Dawn felt able to move on. But another low point hit when acting in her lead teacher role she tried to get all the resources and equipment ready for everyone:
The low was really when I was trying desperately hard to put things in one place so that we could find them, we could access them, rather than having to all go out and hunt, and I probably took on more there than I should’ve, to be honest. (December 2003)

In response to this she took a self help approach and focused more on her own “practice than that of others”. And as the rest of the year progressed she felt “as a classroom teacher she became stronger and stronger”. This allowed her to “really enjoy it” building her own confidence again. By the end of 2003 Dawn felt she’d “got her head around it now, a whole year of numeracy” and was ready “to progress next year”. She rated herself at Stage 3 on the FANT Scale, focused on what the students were doing and saying.

By 2004 Dawn was able to confidently assess where the children “were at” and this she identified as improving her effectiveness as a numeracy teacher. She was “fine tuned” to the progressions in the numeracy framework. Her assessment had become “more fluid”; she was “looking for those windows of opportunity more with children” which allowed her to assess their progress and change their grouping “in line with where the children are”. She talked effusively about the students’ ability to learn using the numeracy teaching model, their independence at monitoring their own learning and their ability to transfer strategies learnt to other settings. These student successes became her motivation. Dawn was a teacher who did not rest on success, but continually looked for improvement. She identified areas for further professional growth to ‘break out of” old models of teaching.

In revisiting her personal journey graph at the end of 2004 (see Figure 13 above) Dawn decreased the slope of her implementation progress over the second half of 2003. She now realised what she did not know back then and adjusted the graph to account for this growth over 2004. The perception that her ability to implement the INP in her mathematics classroom was high at the end of 2003 had been challenged by her new pedagogical development and insights over 2004. She appreciated there was always more to learn and anticipated her future progress as “onward and upward, but a bit of a slog”.

All the teachers I interviewed talked of the support Dawn had given them and her driving of the INP within the school. She was able to enhance student learning and focused on developing independence in her students with her use of independent activities, learning books, student learning logs and student self-monitoring of learning intentions. Certainly a self-motivated learner, Dawn had assisted and motivated the learning of the other teachers. She rated herself at Stage 5 on the FANT scale, but was quick to acknowledge the support of others, especially David, in helping her and others grow as teachers.
Stuart’s Story

Stuart was in his mid-forties, at the start of the INP and had been teaching for twenty-two years. He had taught in the Project Intermediate School for the last three years and this had been his first teaching position at the upper end (year 7 and 8) of the primary system. He was teaching a year 7 class during 2002-2004.

“I was a failure, a complete failure” was how Stuart described his mathematical experience at school in England. He had always been “in the bottom group” and dropped mathematics after Year 10. His frustration at his lack of understanding as a learner stood out in his memory and this need to understand in order to “be able to explain it to the children” pervaded Stuart’s comments about his approach to his learning and teaching of mathematics during his first interviews.

I am still personally really challenged by mathematical concepts ... I have to do a lot of studying myself. And utilise family members, especially my understanding of concepts. I am not too bad at following rules. Where at one time I used to accept that is the way that you do it, ... now I need to know how and why. (October 2002)

Stuart’s approach to the demands of the INP was one of slow, ongoing learning. The diagnostic interview highlighted to him the “huge variations in ability and strategies used” by the children. This prompted him to question his delivery style and he suggested that previously “the students had not been able to apply those strategies in the format” that he presented. Stuart was keen to learn from others including the children and stressed the importance of the children’s successes as giving him confidence:

I find that two or three of the students are often coming up with strategies that I haven’t thought of or have to consider myself to see if they work and they do of course every time. It’s a continuing learning curve for me but I believe that when I look at the success my students have had I think I’m really getting on top of it. I think I’m a lot clearer about where I’m going. (December 2004)
Figure 16 - Stuart’s Personal Journey Graph: December 2003, revisited December 2004.

Stuart’s personal journey graph (Figure 16) showed a stepped, but constant rise in his perception of his ability to implement Numeracy Project approaches in his classroom. He did not acknowledge feeling the low during 2002 that a number of the other teachers felt. At the end of the second year Stuart placed himself at Stage 2 on the FANT scale, focusing primarily on the subject material and the activities in the Numeracy Booklets. He commented “the material is the stuff I’ve really got to get around”, but he felt in some areas he was operating at Stage 4 where he was able to adapt material and adjust his teaching based on the children’s responses. In reviewing his personal journey graph at the end of 2004, he reconsidered the rise in the curve he had drawn at the end of 2003, although he did not change it and by the end of 2004 Stuart saw himself as “still tracking” upwards, but “more slowly”.

Each of the three years in the project had added confidence to Stuart’s perceived ability to implement changes in his classroom and by the end of his third year in the project he considered himself to be “pretty reflective” in his maths teaching He felt he was “reasonably
quick” in responding to the children’s progress and was “not afraid to change groupings during numeracy lessons” as children “cotton on to some concepts a lot faster that others”. He now rated himself at Stage 4 on the FANT scale.

**Campbell’s Story**

Campbell was in his thirties at the start of the INP and had been teaching for seven years. He had taught at KIS for the last two years, his first positions at the Intermediate level. He was teaching a year 8 class during 2002-2004. Campbell had completed three years of secondary school mathematics but identified his lack of content knowledge as a concern, especially in fractions and percentages.

In the first interview Campbell acknowledged the importance of developing his pedagogical knowledge for teaching mathematics saying he wanted a better understanding of “problem solving... [and] where the kids are coming from ...[and] to find exactly where they are at and having a good understanding of all different approaches to teaching rather than just the standard”. He already taught his class in groups for mathematics and prepared material for the student to complete independently. Campbell was alert to how his students were managing the day and often changed the time he taught maths depending on what else was happening in the classroom.

Campbell was open to new learning and felt his ability to implement the INP rose rapidly over the first six months of the project. He enjoyed the workshop sessions, commenting that the use of contexts and equipment had helped make his teaching “more real... rather than just rote learning”. The main change in his approach over this period had been in the use of the equipment and materials, which he found “the kids really enjoyed”. But as the year progressed he became disillusioned with the benefit of the resource material describing the activities as “too game-based” and “shifting the focus from maths”. He was concerned about “the amount of maths talk” that was actually going on suggesting the resource material led to a lot of off-task talk. He had enthusiastically set up four separate teaching groups following the student diagnostic interview but had found this “too much to handle” because the activities were “too short and then [the students] got bored” and they “picked things up at different rates”. Campbell’s willingness to try the programme was overwhelmed by the amount of preparation time and the management of the students in independent groups. This lead to a rapid decline in his confidence about his implementation ability towards the end of the first year.
Campbell attributed his rise in ability over 2003 to his developing understanding of mathematics and his increased confidence in teaching it. He stated, “I’ve got conceptual knowledge of science and how to teach it, and now I get maths ... it’s all confidence” He explored using a smaller numbers of groups and various strategies for independent student work as well as targeting “hot spot” areas that a number of learners struggled with:

It’s just completely changing, completely changing the way that you teach. ...I’ve always been into groups but not that in-depth and not [with] that quite specific [teaching]. (December 2003)

The syndicate planning had helped at the start of the year, but the facilitator modelling and reflecting on the importance of asking the students “the right questions” had been most valuable for Campbell:
Most useful is seeing how the resources fit into the teaching, how you can actually use them, and the way that she [Nina] was, when I observed her teach... the questions that she was asking – and just watching the children’s responses. That’s been most valuable. When you can actually get quite a lot out of the kids. (December 2003)

Letting “go the reins a bit more” and engaging his students in taking responsibility for group and management routines helped contribute to Campbell growing confidence in his ability, synonymous with the peak in his journey graph around October 2003. But in reflecting on the year Campbell drew a rapid slide in the graph to represent his ability over the last few months of 2003. He did not attribute this to anything at school but rather that “things were less than great” for him personally and he had struggled to maintain his earlier momentum and positivity. He placed himself at Stage 2-3 on the FANT scale.

In 2004 Campbell had a more difficult mix of children in his class and only mapped himself as rising back to his medium level of implementation ability by the end of the year:

A lot of my time has been spent with management it’s been really slow going ... what we have done we’ve done quite well but it hasn’t been anywhere like it was last year. (December 2004)

He was quick to praise the lead teachers for their organisational and planning support saying, “it’s been much easier when they have done all the work” but admitted to reverting to his “old ways” with the textbook out at times for topics where the syndicate planning was not completed. Campbell now rated himself between Stage 3 and 4 on the FANT scale acknowledging his overall progress, but also identifying his difficulty with a number of aspects of the programme this year. He concluded, “I’m doing quite well, but it’s been quite fragmented this year”.

Discussion of the Individual Stories

The five individual stories in this chapter presented a diversity of change paths, and responses to the change, brought about by the INP project as implemented at KIS. Individuals adapted and changed their practice at different times and experienced a range of differing emotional responses over the three-year implementation period. In this section the variety of change pathways, and the affective domain of the teacher change, will be discussed in relationship to the literature review in Chapter Three. In the first part of this discussion I explore the differing processes of teacher change as evidenced in the narratives and identify
the challenges to stage and cyclic models of change that emerged. The teachers’ progress was mapped against both the FANT model (D. Carter, 2002; Hughes, 2003; Moody, 2003) and the CBAM model (Hall & Hord, 2006). A discussion on the importance of emotions and their changing face during the implementation journey follows. Finally the diversity in the key barriers to implementation between the teachers is explored.

**Stage-based models of personal change.**

There was evidence of the teachers going through different stages in their attitudes towards change and different levels in the progression of their knowledge and skills as they wrestled with the adoption of the new practices. These were similar to those identified in the CBAM model (Hall & Hord, 2006) and the six responses of diverse learners summarised by Timperley et al (2007). Each teacher identified their perception of their change in relationship to the FANT scale (D. Carter, 2002; Moody, 2003) at the end of the second and third year in the project, but this did not represent the reality of the rollercoaster-ride, including the highs and lows, that teachers entered into at differing points over the three-year time frame. At times, people reverted to earlier stages (Campbell, Jan, Dawn), gave up altogether for a period (Campbell, Jan), or did not start for a long time, but then jumped suddenly to higher levels ignoring earlier stages (David). Only Stuart perceived he undertook a more straightforward, staged path in his ability to implement the new initiative. The reality of this variability and complexity posed a challenge to any ordered, stage-based model of personal change.

The summarised FANT scale (see Table 5 below) for the five teachers in the narratives is presented below. The FANT scale had not been developed for work in the NZNDP by the end of the first year (2002) and hence the self assessment was only completed twice by the teachers.

**Table 5 - Teacher perception of their change in relationship to the FANT scale**

<table>
<thead>
<tr>
<th>TEACHER</th>
<th>End of 2003 Level: Focus</th>
<th>End of 2004 Level: Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>2: Subject</td>
<td>4: Learning</td>
</tr>
<tr>
<td>David</td>
<td>2: Subject or 3: Student</td>
<td>4: Learning or Level 5: Others</td>
</tr>
<tr>
<td>Dawn</td>
<td>3: Student</td>
<td>5: Others</td>
</tr>
<tr>
<td>Stuart</td>
<td>2: Subject</td>
<td>4: Learning</td>
</tr>
<tr>
<td>Campbell</td>
<td>2: Subject or 3: Student</td>
<td>3: Student</td>
</tr>
</tbody>
</table>
By the end of the three-year project there was evidence of a contrast in the teachers’ progress with a range from those still focused on understanding how the resources are used to promote learning (stage 3), to the lead teachers who were supporting their colleagues in their teaching (stage 5) (Moody, 2003). In contrast the CBAM (see Chapter Three) provided greater depth to the analysis of the progress of change that that of the FANT model.

The CBAM has two parts and hence allowed me to map not only changes in the teachers’ use of the innovation (Levels of Use), but also changes in the affective domain in terms of the teachers’ reactions at particular points in time (Stages of Concern). Similar monitoring of attitudes, based on open-ended responses to the change experience, was carried out by Degenhardt and Duignan (2010) during their school reinventing programme. They too found this model useful because it helped them interpret the range of teacher reactions to change by focusing on teachers’ concerns and questions (the affective component) and not just their use of the initiative. I placed the five teachers on the CBAM stage model at the end of the first six months and each of the three-years (Table 8). These dates were synonymous with the interview points. This assessment was based on the research data and my work with the teachers as the co-facilitator of the INP. The teachers did not self-assess themselves on the criteria of this model, but the FANT scale 1-5 correlated well with the Levels of Use progression 2, 3, 4A, 4B and 5. In analysing the teachers’ stories for their placements within the CBAM, I concluded that the Levels of Use and Stages of Concern were not necessarily consistent. For instance, over 2002 Dawn maintained her new teaching practices at Level 4A: Routine Use, despite reverting back two stages on the Stages of Concern progressions in terms of her personal anxiety by the end of the year. This discrepancy is not discussed in the literature (Anderson, 2010; Hall & Hord, 2006) where either only one of the Levels of Use or Stages of Concern have been used to monitor teacher progress (Degenhardt & Duignan, 2010) or alternatively, there appears to be an assumption that the two progressions go hand-in-hand with the stages and levels occurring simultaneously for each number. From my findings it would appear that there is not always a number synergy between Stages of Concern and Levels of Use for any one teacher at any point in time, although they do appear to link at the higher progressions where stage 5 goes with level 5. By the later progressions (5 and 6) the new agenda has theoretically been integrated into the teacher’s practice and reverting to less accepting attitudes towards the change or previous ways of teaching would seem less likely.
This table (see Table 6) shows the diversity of: attitude to change, and knowledge and skills, at any one point in time, as well as the movement through the three-year timeframe. For instance, my ratings of the teachers’ stages of concern at June 2002 reflected differing teacher behaviour. Dawn’s initial confidence and focus on the outcomes of her teaching for students meant I placed her at stage 4. Stuart’s relaxed and accepting approach and Campbell’s willingness to engage with the INP meant their concerns were more about implementing the new practices (stage 3) rather than focused on further information seeking (stage 1) which was David concern. Jan’s personal anxiety around how the changes would affect her was reflected in her placement at stage 2. In terms of considering the development of knowledge and skills as represented by the Levels of Use, a contrast became apparent early on with the five teachers spread over the levels 1-4 by June 2002.

The range of placements at any point in time is consistent with the finding of Degenhardt and Duignan (2010), but the back-tracking over time evident in Dawn’s and Campbell’s dispositions to change, or the jumping of stages evident in David’s attitude towards the initiative and Campbell’s levels of use, is not specifically identified in Degenhardt and Duignan’s results. Although other researchers (Anderson, 2010; Hall & Hord, 2006) note that not all teachers move to the final stages of the CBAM, or that this staged evolution may not always occur, there is less discussion on the nature of any multidirectional, in particular downward movement, between the stages. This is a gap in the research literature on stage model of personal change highlighted by the results of this thesis.
Contrasts in the movement through the three-year timeframe, as well as vertical comparisons at any point in time (as made above), can be seen from the individual horizontal progressions in the table above (Table 6). These contrasts are clearly evident in the teachers’ stories, including their journey graphs, presented at the start of this chapter. It is worth noting that no-one has been placed at either stage 6 or level 6. Moving to levels 5 and 6 often needs to be supported by changes at the organisational level within the school (Anderson, 2010), which are consistent with the operation of a professional learning community (DuFour, 2004). KIS, and other schools in New Zealand (Bishop, et al., 2010; Timperley, et al., 2007), were just starting to develop as professional learning communities around 2004, at the conclusion of this project. Further development of a professional learning community and the focus on collaboration to improve outcomes for students would have supported future movement of teachers though the CBAM subsequent to the conclusion of the INP in KIS.

In summarising the stage models used to discuss the progress of the individual teachers, what stands out is the diversity and idiosyncratic nature of the progress, even over the first six-months of the project. These models are useful in identifying a forward ‘hopping’ change path with the varying pace of movement between the steps acknowledged in the literature (Anderson, 2010; Hall & Hord, 2006). But to represent the diverse growth paths of individual teachers the models need to be considered more flexibly. The cyclic, iterative nature of sense-making as described by Piggot-Irvine & Gratton (2004) and Timperley, et al. (2007) is not reflected in stage models and was more consistent with the experience of these teachers. It is limiting to represent change as a linear model. In reality, a caveat that allows for multidirectional pathways and jumps between stages in no apparent order would make these models more useful. Also these jumps, or changes in direction, are often pre-empted by emotional responses to change not directly presented in these models. To add a further dimension to our understanding of the process of individual change we need to consider the affective domain and the impact of emotions on one’s personal capacity to implement change.

The change grief cycle and the role of emotions.

The CBAM Stages of Concern addresses broad attitudes to change, but the changing role of emotions and the ongoing flow of change were more comprehensively depicted in the teachers’ journey graphs and their stories. Jan’s and David’s journeys looked similar, both depicting a long period of inaction and emotional struggle before being convinced of the value of implementing the new initiative. There are different reasons behind this and they will be discussed subsequently in the section on the barriers to individual change. Dawn’s story,
with a starting growth in confidence followed by a decline into ‘the pit’ and the associated emotional turmoil, then a subsequent rise out of the despair, is commonly reported in the literature (Claxton & Carr, 1991; Edwards, 2008; Fullan, 2001b; James, 2010; Piggot-Irvine, 2005). In contrast, Stuart’s graph shows a slow, constant increase in confidence throughout the three year time period with less apparent depth of emotional response. Both Dawn’s and Stuart’s stories were similar to other teachers in the school, but Campbell’s graph was unique. His showed two peaks and troughs with multiple struggles over the first two year period (a possibility noted by Edwards (2008) and Piggot-Irvine (2005)), before it flattened out to represent some level of ongoing confidence in his ability to implement the INP. Three (Jan, Dawn and Campbell) of the five journey graphs exhibit a ‘pit’ like response to change (Edwards, 2008; Fullan, 2001b; Piggot-Irvine, 2005) with broad similarities to Piggot-Irvine’s (2005) Change Grief Cycle. But the contrasts in response to change as exhibited by Stuart’s calm, accepting, ‘turtle-style’ approach and David’s stationary rejection followed by an enthusiastic, ‘hare-like’ response provided alternative longitudinal paths to change not so overtly documented in the literature on affective responses to change. These responses were associated with a range of emotions.

A range of strong emotional responses, both negative and positive, were experienced by the teachers as they worked to use the new theories and practices. In reflecting on her progress over the first 18 months of the project, Jan talked of her negativity, getting grumpy, her lack of understanding and of not wanting to teach in the mathematics area. Her emotions were similar to the anger, ambivalence and striving for meaning that Piggot-Irvine’s (2005) used in the Change Grief Cycle (Chapter Three) and referred to by other researchers (Claxton & Carr, 1991; Edwards, 2008; James, 2010; Kotter, 1995). Jan used “rebellious” to describe her feelings over this period and only once she felt able to take ownership of how she used the new practices, following her efforts at “up-skilling” and the facilitator modelling, did her confidence improve. In the last year of the project, Jan was able to extend the INP ideas across the curriculum as part of school’s formative assessment work. Claxton & Carr (1991) noted this extension to other areas of teaching as a characteristics of the recuperation phase in their framework. The pleasure at reflecting on her growth and a sense of accomplishment (Fullan, 1993) is clearly evident in the final paragraph of Jan’s story. David’s responses reflected entrenchment and opposition as well as denial (Claxton & Carr, 1991; Timperley, et al., 2007). He talked of “non-acceptance” and “playing the devil’s-advocate” while holding on to his usual ways of doing things. At the end of the second year he identified his experimentations with fitting the new practices into the old (Anderson, 2010; Clarke, 1997; Claxton & Carr, 1991; Hall & Loucks, 1978; Timperley, et al., 2007) and his need to change
this around. David identified a specific turning point “that felt really good” after a series of lessons in which his use of the numeracy teaching model (Pirie & Kieren, 1989) helped his students make conceptual sense of integers. He became more reflective and almost evangelical (Claxton & Carr, 1991) in his enthusiasm for the project moving into a leadership role in the school in the final year.

Deflation (Claxton & Carr, 1991) caused by excessive planning time translating into little classroom mileage was evident in Campbell’s story leading to his first low point. This re-emerged in his last year of the project, based on management issues with a particularly challenging class. At her low point, Dawn talked of her frustration with herself and with other teachers and the conflict she felt between managing her own class and supporting others in her lead teacher role. James (2010) identifies this struggle for equilibrium felt by Dawn and the draining effect this has on people. But Dawn’s story offered insight into the greater level of energy that was needed and the subsequent greater level of emotional response that resulted as she tried to manage both the personal conflict in resolving the dilemmas of the new practices and the interpersonal conflict in motivating and supporting others in her leadership role within the school. The multileveled dimensions evident in Dawn’s conflict reflects the three planes of personal, interpersonal and community processes that underpin Rogoff’s (1995) plane analysis that informed my methodology in writing this thesis, as discussed in chapter four.

The stories of Dawn, David, Jan and Campbell all suggest that they experienced a range of negative emotions over the three-year period. In contrast to this, Stuart did not talk of becoming stressed or reacting negatively to the change process, but maintained an outwardly ‘easy-going’ approach without letting the expectations pressure him. This suggested to me that the way some people respond to change agendas may be as much a product of their personality, ability to manage stress and openness to change rather than other factors, such as their level of content knowledge, pedagogical skills or capacity for work. All of the teachers, including Stuart, shared positive emotional responses to the changed practices. Their stories show these positive emotions to be initially prompted by personal learning from the workshops and student diagnostic interviews. For example, Dawn talking of feeling “really high about it” over the first year. In the later stages of the project teacher positivity and engagement tended to be in response to student successes with classroom activities or assessment results. These catalysts for change have been discussed earlier, in Chapter Six of this thesis, as part of the whole-school story.
In conclusion, the Change Grief Cycle (Piggot-Irvine, 2005) and associated emotional reactions to the process of implementing change, documented in the literature, provided a useful analysis tool to map the responses of the participating teachers over the implementation period of the initiative. At some point emotional responses to the expectations and/or enactment of change generated inactivity and negativity towards the implementation of the initiative; the need to change was not evident or the expectations and work involved in using the new practices became overwhelming. Four of the journey graphs drawn by the teachers showed a low point, or ‘pit’, before any sustained rise in their perceived implementation ability. And although most of the teachers’ stories attest to the negative emotions associated with the ‘pit’, the low points occurred at different times over the period of the programme and for different reasons. I surmised that The Change Grief Cycle would be best considered as a general trend line that no one person may actually follow. Rather, the cycle is composed of multiple alternative routes, whose divergent paths are precipitated by personal realities. These paths often end up in a similar place having traversed a mixture of emotional highs and lows. In the next section I address the major barriers to change for the individual teachers in order to shed further light on the reasons for difference in these pathways.

**Barriers to implementing change.**

The barriers specific to the five individual teachers stories are discussed here. Other barriers in relationship to the school story have already been discussed in Chapter Six. Lack of content knowledge and pedagogical content knowledge were impediments to the progress of Stuart, Campbell and Jan, whereas a relative abundance of content knowledge may have initially, impeded David’s further development. Resistance to new ideas was a barrier for Jan and David. The foremost frustration for Campbell in his early efforts to change was a lack of time and the inability to see the value for students in using the new resources. These issues also concerned David and Jan. Dawn expressed concern about not understanding the “new terminology” and the progressions in the numeracy framework. This lack of knowledge about how students learn created the initial barrier for Dawn, but emerged later for the others once they had developed greater content and pedagogical knowledge. Overloading herself with her perceived responsibility for getting resources and equipment ready for everyone, and balancing her own teaching along with her commitment to the lead teacher role, created a major barrier specific to Dawn. In their end of year interviews, all the teachers identified the importance of ongoing professional development as vital to their professional growth and a lack of individually targeted professional development as an ongoing barrier to change.
The importance of underpinning content knowledge in order to teach, especially in mathematics, is omnipresent in the literature and an obvious barrier to developing pedagogical content knowledge and knowledge of how students learn (Anthony & Walshaw, 2007; Ball, 1996; Ball & McDiarmid, 1990; Fennema & Franke, 1992; Higgins, 2004; Higgins & Parsons, 2009). It took the first two years of the INP for Jan to develop a level of content knowledge so that how the students got the answers was no longer “magic”. Similarly, Stuart talked about his ongoing learning to understand concepts by asking his family members and the children in his class. Campbell had a stronger level of content knowledge to begin with, but he found that his lack of understanding of how to teach mathematics was a barrier to his growth. By the end of the second year he commented on his developing understanding of mathematics and the confidence this had given him in exploring new teaching strategies. Having subject content knowledge and pedagogical content knowledge does not necessarily mean you have knowledge of how students learn (Ell & Irwin, 2006; Timperley, et al., 2007). The complex interplay between these three areas of knowledge and the ability to access students’ learning emerged as a key barrier for Dawn. This difficulty is confirmed by Timperley (2008) in her synthesis of teacher professional learning and as a major challenge to ongoing sustainability in the NZNDP by Ell and Irwin (2006). This complexity is overlaid with further dimensions played out in the interaction between teachers’ beliefs and practices. Disharmony and resistance to change can be generated by the conflict between new and old ideas and practices (Degenhardt & Duignan, 2010).

Resistance to change can be linked to the perceived success of present beliefs and practices, and even confident teachers can feel discomfort when required to reconsider and reframe their practice (Timperley, et al., 2007). All of the teachers resisted the expected changes at some point but it was most evident in David’s story. David placed importance on the rules and structures of mathematics and applying these to get the right answer. He was skilled and confident in a traditional algorithmic approach to teaching mathematics and wanted evidence of improved student outcomes before making changes. The importance of student successes leading to changes in teachers’ beliefs and practices is well documented in the literature (Guskey, 2002; Hughes & Petersen, 2003; McDonough & Clarke, 2005; Thomas & Tagg, 2005). Both Jan and David had a long flat section of resistance to change shown in their journey graphs (Figures 13 & 14), but the resistance developed for differing reasons. Lack of content knowledge and confidence was the main contributing factor for Jan, whereas David’s greater content knowledge and his confidence in using traditional mathematical pedagogies blinkered his vision of the new practices. David commented about appearing against the initiative at the workshops and these sentiments may be testament to a challenge to
his self-esteem or a perceived imbalance of power between facilitators and teachers as identified by Spillane, Reiser & Reimer (2002, as cited in Timperley, et al., 2007, p. 200). As Timperley et al (2007) confirmed, there is no easy solution to this and for David, change took time. Watching and being part of his students’ learning while experimenting with the changing approaches ultimately provided the catalyst that precipitated David’s changing attitude to the value of the INP reform. He needed observable justification of better student progress before he was prepared to make a big change and he needed it to happen for his students based on his teaching. Not only ownership, but ultimately leadership of the initiative was required in order to help David engage fully with the ideas presented. His challenging, but reflective approach may have meant that the resultant change in his beliefs about teaching and learning were more permanent. Resistance also developed when the time demands associated with planning and resource production and use arose.

Time was an omnipresent barrier for all the teachers and is similarly identified in the literature (Bishop, et al., 2010; Degenhardt & Duignan, 2010; Irwin, 2003; Thomas & Ward, 2006) and in the discussion in Chapter Five. I will only mention it briefly here in relationship to resource use and production which appeared to be a key barrier for Campbell, along with the content and pedagogical content knowledge mentioned above. Campbell became disillusioned with the use of resources and the value they added to student learning in relationship to the time taken to prepare them. Issues of off-task student behaviour in independent groups, students completing resource-based tasks early as well as the students’ perception of activities as games all became problems. These issues are common in the literature on the NZNDP (Irwin, 2003; Thomas & Ward, 2006) and will not be discussed further here. For an in-depth analysis of teaching orientations and equipment use see Higgins (2005). Changing grouping structures, the facilitator modelling of equipment use with groups, and giving more responsibility to students for self-managing helped Campbell overcome this barrier. In the latter stages of the INP collegial equipment and resource preparation reduced the time involved in planning, which also supported Campbell. The major barriers to change at any one time were specific to individuals and the teachers all identified the need for ongoing, individually-targeted professional development as one solution. The lack of this became an ongoing barrier that the school’s numeracy leadership team began to address in the final year of the project as the involvement of the external facilitators decreased.
Summary

In this chapter I have presented five different, individual narratives of teacher change and analysed these stories in light of the literature on the process of change for individuals. Making evident individual difference was at the heart of this chapter. Divergence in knowledge and skills, attitudes to change, emotional responses to change and the barriers for each person to overcome at any point in time clearly emerged. These multiple, interconnected dimensions need to be part of any consideration of the process of change. Hence I related each teacher’s journey to multiple models of change, building up layered dimensions to the change process. This included the FANT scale (D. Carter, 2002; Hughes, 2003; Moody, 2003), CBAM (Hall & Hord, 2006), the Change Grief Cycle (Piggot-Irvine, 2005) and frameworks of emotional change (Claxton & Carr, 1991; Edwards, 2008; James, 2010).

The key barriers to change for the individual teachers concluded this section. Although there were a number of common barriers, specific barriers emerged from the data as more inhibiting than others for individual teachers. These were content knowledge, pedagogical knowledge, knowledge of how students learn, resistance to change, time demands and resourcing, and a lack of ongoing professional development. Contrasts existed in the teacher’s perception of the impediment these barriers created and in the intensity and nature of their emotional response to the overall change process.

This chapter highlighted Rogoff’s (1995) personal plane and how individuals changed through their participation in the unfolding of the INP and the associated activities. I used models that are built on change as a process over time to confirm the dynamic nature of people’s participation as stressed by Rogoff. I surmise that no one model will ever capture the diversity of the change experience. Alongside reference to numerous models, change managers need to take account of emotions as well as critical barriers and catalysts to change at the personal level in order to facilitate the process of individual change.
Chapter Seven - Implications for Managing Change

Intrinsic dilemmas in the change process, coupled with the intractability of some factors and the uniqueness of individual settings, make successful change a highly complex and subtle social process. (Fullan, 2001c, p. 70)

Introduction

This thesis set out to explore the process of change over time prompted by a school’s participation in a school-wide professional development initiative. In Chapter Five we looked at the process of change for the whole school, which addressed the first research question. The change process for the school was compared with change models in the research (Cowie, et al., 2011; Degenhardt & Duignan, 2010; Fullan, 2001c; Higgins & Parsons, 2009; Piggot-Irvine & Gratton, 2004; Timperley, et al., 2007). Chapter Six explored the process of change for individual teachers and this addressed the second research question. In both of these chapters we considered the catalysts and barriers to change and how these were managed by the school and the teachers, which was the focus of the third research question. In this chapter the implications of these results for those involved in managing the process of change as school leaders, lead teachers, professional development providers or in-service teachers is presented. Rogoff’s (1995) three plane lens provides the framework for this chapter. Implications within each of the personal, interpersonal and community planes will be foregrounded while acknowledging their interconnectedness and inseparability. I have focused here on implications that have emerged from my research that are less prevalent in the literature in the hope they might provide or confirm new directions in the understanding of the process of change.

The Community Plane

The school as a community needs to acknowledge and take ownership of change processes. Ongoing consideration of school-wide organisation and practices that need to be changed, developed or adjusted to support the change process is required (Le Fevre, 2010). This may include provision for resourcing, group meeting time, peer support in classrooms, classroom organisation and planning professional development (Timperley, et al., 2007) and further than this, the reconsideration of which areas need emphasis as the implementation of any change unfolds. A cyclic process of trial, analysis and adjustment (Cowie, et al., 2009;
Piggot-Irvine & Gratton, 2004) with ongoing refinement and input from the community of participants (leaders, teachers and students), can help identify the next steps. Degenhardt & Duignan (2010) attest to the continual reinvention of the ‘ways of doing things’ that is needed as a school grapples with major change. Many of these decision lie within the leadership domain and thus the role of school leaders in initiating and coordinating a change process is crucial.

Leaders need to understand, articulate and discuss the process of change with the teachers (Fullan, 2006a) and ultimately the wider school community (Degenhardt & Duignan, 2010). The importance of creating spaces where progress can be discussed and challenged was highlighted by the teacher initiated meeting and survey reported on in this research. An implication from this is that the principal and/or professional development facilitators should deliberately allow time for discussion on the change process that is independent of their input and presence. They need to create ‘windows in time’ where teachers can off-load their concerns and face up to their progress within a confidential and supported environment; where problem solving and future collaborative action should be an outcome. Professional development providers or lead teachers may need to take a ‘hands off’ approach at times to help build or return ownership to the teachers. When this is appropriate, or alternatively when the provision of knowledgeable and motivating guidance is needed, is a dilemma for professional development providers to grapple with. I suggest regular, non-judgemental school-wide reality checks are held where progress, enthusiasm for change and specific barriers are identified, reflected upon and acknowledged as an integral part of the change process. The decision on future action and support strategies, which could include: further individual support, new group learning, a period of consolidation of practice so teachers can recharge or a creative shift to new practices, could be an outcome.

Grounding change within the school and the individual teacher’s classroom context aligns with Rogoff’s (1995) apprenticeship metaphor within the community plane and the process of legitimate peripheral participation (Lave & Wenger, 1991). An example of this was the longer modelling by the facilitator at KIS, where a number of teachers observed the programme over a whole week, together in a single teacher’s classroom. This allowed the teachers to talk about a common experience, negotiate and renegotiate meaning with each other and with the professional development facilitator. This peripheral participation became pivotal to their increased confidence. Observation and modelling lessons are still often delivered as one-off experiences, although they may be regular in nature. This study suggested that continuity of modelling within an apprenticeship metaphor may be more
valuable than a once a week or regular but disconnected visit. The importance of intensive, authentic modelling by a colleague or facilitator that allows a teacher to see progressions in practice and student learning over a continuous period of time is a key implication of this research. This modelling needs to be delivered at a critical developmental stage to provide new insights into student learning and teacher practice and promote motivation for future change. It may be better to free up a group of teachers together for a number of continuous periods. This would allow them to observe and discuss a colleague or facilitator modelling ongoing practice rather than at separate disconnected times or as individuals. The difficulty here lies in determining the critical moment when a group of teachers will engage with and learn from such an experience. The interpersonal plane (Rogoff, 1995) and the process of guided participation were inherent in the facilitator and lead teacher classroom modelling. Although this plane is backgrounded here, it was integral to the enactment of the apprenticeship metaphor and the community plane in this research study.

The Interpersonal Plane

The nature of the teachers’ engagement with others (including the students) and with the workshops, class modelling, activities and the materials associated with the INP both supported and inhibited the change process. Interactions with others and the coordination of people’s efforts underpin the interpersonal plane. Three key implications emerge from this study within the interpersonal plane. The first is the need to embrace and encourage challenging discourse and questioning of new practices (Timperley, 2008). Secondly that peer pressure from engaged colleagues (Fullan, 2010) through everyday incidental comments and actions is a major determinant on the direction in which people are encouraged to move. Lastly the powerfulness of inclusive action that engages everyone in common practical goals needs to be acknowledged.

Critical discourse and the posing of challenging questions should be embraced by change proponents (Bishop, et al., 2010; Timperley, et al., 2007). If uncomfortable conversations are left unsaid or glossed over then the justification for, understanding of, or motivation to change, can be less evident. Within the workshops at KIS, the teachers who were less confident in their own content knowledge tended to challenge the changes less. For some this led to a lack of real engagement or ownership of the changing practice. Those who openly discussed challenges to the new practices with others and were less accepting of new resources and approaches later became some of the strongest advocates for change. Evidence
of improved student performance based on a teacher’s deliberate actions helped provide the motivation for change. The challenging discourse appeared to allow the teachers to critically reflect on the merits of any changes and subsequently take action that they could justify. Promoting, and knowingly presenting for critique, alternative views to those presented in any new initiative; to ‘play the devil’s advocate’, although appearing counter to expectation, could provide a key lever for change. There are benefits to be gained through a willingness of change initiators to encourage, accept, explore and address doubt and counter-views in an ongoing iterative way.

Teacher discussions about resource use and classroom events in the staffroom, visiting one another’s classes to observe practice and helping each other plan and teach specific activities were the practical everyday things that made a difference to the enactment of the INP in KIS teachers’ classrooms. Learning from peers is one of the most powerful catalysts for change (Fullan, 2006a). Common decisions and efforts in syndicate groups and shared ways of talking about how learning takes place were important (Cowie, et al., 2009) and helped provide positive pressure for change (Fullan, 2010). This included discussing and sharing: planning, student groupings, resource production and the setting of achievement targets. Such actions are consistent with the characteristics of a professional learning community (Bishop, et al., 2010; Parsons, 2005; Timperley, 2003). A sense of unity emerged when all the teachers were involved. Such activities helped generate interdependence, where everyone’s input was needed to achieve the desired outcome, and this inclusive approach provided motivation and support to move forward.

I conclude that at this interpersonal level there is an overarching need to place importance on the development of strong inter-personal relationships between teachers. The fostering of school and teacher unity through professional and social activities that build trust and collegiality should provide an environment where together teachers have the resilience to tackle and support the change process. Although not covered in this research study, ideally this would also include unity with the wider parent and school community about the direction and nature of change. This links back to the community plane and confirms the value in considering Rogoff’s (1995) different lens simultaneously to add new dimensions to our understanding of participation in an event of activity.
The Personal Plane

The implications as viewed through the lens of the personal plane are interwoven with, and contribute to, the implications within both the interpersonal and community planes. The teaching staff as a whole is made up of the sum of the different individual teachers; their personal experiences and actions influence and are influenced by the actions of others within the inter-personal plane and school-wide institutional practices within the community plane. The progress of the teacher who is least engaged with the changed practices and the progress of his or her students, could be used as a measure of school-wide change, assuming the improved engagement and achievement of all students in the school is the goal. The school was composed of individuals and their change process contributed to, but individually was not the same as, the school-wide process. Hence the need to consider the idiosyncratic change journey of each teacher rather than consider them only as part of a specific group (interpersonal plane) or the whole teaching staff (community plane) is an important outcome of this research study.

My first implication within the personal plane emerged from my stage models analysis of individual change where the need to consider the different progress of individual teachers over time became evident. Each individual is unique; their personal and professional histories, experiences and social interactions all impact on their ability and motivation to internalise new practices (Higgins, 2004) and take on changes. The teacher needs to use new knowledge or information on their own terms adjusting, changing or incorporating approaches so they feel personal ownership of their practice. Because the change process is personal and idiosyncratic, individuals need different types of assistance at different stages (Loucks-Horsley, et al., 2003). No two teachers in my study had the same change journey or experienced the changes precipitated by the INP in the same way. Talking with individual teachers, having them write and share anecdotal notes about their experiences and the specific issues that concern them would help leaders monitor their teachers change journeys and plan targeted assistance. This would be consistent with a “Teaching as Inquiry” (Ministry of Education, 2007b, p. 37) process where change leaders collect evidence, plan action, evaluate progress and make changes to a professional learning programme cognisant of the needs of individual teachers. The principal, or change leaders, plan Individual Educational Programmes (IEP) for teachers that include ongoing reflection with a teacher on how they see their progress and how they feel about the changes they are expected to be making. Discussing and using models of individual change with the teachers such as the FANT scale (D. Carter, 2002; Hughes, 2003; Moody, 2003), the CBAM (Hall & Hord, 2006) or, better
still, one developed by the teachers that is specific to their project or initiative, can provide a frameworks for progression and monitoring of individuals over time. Ongoing analysis of individual teacher’s change journeys and their readiness for the next steps in changing practice would sit well as an added but complimentary dimension to the process of teacher appraisal. But such analysis needs to be extended to encompass individual emotional responses to change to help determine individual’s readiness for future professional growth.

At KIS, emotional responses to change were key determinants of a teacher’s perception of their ability to implement changing practices. My second implication within the personal plane is the need for change managers to engage with teachers’ emotions and personalities. The use of models such as the Change Grief Cycle (Piggot-Irvine, 2005) and frameworks of emotional change (Claxton & Carr, 1991; Edwards, 2008; James, 2010) in this study shed light on the different nature and level of intensity of emotional responses to change. Guilt, tension and a lack of confidence were clearly evident in David, Jan and Campbell’s stories as they struggled with their emotions, which were often hidden from others. Greater exploration of models of emotional change with teachers throughout the implementation of a change agenda could help teachers see emotions, both positive and negative, as a normal part of the change process. Emotional responses need to be openly discussed, expected and engaged with as part of the change process.

Those associated with change management in schools need to be aware of, and accommodate individual differences right from the start of the implementation process of any change agenda. A ‘one size fits one’ approach with attention to individual progress, context-based classroom practice (Bishop, et al., 2010; Higgins, 2004, 2006) and personal emotional responses (James, 2010) will be needed in order to assist the professional growth of teachers that has, at its heart, improving educational outcomes for all students.

Conclusion and Recommendations

In this study I started with the whole-school change journey and unpeeled layers of collaborative interactions and individual stories, and discovered the difficulty in isolating one from the other. Multiple change factors are interconnected as they emerge and re-emerge in the change process (Higgins, 2004) and I have shown this in the way I presented the narratives and the discussions that followed. A socio-cultural approach embraced these connections and highlighted the importance of seeing things through the eyes of different groups and individuals. This includes alertness to individuals, while also seeing them as part
of a collegial group and the wider school community. Rather than being overwhelmed by the complexity of change, facilitators and leaders need to focus on smaller parts while still being cognisant of their connection to the wider picture. Attention to the detail of everyday conversations, individual teachers’ emotional responses to change and the collective energy and motivation of groups of teachers is required in order that the whole school change process maintains its momentum.

The role of collegiality in within school-generated change (Bishop, et al., 2010) and the pressure exerted by highly motivated peers (Fullan, 2010) are vital to engaging individuals and supporting ownership of the changes by the teachers and the school. A combined focus on meeting the achievement targets for all students and acknowledging and celebrating student successes helps provide the motivation to maintain a change process.

The complexity of change and the interconnectedness between the personal, interpersonal and community aspects of the school environment demand a multifaceted approach to managing the change process (Cowie, et al., 2011). No one model of school-wide or personal change will map the process of change or give specific direction to the ongoing needs of a particular school or person. Change managers should draw upon a range of models in planning for and managing change and be open to considering aspects of different models at different times. Change needs to be viewed as part of life in a school and it should be discussed, supported and planned for (Le Fevre, 2010; Piggot-Irvine, 2005). Taking time to map and reflect upon the change process while engaged in it is crucial to identifying and overcoming barriers to implementation. The challenging and often tumultuous nature of the change journey needs to be acknowledged, discussed and seen as an inevitable part of doing things differently in order to maximise the achievement and life choices of the students we teach.

**Limitations of the study**

One set of limitations of this study relate to the research design associated with the lack of purposive sampling in determining the school to be studied, and my role as a facilitator of the INP. My decision to carry out research at KIS was determined by the Ministry of Education criteria for the inclusion of schools in the INP in 2002. I did not choose to carry out research specifically at KIS but rather the circumstances I was in as a facilitator of the INP allowed me to research in this particular school. My role as both a facilitator and a researcher in the school could be seen as generating a conflict of interest. I was not only observing the
process but was also a part of it. Being directly engaged in the events at KIS and the impact
this may have had on the reported research needs to be acknowledged as a limitation of the
study. Working within the school allowed me to form a different relationship with the
teachers than if had I been solely a researcher. In their interviews, the teachers may have tried
to please me or respond in a way they thought I would expect. But, I think, the data became
richer because of my dual role and my three-year involvement in the change process at KIS.
The teachers willingly shared their self-perceived weaknesses and emotional responses to the
change process with me knowing that I was working alongside them, over time, and that I had
a stake in the outcome. Some might consider it a limitation that the original research design
was focused on the implementation of the Numeracy Project. But the research was always
focused on change and developed to consider the general process of change rather than on
teacher mathematical beliefs and pedagogy.

This study focused on the teacher’s perception of their experience of the change process
and this differs from the reality of the changes that occurred. Many researchers have reported
inconsistencies between a teacher’s perception of, and the reality of, their classroom practices
(Wilson & Cooney, 2002). Within a research setting, Wilson & Cooney (2002) noted the
need to consider both “what a person says and what a person does” (p. 130). I did not include
data from direct classroom observation of the teachers, from videos of classroom lessons,
from interviews of students or from records of student achievement. The use of these research
strategies would have added further evidence to enrich the teachers’ stories of the process of
change, but they were beyond the scope of this study in terms of resourcing and time.
Nonetheless, the lack of comparison between the participating teachers’ claims and their
practice could be identified as a limitation.

This school had a unique group of teachers, in a unique situation, at a unique time, and
as such the data only talks of this particular experience and is in no way representative of any
other school or group of teachers. I interpreted the data and produced the narrative hence the
lived experiences of the participants were distorted in some way by how I chose to report
them (Chase, 2005). The uniqueness of the participants and the setting, and the researcher’s
role as the interpreter of the data, are concepts consistent with a qualitative research study, but
these could be seen as limitations compared to a large-sample size, quantitative study.
Recommendations for further study.

The study of school change “gets murky indeed” (Anderson, 2010, p. 70) and further longitudinal studies that focus on the change process would help add to the detail if not the clarify, of the overall tapestry of change. I make the following recommendations for further research.

1. Research on how schools sustain change and reinvent themselves over longer periods of time (3-5 years) and what structures can support a focus on ongoing improvement.

2. Consideration of how teachers inquire into their own practice as part of a Teaching as Inquiry process (Ministry of Education, 2007b) that is linked with ongoing school-wide change.

3. Investigation of ways to collaborate with students in initiating and sustaining change.

4. Exploration of the wider parental or community engagement with change and the development of strategies to include these groups in decision-making around the nature of the changes that should occur.

When drawn together, research in the final three areas above would acknowledge the key aspects of a school community; teachers, students and their parents and caregivers and these should all contribute to any forward path for school improvement. However to move forward we need to reflect on where we have come from.

This research started nearly ten years ago, but this or any future studies on the process of change will never be out of date. Studies on the nature and impact of change on individuals, organisations and systems will always provide insights from which we can increase our understanding of this complex, multifaceted and timeless process. Change and the expectation of change are central to improving our schools and ultimately the lives of our students. As educationalists, it is imperative that we continue to read and talk about the process of change!
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THE IMPACT OF THE INTERMEDIATE NUMBER PROJECT (INP) ON TEACHER CLASSROOM PRACTICE.

CONSENT FORM FOR PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:
1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. The data [audio-tapes and electronically held data] will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed;
4. This project involves an open-questioning technique where the precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops. Consequently, although the Ethics Committee is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s) and also that you may withdraw from the project at any stage without any disadvantage to yourself of any kind.
5. I will receive no payment or compensation for participating in this study.
6. The results of the project may be published but my anonymity and the anonymity of my school will be preserved.

I agree to take part in this project.

........................................................................................................................................
(Signature of Participant)
........................................................................................................................................
(Date)

This project has been reviewed and approved by the Ethics Committee
of the University of Otago

UNIVERSITY OF OTAGO
Appendix 2 – Teacher Interviews

Teacher Interview 1

Background
Age
Gender
How many years have you been teaching?
How many years teaching in Intermediate schools?
How many years at this Intermediate school?

Professional development
Tell me about your own background in mathematics before you started teaching.
What about you teacher training in mathematics?
What mathematics based professional development have you participated in before this project?

Teacher attitude and knowledge
Do you enjoy teaching mathematics?
What do you like about it? Dislike about it?
What content areas do you feel most confident in teaching?
What content areas do you feel least confident in teaching?
What knowledge do you need in order to teach mathematics effectively?
(Content, pedagogy, children’s learning)

Teaching Practice
How is the whole school mathematics programme organised?
How do you determine what to teach?
How much time each day, week, do the children spend doing mathematics?
What happens in your usual maths lesson?
What approaches do you have to teaching mathematics – whole class, groups –cooperative, ability?
How do you view the use of equipment?
What is the most effective way for the children in your class to learn mathematics?

What would you identify now as your personal needs for professional development in mathematics?
Teacher Interview 2

Teacher attitude and knowledge

1. Do you think you attitude to maths has change as a result of your participation in the project?
2. Has your content knowledge of maths been developed in any way by participating in the project?
3. Has your understanding of how children learn number changed as a result of your participation in the project?

Classroom practice

4. Has you approach to teaching your maths class changed in any way due to your participation in the project? What have you done differently?
   - Examples if needed
     - How do you determine what to teach?
     - How do you start the lesson?
     - What approaches do you use?
     - Have you grouped the students for instruction, if so how?
     - What equipment have you used? How effective was the equipment in helping the children understand the concepts?
     - How do you approach the teaching of number knowledge?, strategies?
5. You identified …………………………… as a concern at the last interview. Has this been addresses in any way through your participation in the project?
6. Has the work in the number strand in the project had any affect on the way you have taught in the other strands? In other areas?
7. Share a particular lesson that went really well.

School culture

8. What support systems, structures have operated within the school that has helped you with the implementation of the numeracy project in your classroom?
   - How has this been helpful?
9. In what way have things changed in the school?

Professional development

10. In your opinion what aspects of the project helped you the most? How and why? How useful was the in class work with the facilitator?
11. What further assistance do you need from here?
12. What would be most helpful for you next year?
13. What aspects of the project were least helpful or confusing? Why
Teacher Interview 3

November/December 2003

Teacher attitude and knowledge
1. Has your content knowledge of maths been developed in any way by participating in the project?
2. What content areas do you feel most confident in teaching?
3. What content areas do you feel least confident in teaching?
4. Do you feel comfortable with the strategy stages?

Classroom practice
5. Has your approach to teaching your maths class changed in any way due to your second year of participation in the project? What have you done differently?
   a. Examples if needed
   b. How do you determine what to teach?
   c. How do you start the lesson?
   d. What structure does your lesson take?
   e. Has your teaching style changed over the last 2 years?
   f. Have you grouped the students for instruction, if so how?
   g. Has the student practice time and independent activities worked effectively?
   h. What equipment have you used? What equipment has been most effective in helping the children understand the concepts?
   i. How do you approach the teaching of number knowledge? Strategies?
   j. What is your major concern with regard to teaching in your mathematics classroom?

6. Has the work in the number strand in the project had any affect on the way you have taught in the other strands? In other areas?
7. Share a particular lesson or unit you taught that went really well.

School culture
8. Collegiality and syndicate planning were sited as the most useful systems that operated within the school to support the implementation of the numeracy project in your classroom in 2002. How has this continued in 2003?
9. Are there any other, different initiatives that have been helpful this year?
10. Has the way you planned personally changed?

Professional development
11. In your opinion what aspects of the project helped you the most? How and why? How useful was the in class whole week modelling work with the facilitator?
12. The amount of reading material was an issue at the end of the first year – is this still the case?
13. How confident do you feel about your ability to sustain the project next year as an individual? As a whole school?

Personal Journey
14. At what stage in the Journey would you place yourself?
   Stage One: Changing the organization of your mathematics class
   Stage Two: Focus on the subject material – activities in the book
   Stage Three: Focus on what individual students are doing
   Stage Four: Focus on student learning- formative evaluations, adapting teaching, range of strategies to advance student thinking
   Stage Five: Enhancing student learning, independent learners, self-motivated teacher development, supporting others to enhance practice
Teacher Interview 4

December 2004

Teacher effectiveness
1. Has your effectiveness as a numeracy teacher improved this year?
   Consider if needed:
   - Mathematical content knowledge
   - Knowledge about learning in numeracy
   - Engagement in numeracy teaching and learning
   - Awareness of the learning needs of students
   - The importance of success for all students
   - Reflection on your numeracy teaching
     What activities have you undertaken or practices have you employed that have allowed this to happen?
     How confident are you at assessing the students’ knowledge and strategies against the framework?
     How confident are you at teaching to meet the needs of students based on your assessment of their ability

Classroom practice
2. How is your mathematics classroom different from 2002/2003?
3. Have you continued to integrate the Numeracy Project ideas into your classroom practice?
   How?
4. What is your major concern with regard to teaching in your mathematics classroom?
5. Has the work in the number strand in the project had any affect on the way you have taught in the other strands? In other areas?

School culture
6. What systems have operated within the school, this year, that have allowed you to keep going or move forward in your numeracy/mathematics teaching?
7. How have these been helpful?

Professional development
8. What will be your main focus for your mathematics teaching next year?

Personal Journey
9. At what stage in the Journey would you place yourself?
   Stage One: Changing the organization of your mathematics class
   Stage Two: Focus on the subject material – activities in the book
   Stage Three: Focus on what individual students are doing
   Stage Four: Focus on student learning – formative evaluations, adapting teaching, range of strategies to advance student thinking
   Stage Five: Enhancing student learning, independent learners, self-motivated teacher development, supporting others to enhance practice
Appendix 3 – Principal Interviews

Principal Interview 1

Involvement in the INP

1. Why were you keen for the school to be involved in the Intermediate Number Project?
2. How do you hope the teachers and the children will benefit from the school’s involvement in the project?

Present school mathematics programme

3. In your view what are the positive aspects of the school mathematics programme at this time?
4. In your view what changes do you see are needed to improve teaching and learning in mathematics in your school?
5. What structures exist within the school to facilitate leadership, collegial support and sharing within the mathematics programme. What is the role of the syndicates?

Professional development

6. From your perspective what should be the focus for staff professional development in mathematics?
7. What activities do you see as advantageous to whole staff professional development in mathematics
   a. Mathematical content knowledge
   b. Pedagogical content – teaching strategies, group management
   c. Knowledge of how children learn.
8. What impact has the project had so far on the teachers?
   a. The diagnostic interview
   b. Workshops
   c. Knowledge activities and resources
9. Any other comments you would like to make at this stage?
Principal Interview 2

Involvement in the INP

1. What have been the main effects of your school’s involvement in the Intermediate Number Project from your point of view?
   a. For the teachers
   b. For the children

Changing practice

2. Have you noticed any specific changes in:
   a. the mathematics programme?
   b. classroom practice?
   c. teacher attitude?
   d. teacher knowledge
   e. school culture?
3. In your view what has facilitated any changes that have taken place?
4. Has the project had an impact on any other areas other of the school?

School culture

5. What structures within the school have worked best to facilitate leadership, collegial support and sharing within the mathematics programme. Has the role of these changed through the teachers’ involvement in the project?
6. How will the project be sustained next year (2003) with less involvement from the facilitators?

Professional development

7. In your opinion what aspects of the project have been most helpful? How and why?
8. What aspects of the project were least helpful or confusing for staff? Why?
9. Following one year’s involvement in the project, in your view what changes do you see are needed from here to improve teaching and learning in mathematics in your school? What support is needed?
10. Any other comments you would like to make at this stage?
Principal Interview 3

Involvement in the INP
1. What have been the main effects of your school's involvement in the Intermediate Number Project from your point of view?
   a. For the teachers
   b. For the children

Changing practice
2. What advances have taken place this year?
3. What level of change has occurred?
   i. Differential change noted last interview
   b. a the mathematics programme?
   c. classroom practice?
   d. teacher attitude?
   e. teacher knowledge
   f. school culture?
4. In your view what has facilitated further changes that have taken place this year?
5. Has the project had an impact on any other areas other of the school?

School culture
6. How has staff ownership of the project been evident this year?
   i. Numeracy Team operation?
7. Staff receptiveness to ongoing PD? Observation of and by others?
8. How will the project be sustained next year (2004) with very limited involvement from the facilitators? Is self-sufficiency a viable goal for 2004?

Professional development
9. In your opinion what has allowed the project to make gains within the school and individual classrooms this year?
10. Following two years involvement in the project, in your view what changes do you see are needed from here to improve teaching and learning in mathematics in your school? How do you see this happening?
11. Any other comments you would like to make at this stage?

Journey Graph
12. Complete the school journey graph
Appendix 4 – Facilitator Interviews

December 2003

Comment on the changes you have noticed over the last two year period of the INP intervention

Teacher attitude and knowledge
1. Has the mathematical content knowledge of the teachers developed in any way?
2. What do you see as the strengths and weaknesses in the teachers’ content knowledge?
3. How familiar are the teachers with the strategy stages?

Classroom practice
4. What changes have you observed with regard to pedagogical approaches?
   What are the teachers doing differently?
   Examples if needed
   a. Start, structure of lessons?
   b. Grouping
   c. Has the student practice time and independent activities worked effectively?
   d. Equipment. What equipment has been most effective in helping the children understand the concepts?
   e. Teaching of number knowledge? Strategies?
   f. What is your major concern with regard to teaching of mathematics in the teachers’ classrooms?
5. Has the project had any effect on the way they have taught in the other strands? In other areas?
6. Share a particular lesson or unit you observed that was taught really well.

School culture
7. What systems have operated within the school to support the implementation of the numeracy project in teachers’ classrooms? How effective have these systems been?

Professional development
8. In your opinion what aspects of the project helped the most? How and why?
9. How receptive were the teachers to the feedback sessions following the in class observation?
10. How confident do you feel about the schools ability to sustain the project next year?

Personal Journey
11. At what stage in the Journey would you place each of the teachers?
   Stage One: Changing the organization of your mathematics class
   Stage Two: Focus on the subject material – activities in the book
   Stage Three: Focus on what individual students are doing
   Stage Four: Focus on student learning- formative evaluations, adapting teaching range of strategies to advance student thinking

12. Complete the school journey graph
Appendix 5 – School-initiated Survey

Let's talk -

Numeracy!

1. How do you feel about the numeracy project? (Tick the continuum appropriately)

2. Do you feel comfortable with the seven stages of development of the Numeracy Project?

3. Do you feel comfortable with the strategies for each developmental level?

Are you implementing the Knowledge Activities into your Maths Lessons? How?

1. I do not think so
2. Yes - during maintenance
3. Occasionally - class management strategies are an issue. Activities have to follow the splinter grouping
4. not teaching from INP yet
5. not really, I incorporate the odd game. I have used the number fans and number lines but that is about all, so far
6. N/A
7. I use knowledge activities in what used to be the maintenance time - my repertoire of activities has broadened - children are getting more chance to practise and broaden their bases.
8. Yes - in maintenance and beginning activities or, the starting lesson point.
9. Instructional, then rotate onto the reinforcement/homework schedule

Have you used any activities to teach strategies? Which? How did they go?

1. I am still a little unsure about the difference - I could go look it up but I think it is more useful to admit this is not mastered knowledge yet.
2. Number fans and Figure It Out
3. Place Value Houses (- now named Coro Number St)
   Rocket - ordering whole numbers
   The Same but Different - renaming fractions
4. Not teaching INP yet
5. Not really. Only the ones I already knew - eg. Partitioning - went well
6. yes - fine
Teaching the strategies has helped me to break down the developmental stages for the AC - EA (obviously, children that are struggling) and also meant that I am extending the AM - AP kids with material that I had never thought of giving L4-5 kids before... I have used fly flips, tens frames and hundreds boards regularly in my teaching. Multi round - about was brilliant for practice after teach session.

Yes - They went quite quickly and are good to follow used - eg. Long jumps and turn abouts

I have used strategy activities from text books

Have you read the new Getting Started booklet? Was it of any help?

1. Not yet - have sort of given up
2. Indeed, especially with splitting the knowledge and strategies
3. Yes
4. 
5. No, but I desperately need to find the time to do so
6. Yes - fine
7. Yes - the light went on - so to speak - really liked the portfolio checklists and the fact that the overviews acknowledge the transition from group to group rather than isolating the seven groups
8. Yes - the new one is much better, it has what I am learning better set out
9. No

Are you using the equipment from your class maths box? What have you used? For what?

1. I used some of the gear last term when I tried to teach a unit
2. fans/ loopy/ dice/ tens boards/ fraction houses/ rods/ number lines/ fraction wheels
3. yes - number lines, dice, counters, blocks - for numeration and decimals
4. abacus, counters, number lines
5. number lines - add and subtract
   number fans - x tables recall
   +/- number bonds - recall and practice
6. N/A
7. keyboard digits - warm-up - estimating and place value
   number lines-place value, ordering-whole numbers and decimals, +/- wooden cubes - to supplement games I have made
   transparent counters - for games and OHP demonstrations, imaging
   interlocking cubes - overloading
   happy hundreds/hundreds boards - +/-, skip counting and grouping based activities
8. Yes - hundreds chart for skip counting
   Diver Dan - integers
   Number Lines - heaps of uses
   Dice - starters/ games/ applications
   Counters - imaging
9. Number lines - number, estimation
4. What, as you see them, are the strengths and weaknesses of the numeracy project for the teacher?

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Spot isolation</td>
<td>Too much planning time</td>
</tr>
<tr>
<td>Some good inventive activities</td>
<td>Too many groups for sensible, reflective teaching</td>
</tr>
<tr>
<td>Updating what children of NZ need to survive maths</td>
<td>Not enough time put into professional reading</td>
</tr>
<tr>
<td>Developing my own strategies for mental comp</td>
<td>Planning - I am not going to spend ages planning a few minutes of activities</td>
</tr>
<tr>
<td>Adding to my knowledge base of games</td>
<td>Too big, too broad, too much</td>
</tr>
<tr>
<td>Understanding the development of knowledge and strategies in the chn and the path it takes</td>
<td>TIME</td>
</tr>
<tr>
<td>Teaching a range of strategies - not just one method of solving problems</td>
<td>Not enough time to read and understand all the books</td>
</tr>
<tr>
<td>Builds understanding of the formal algorithm</td>
<td>Takes a long time to plan</td>
</tr>
<tr>
<td>(I have learnt strategies too!!!!)</td>
<td>Games are not structured enough to justify a whole maths session for one group working independently</td>
</tr>
<tr>
<td>based on individualised instruction - reminder to teachers</td>
<td>Lots of reading</td>
</tr>
<tr>
<td>introduces a lot of teaching aids</td>
<td>Quite difficult in a short time frame but I am getting quicker</td>
</tr>
<tr>
<td>closely monitors individual progress</td>
<td>Getting to know the system</td>
</tr>
<tr>
<td>defined stages for each progression</td>
<td>Knowing extension material for top children</td>
</tr>
<tr>
<td>defined strategies for each level</td>
<td>Far too much time required to get through set up for the return in teaching time - the teaching points could be achieved with less effort</td>
</tr>
<tr>
<td>gives teachers more ideas to aid students</td>
<td>Facilitated in such a way that I was lost from the start. I feel this is the root of all difficulties</td>
</tr>
<tr>
<td>identifies student weaknesses and strengths that need to be developed clearly</td>
<td></td>
</tr>
<tr>
<td>opens ones mind to new strategies to teach</td>
<td></td>
</tr>
<tr>
<td>provides a range of strategies</td>
<td></td>
</tr>
<tr>
<td>allows for grouping more accurately</td>
<td></td>
</tr>
<tr>
<td>provides PD for getting around maths concepts and processes</td>
<td></td>
</tr>
</tbody>
</table>
What, as you see them, are the strengths and weaknesses of the numeracy project for the student?

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Hot Spot isolation</td>
<td>- Compartmental learning</td>
</tr>
<tr>
<td>- Enjoyment through hands on activities</td>
<td>- Too many groups - less teacher time</td>
</tr>
<tr>
<td>- Strategies for less able students - plugging the gaps</td>
<td>- Some don't need it</td>
</tr>
<tr>
<td>- Increases the fun aspect</td>
<td>- Cuts down the time spent on practise - applying the concepts taught</td>
</tr>
<tr>
<td>- Their needs are targeted</td>
<td>- Sometimes not enough time spent on one strategy to consolidate it - then get overloaded with strategies and get confused</td>
</tr>
<tr>
<td>- Learn more than one way to solve problems</td>
<td>- Perhaps putting too many kids into situations that require more control that they have - ie. Playing with materials</td>
</tr>
<tr>
<td>- Can solve a problem even if they cannot do an algorithm</td>
<td></td>
</tr>
</tbody>
</table>
What help, resources, etc. do you feel you/we need to develop the teaching of the Numeracy Project further?

- Some more PD now, so that it all seem like a foreign language (eg. In school - staff that are successfully teaching)
- Assessment/ testing time in year 8
- Need to take ownership as a school now - master this in our own way, based on our needs
- Getting the planning started
- Planning - getting the balance between maintenance, teaching (game - activity) practice , "wind down"
- I am just pottering along at the tail end - I'll get there
- I would like to have help planning THOROUGHLY my first units on +/- and x/div - once I get it. I am sure I will be okay to do the rest on my own
- While planning for particular groups I need to go through the booklet - Getting Started, etc. so I actually understand it and how it relates to all activities
- TIME for planning
- Ownership from the staff - making resources, sharing successful stuff - team planning sessions
- Time to organise equipment
- Time to talk to other teachers
- Time to read material
Appendix 6 – Coded Interview Transcript

Stuart Interview: 4 December 2003, 10.30am; School Library
Transcript Section: pp.6-7

Stuart Using the Slavonic abacus. It’s been amazingly successful for the less able children.

Julie Right.

Stuart Watching them grouping, watching them counting, watching the stages they go through as they separate the beads and then being able to put the stage they’ve gone through manually onto paper and show them what they’ve done – and then they pick it up really quickly. They all want to have a go. And sometimes they want to explore different methods of bead sorting, grouping, whatever.

Julie That’s great. Some people probably haven’t used that as much, so that’s really good.

Stuart That’s where the equipment is important, especially for the less able kids.

Julie Right, okay. Great. Looking at sort of the culture within the school. At this time last year with a few people the sort of collegiality and the syndicate planning were sort of a couple of things that were really important in terms of what helped them with regard to implementing numeracy. Has that sort of thing continued this year?

Stuart Pretty much. I think most of us, well in form one [year 7] will go to Dawn, form two [year 8] is probably going to May, and ah Eve, and the help is always there, they’re very willing and able, and the resources come straight through, so that’s not a problem.

Julie Right, okay. So you’ve found that you’ve been able to work with that help.

Stuart Yes.

Julie Good, wonderful, okay. And anything else that’s been helpful this year?

Stuart Anything different that’s happened?

Julie

Stuart Oh, being aware of the websites and what’s available from them. I suppose like most of us I need to spend a whole lot more time going through them, because there’s a wealth of activities and knowledge there.
Julie: Right, okay, great. And looking at your personal planning or any of your shared planning. Has the way you’ve done that planning changed at all?

Stuart: I’ve pretty much followed the Getting Started format. That’s worked pretty well for me, keeping track with them, and also limiting it to say two or three days at a time rather than the whole week. Because I can find that sometimes you can just breeze through some of them real quick, sometimes you really hit dead spots and it takes you quite a bit longer to get through.

Julie: So what you’re saying I guess is that you’re a bit more flexible in terms of listening to your kids and progressing them as you see you need to as opposed to thinking ‘that’s what I’m going to do this week’?

Stuart: Well you know what you want to do, but whether they’re able to do it is the thing.

Julie: Right, okay, that’s interesting. And looking at sort of professional development – what sort of aspects of the project, I guess focusing on this year a bit more, have been most helpful. I mean we’ve had a couple of workshops and then Nina came in and did a couple of week sessions and it hasn’t been so much as the initial year – but what sort of things helped out in the school, what sort of has been the most helpful for you?

Stuart: Probably watching Nina. Seeing clear work, seeing organisation, layout of materials, activity sheets, focused teaching – what I really want to get into personally next year is pretty much what Nina was doing with the big booklets.

Julie: Oh, the modelling books, yeah.

Stuart: For the children to continue to refer to at all.

Julie: Okay, that’s great. And at this time last year reading material was a real issue and perhaps you’ve already mentioned this early but, you know, that seemed to be bugging people down, there was just so much to take on – do you sort of still feel a bit like that at this point?

Stuart: Yes and no. But it’s not so much the ministry documents, it’s the booklets that came out – the supporting booklets, there’s so many of them.