Cross-grouping in mathematics

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Abstract

Improving mathematics teaching in primary schools is an ongoing research focus as achievement comparisons in international studies draws attention to shifting achievement levels and acknowledges that "improving educational outcomes is a vital economic necessity" (Wiliam, 2011, p. 26).'Cross-grouping' in primary school mathematics (whereby students are shifted across classes to provide ability grouping within a subject), has become a popular option in some New Zealand primary schools (Years 1-8) over the last few years. This is perhaps an unforeseen consequence of the Numeracy Professional Development Project (NDP) that was offered in more than 95% of New Zealand primary and intermediate schools between 2000 and 2009 (Holton, 2009).

My present study has critically examined teacher perception of how (and if) cross-grouping in mathematics impacts upon teacher practice. Research from international studies supports the viewpoint that when 'streaming' (in the New Zealand primary school setting, known as 'cross-grouping') is adopted, teacher expectations of students are impacted upon and overall student achievement is not improved (Boaler, Wiliam, & Brown, 2000; MacIntyre & Ireson, 2002; Slavin, 1995). At present, there is very little research based in New Zealand schools on cross-grouping. This research may have implications for teaching as inquiry which is considered to be a characteristic of "effective pedagogy (which) requires that teachers inquire into the impact of their teaching on their students" (Ministry of Education, 2007, p. 35). A 2011 report from the Educational Review Office (ERO) (Education Review Office, 2011) suggested that many schools and teachers were still working towards gaining a clear understanding of the intent of teaching as inquiry.

A qualitative approach applying an interpretivist paradigm underpinned this study, with a narrative inquiry process utilised which allowed the participants' viewpoints to be heard. Interviews were conducted with eight teachers working in cross-grouped mathematics classes with students aged between eight and thirteen. Findings from the study revealed that all the teachers were in favour of cross-grouping, despite some teachers having some minor reservations. Some of the perceived benefits of cross-grouping were: it was more effective in meeting the needs of students and teachers, it allowed schools to ensure mathematics was actually taught each day, and it permitted teachers to become more confident in teaching a particular level of mathematics. It was also found that cross-grouping was likely to contribute

to a more fixed notion of ability and was likely to have impacts upon teacher and student expectations.

In most of the schools, there was little critical analysis undertaken into the reasons for or the validity of cross-grouping which suggests that this would be a useful future focus for school leaders and teachers. Results of the study suggest that questioning some long-held established practices (which are not necessarily evidence based) could be a useful starting point in developing a teaching as inquiry focus within a school. It is expected that this research will reveal ideas regarding the effects of streaming students in mathematics in primary schools and the impacts on flexible and responsive teacher practice. These findings may lead to a larger research project which considers aspects such as student attitude and self-belief or a comparison study which considers developing communities of mathematical inquiry (Ministry of Education, 2012) within some classes.

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“I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.”

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Chapter 1: Introduction

Introduction

'Cross-grouping' (or ability grouping across classes) appears to have become increasingly utilised in primary school classrooms for teaching mathematics in New Zealand. In 2013, the Education Review office (ERO) released a report which looked at mathematics learning in Years 4 to 8 in New Zealand primary schools (Education Review Office, 2013). This report identified that accelerating the progress of priority learners was a challenge for most schools. "Most used ability groupings within or across classes or resourced teacher aides. Few had evidence that such programmes, initiatives and interventions, or additional staffing, such as teacher aides, actually accelerated the progress of their priority learners" (Education Review Office, 2013, p. 2). The issue of ability groups within or across classes and the positive or negative impacts that these types of groupings have on student achievement, self-efficacy, and teacher practice has been a controversial topic for many years e.g. (Boaler, 2000; Slavin, 1987, 1995). The on-going debate in regards to mathematics achievement and the connection with international rankings, such as that provided by the Programme for International Student Assessment (PISA) ensures that this is a topic that has high interest for teachers, schools, the community in general, and business and educational leaders.

Choice of topic

My own personal experience of mathematics teaching and learning began in primary schools in New Zealand in the 1960's where I remember many years of textbook-based mathematics. I personally enjoyed mathematics, particularly trying to solve problems and work out what the patterns were in strings of numbers or shapes. I remember a 'light bulb' moment in Form 1 when my teacher explained division by exploring how long division could be understood through developing an understanding of place value. During my secondary school years I had a range of extremely positive and negative experiences, which varied according to the teacher that was assigned to our class.

Over the last thirty years, I have worked as a primary school teacher, professional development provider and most recently, a pre-service lecturer. I became a lead teacher of mathematics when teaching in primary schools and was also employed for a year as a specialist intervention teacher of mathematics for low-achieving students aged 8 to 12.

In that time, I have seen substantial changes and variations in the ways in which mathematics has been taught. This has ranged from the whole class teacher 'talk and chalk' with two pages a day from one text book, little differentiation, limited student discussion, a focus on algorithms and rules and limited use of materials, to working with a number of groups selected according to their strategy stages with a greater focus on understanding concepts and explaining thinking. In recent years, I have increasingly seen the practice of grouping in strategy stages be extended to cross-grouping (what many of us know as 'streaming') across classes. Questioning this practice, perhaps because I had never worked in this way, I was interested to see how teachers perceived their actions and attitudes changed when working in this manner. I had also begun to question my own mathematical pedagogical practices as I have had a number of years' experience of using a similar grouping practice within my own classroom. This research led me to question my own pre-conceived beliefs and ideas about mathematics and learning; is cross-grouping across classes any different to staged grouping within a class?

There has been little research undertaken in New Zealand in this area but the research from overseas studies has essentially demonstrated that mathematics ability grouping does not result in desirable outcomes for most students (the current literature will be explored extensively in chapter two). However, in spite of the evidence against the educational benefits of ability grouping, many schools continue to work with streamed mathematics classes.

World-wide, classroom practices in mathematics (and other curriculum areas) are continually evolving and changing in response to research and government initiatives. One aspect that has perhaps remained constant is teacher nervousness and lack of confidence in teaching mathematics. This has become increasingly evident to me now that I work in the pre-service area of education. I see many of our prospective teachers enter their degree courses with considerable dread and a feeling of antipathy towards mathematics.

Background information to the research topic of ability grouping across classes

The impacts (both negative and positive) of ability grouping (or streaming) in schools have been widely debated for many years; these have been discussed in relation to the impact on student self-efficacy, achievement levels, teacher practice, lifelong attitudes towards mathematics, and other issues. When looking at achievement, Slavin (1990), in one of the

most comprehensive and well known reports on this topic, conducted a meta-analysis of streaming in secondary schools in the United States. Slavin (1990) reviewed research from twenty-nine reports; his meta-analysis looked at all subject areas and it was reported that there was a minimal overall impact on achievement (any gains in high tracks were cancelled out by the losses of lower tracks). In a slightly earlier report by Slavin (1987) it was reported that within-class grouping appeared to have a favourable impact on achievement levels. Lou, Abrami, Spence, Poulsen, Chambers and d'Apollonia, (1996) found in their meta-analysis of within class grouping that students who were taught in smaller groups were likely to benefit from this method of instruction. It has also been pointed out by Hattie (2012), in his work which refers to his meta-analysis of achievement effects in schools, that the quality of classroom instruction (irrespective of the grouping mechanism) is perceived to be the most influential factor when looking at 'what makes a difference'.

Mathematics appears to be the subject area in which grouping for ability most commonly occurs (Burris, Heubert, & Levin, 2006; Davies, Hallam, & Ireson, 2003; Forgasz, 2010) and there are a number of studies which show that most teachers of mathematics have a positive attitude toward ability grouping (Burris, Heubert, & Levin, 2006; Linchevski & Kutscher, 1998). This is perhaps because mathematics is perceived as being linear, or cumulative, making it difficult to work with groups of students with a wide range of knowledge and mathematical abilities (Linchevski & Kutscher, 1998).

For more than one hundred years there has been debate around ability grouping and streaming practices in many western countries. In Britain and the United States (whose practices are often followed by Australia and New Zealand) there have been times when the notions around social justice were influential in educational policy and there was support for an egalitarian position in schools. This political stance encouraged the adoption of mixed ability teaching as a means to improving equity and diminishing the impacts of factors such as socio-economic difference and gender (McSherry & Ollerton, 2002). This focus in the 1960's and 70's has changed quite substantially in the last few years, in response to a "less egalitarian philosophy, a greater emphasis on parental choice and an educational debate dominated by 'standards'" (McSherry & Ollerton, 2002, p. 2).

The focus on ability grouping has been particularly strong in Britain in the last few years with a government directive that "setting should be the norm in secondary schools" (Department for Education and Employment, 1997, p. 38 cited in Wiliam & Bartholomew, 2004, p. 281).

Increasingly, this approach to ability grouping in Britain is being used with between class grouping in primary schools now, as many believe that this will help improve scores on National Curriculum tests (Wiliam & Bartholomew, 2004). This notion has further been reinforced by another government report in Britain, The White Paper, *Excellence in Schools*, which suggested that "setting is worth considering in primary schools" (Hallam, 2012, p. 58). Hallam (2012) referred to data from the Millennium Cohort Study and noted that a larger proportion of British children were being placed in streamed classes at an increasingly younger age for numeracy and literacy.

In New Zealand there have been fewer government directives in regards to adopting ability grouping as a pedagogical practice which will purportedly lift achievement in schools. In 2009, the New Zealand government controversially introduced National Standards in literacy and mathematics (Ministry of Education, 2009) but refrained from introducing standardised testing or directing the ways in which schools should assess students. The latest initiatives in New Zealand mathematics education and professional development, over the last ten to fifteen years, have been linked to the Numeracy Development Project (NDP) which aimed to improve teacher content knowledge in relation to both strategy and knowledge (Holton, 2009). In the last two years, professional development in mathematics has focused on incorporating teacher understanding of the numeracy stages (as described in the NDP and the New Zealand curriculum) (Ministry of Education, 2007) and moving more towards utilising a mixed-ability, problem-solving approach to learning mathematics.

One aspect of the Numeracy Development Project which resulted in some rigid practices was the promotion of using Numeracy Project Assessment data (NumPA) to create groups based on the current strategy stage the students were at (Ministry of Education, 2004). This was considered by many to be a directive to create ability groups within a classroom. Many teachers were flexible with the assessment information and regrouped children regularly and in response to need, whilst also providing a variety of learning situations such as whole-class discussion and mixed ability groupings. However, in some schools this assessment has then been used to cross-group across classes (stream across a number of classes). My research will focus on teacher perception of the impacts that cross-grouping has on teacher practice when operating in a cross-grouped classroom for mathematics. The reasons for adopting cross-grouping are explored and my research has ascertained what impacts there are upon teacher practice as opposed to that undertaken in a mixed ability mathematics class. My participants

were questioned about their beliefs in regards to the impact that cross-grouping had on their ability to practice teaching as inquiry as suggested by the New Zealand curriculum (Ministry of Education, 2007).

Definitions

There are many terms which are used in regards to the topic of ability grouping and these differ according to the country and the period of time which is being referred to. In Great Britain, grouping by ability was a widely adopted practice through Victorian times until the beginning of the twentieth century, whereby children were grouped by **'standards'**. There was a wide range of age groups within any class and financial incentives were provided in order to ensure children passed various tests (McSherry & Ollerton, 2002). This often meant that teaching was directed towards 'passing the test' and getting as many children as possible through the '**standards'. 'Streaming'**, in which children were placed into ability groups (usually across classes), was then introduced in the United Kingdom after the 1931 Primary School Report (McSherry & Ollerton, 2002). By the 1950's '**streaming**' was widespread but from the 1960's on there was a greater focus on egalitarianism and '**mixed ability groups'** were widely encouraged. In the previous twenty years there has been a return to an emphasis on standards and most children in Britain are now placed in '**sets**'. By 2002, a large majority of British schools had changed to some form of ability grouping and 30% indicated that they taught their students in 'setted' groups, in an effort to implement the national Numeracy Strategy or to improve Standardised Assessment Tests (SAT) scores (standardised testing scores implemented in all British primary schools) (McSherry & Ollerton, 2002). SAT's are a measure of ability for many core subjects and are utilised when compiling league tables which compare school performance indicators. In Britain, '**setting'** frequently occurs even with very young children (from the age of five). In recent years there have been many critics of this practice and many researchers have discussed issues such as equity, impacts upon student self-efficacy, limited life and curriculum opportunities and restricted teaching practices e.g. (Askew, 2012; Boaler et al., 2000; Boaler, 2009; MacIntyre & Ireson, 2002; Marks, 2013).

In the United States, **'tracking'** and **'ability grouping'** are often seen as interchangeable terms; however, '**tracking**' provides broad divisions that separate all students into various pathways, such as academic, vocational or general programs and is more likely to occur in United States high schools (White, Gamoran, Smithson, & Porter, 1996). Students stay in

these groups for all of their classes and research largely supports the viewpoint that this does not assist achievement, student attitude or reduce inequality (Slavin, 1987). At other times, **'ability grouping'** has been used to describe the movement across or within classes for specific curriculum areas (usually for reading or mathematics). Hattie (2002) suggests that due to variants in practices and terminology in the United States, it is often difficult to ascertain the extent of **'tracking'** or **'ability grouping'** in schools and therefore Hattie (2002) uses the term **'tracking'** to cover a wide manner of ability grouping practices. Hattie (2002) also mentions the Joplin plan whereby students are grouped by achievement in specific curriculum areas across a number of age levels; this has been seen to have some positive aspects, particularly if students are monitored regularly and fluidity of placement is considered.

In New Zealand in the twentieth century a similar approach to that used in Great Britain was utilised to group students. During the 1960's, '**streaming**' was utilised in high schools and provided the options of academic, commercial or technical courses and was generally decided by intelligence tests or scholastic ability (Codd, Harker, & Nash, 1990). Since that time **'streaming'** has continued in some core subjects and is more likely to be found in secondary schools. In primary schools there was often little movement across classes and any grouping that occurred within classrooms was considered to be flexible. However, in mathematics after the introduction of the NDP from 2000, teachers were encouraged to group children within their classes, according to numeracy strategy stages, as defined in the Number Framework (Ministry of Education, 2004). In recent years, this suggestion has at times been interpreted as a recommendation to extend this idea further so that grouping (according to strategy stages) has been utilised *across* classes. This phenomenon has resulted in a term which appears to be unique to New Zealand, which is known as '**cross-grouping'**.

Aim of study

The aim of this study was to discover how teachers in primary schools perceive their practice to be impacted when they work in a cross-grouped situation for mathematics. Additionally, I wished to find out what teachers believed the advantages and disadvantages were for both teacher and students. The reasons for adopting cross-grouping were investigated. Teachers were asked to consider whether working in a cross-grouped class assisted or detracted from teaching as inquiry (Ministry of Education, 2007).

Research question and methodology

The initial research question was "What impact does cross-grouping in mathematics have on teacher practice?" A qualitative design was used to answer this and an interpretivist paradigm was applied (Punch, 2009). Interviews were used to investigate the beliefs of the teachers who took part in this research. A pragmatic approach was taken as I had identified some sub-questions that were worth investigating and had been identified from my own experience (Mutch, 2005). I had also seen that there was a need for New Zealand-based research to support and inform teaching practice in schools. Narrative inquiry was used to obtain the stories of my participants (Farquhar, 2010).

Overview of chapters

In chapter 2, I report on the existing literature on the topic. The literature on ability grouping practices and its impacts were grouped into what works to enhance mathematical achievement, grouping of students, some general considerations in regards to ability grouping, impacts upon teachers, impacts upon students, and teaching as inquiry. When looking at what works to support mathematical achievement a wide range of factors were considered including group composition and pedagogical practices which lead to enhanced achievement for all students. The grouping of students included looking at the potential benefits of small group work, particularly when co-operative learning attributes are incorporated. There is discussion which refers to the substantial research which has previously been published internationally in regards to ability grouping in mathematics and the potential issues are brought forward. Consideration was given to the actual meaning of achievement versus that of ability, recent work in regards to developing a fixed or growth mindset in learning (Dweck, 2006, 2012), the difficulties in assessment or moderation and questions in regards to gender. Following this, I have discussed possible impacts of these ideas on teacher practice and the potential impacts on student achievement.

Chapter 3 is the research approach chapter. In it, I have justified my choice of the interpretivist, qualitative approach which I used in this study. Reference was also made to the utilisation of narrative inquiry as a technique to explain the importance of allowing the participants' viewpoints to be considered. The use of a semi-structured interview process is explained in this chapter along with a description of the credibility and reliability factors which were central to the study. The data collection methods and data analysis procedures are described and ethics considerations were also included.

In chapter 4, I have presented the findings that resulted from my data collection. These findings presented several themes; the teachers' sense of responsibility, teachers expertise and confidence, planning considerations, a linear view of mathematics, the development of a fixed mindset, reporting and communication, and exploration of previous mixed ability experiences. Two additional aspects (which were not specifically connected to the research question) came out of the interviews and have briefly been reported on here; these are Modern Learning Environments (MLE's), and the use of digital technology.

Chapter 5 is a presentation of the discussion that arose from the findings, linked to existing literature. While all of the participants were in favour of cross-grouping in mathematics it became evident that most of the decisions within the schools had not been based on research. Some aspects that were identified as advantages by the participants can be seen to be useful considerations but cross-grouping did appear to contribute to more of a fixed mindset amongst teachers as to student ability levels.

In chapter 6, I conclude the study. Some of the implications for schools, teachers and students are discussed. I also discuss some of the limitations of my study, particularly in regards to the fact that there was no observation of actual teacher practice and student voice was not considered. In addition there was no use of quantitative data which may provide additional information in regards to the composition of the schools and the ability groups that were being taught. This information may have provided evidence when considering equity for all students. A number of suggestions are made for further research.

Chapter 2: Literature Review

Introduction

In this literature review I have considered New Zealand's achievement in mathematics (in comparison to other countries) and considered various aspects which contribute to effective mathematics practice in schools. I also looked at the potential issues that may arise as a result of the development of inflexible grouping structures (especially ability grouping across classes) in mathematics learning.

In Chapter 1, I briefly explored the historical background in regards to ability grouping across classes (in New Zealand and beyond). There is a considerable body of international research in this area, some of which refers specifically to mathematics. I have drawn on this international work to provide much of the recent material in this literature review, as there has been very little research in the New Zealand setting.

I have also considered the notion of teaching as inquiry in the New Zealand curriculum (Ministry of Education, 2007) and some of the recent literature in regards to the adoption of practices which foster an inquiry cycle for teaching practice. This cycle of learning has been utilised as part of the framework for the Best Evidence Synthesis (BES) exemplar (Ministry of Education, 2012) which provides guidance for schools and teachers when they are developing communities of mathematical inquiry. The practice of cross-grouping will then be examined within the intended practice of teaching as inquiry.

Mathematical achievement in New Zealand

The 1995 Trends in International Mathematics and Science Study (TIMSS) assessment revealed that New Zealand's mathematics achievement, on an international scale, was much lower than was desirable (Caygill, 2008). This insight led to a focus on providing better ways of teaching mathematics in primary schools in New Zealand. In 1999, after recommendations from the 1997 science and mathematics task force, a numeracy group explored international initiatives and used the "Count me in Too" (Mulligan, Bobis, & Francis, 1999) numeracy project, from New South Wales, as the basis for a pilot study in 80 New Zealand schools. This project was then adapted and introduced throughout the majority of New Zealand schools over the next decade and became known as the Numeracy Development Project (NDP). The key purpose was to improve student achievement through boosting teacher

content knowledge and confidence (Holton, 2009). Between 1999 and 2009, there were gains in student achievement (Young-Loveridge, 2009) with students consistently demonstrating improved progress on the Number Framework (Ministry of Education, 2012). When looking at an international measure, the TIMMS assessment from 1995 to 2007 showed a gain of 17 points on the average student score (Caygill, 2008). However, there was still a shortfall in reaching the expected levels described in the New Zealand curriculum (Ministry of Education, 2007), particularly at the upper levels of primary school (Young-Loveridge, 2009).

However, between 2007 and 2011, there was a slip backwards of 6 points on the TIMMS scale for Year 4 students (Caygill, 2013). The publication of these results provided considerable angst for New Zealand mathematics educators and much public debate was generated in the New Zealand media about mathematics teaching, with some calling for a 'back to basics' approach (Laxon, 2013). It was also concerning that there had been continued inequities in regards to achievement for Maori and worsening inequities for Pasifika students, according to 2009 National Education Monitoring Project (NEMP) data (Ministry of Education, 2012).

As a nation, according to the Programme for International Student Assessment (PISA), New Zealand was still well below the highest achieving countries such as China, Singapore, Korea and Hong Kong (OECD, 2014). Research had indicated that teachers in these high-achieving countries spend considerable time on ensuring connections are made between mathematical ideas (Askew, 2012; Stigler & Hiebert, 1997).This may suggest that teachers in New Zealand were, at times, still struggling to make the connections themselves and therefore had difficulty in assisting their students to make these connections. This possibly comes back to a lack of mathematical content knowledge which has continued to be a widely acknowledged issue for many teachers (Haylock, 2010; Siemon et al., 2011).

There are many other possible reasons for this discrepancy in regards to mathematical achievement in many Western societies and the high achievement which occurs frequently in many Asian countries. Various theories have been suggested including the influence of societal expectations and values, parental attitudes, and the benefits of rote learning, to mention just a few (Goyette & Xie, 1999). A great deal of emphasis is placed upon high achievement in Asian education which often leads to considerable pressure and there is significant involvement in after school tutoring programs for many primary school aged

children (Hsin & Xie, 2014). Even Asian pre-schools have a very competitive, academic, knowledge based focus (Li & Lappan, 2014). In many Asian cultures, education is more highly valued than it is in New Zealand by society and family; this is particularly true of mathematics (Li & Lappan, 2014).

It was suggested that the grouping structures that have been widely adopted in recent years in many New Zealand schools, were not having a positive effect on the mathematics achievement of the most needy students (Education Review Office, 2013), and a recent report, "Mathematics in Years 4 to 8: Developing a Responsive Curriculum" had identified that only 11% of the schools included in this report were highly effective in their curriculum review and design in mathematics (Education Review Office, 2013). It was recognised that accelerating the progress of priority learners was a challenge for most schools. "Most used ability groupings within or across classes or resourced teacher aides. Few had evidence that such programmes, initiatives and interventions, or additional staffing, such as teacher aides, actually accelerated the progress of their priority learners" (Education Review Office, 2013, p. 2).

Hunter (2010) looked at the widening gaps in achievement for Maori and Pasifika learners and considered the impacts of the organisational approach that was proposed in the initial Numeracy Development Project training. Hunter (2010) suggested that the traditional ability grouping process that was promoted in Numeracy Development Project professional development led to a distinct disadvantage for priority learners in New Zealand, particularly Pasifika and Maori students. Hunter's research (2010) looked at developing support for establishing communities of mathematical inquiry within classrooms based on mixed-ability groups and this was utilised as the basis for a Best Evidence synthesis update document (Ministry of Education, 2012).

The Education Review Office (2013) also recommended that the Ministry of Education support schools to access and use research findings such as that in the Best Evidence Synthesis (BES) publications. In 2013-14, ERO and the Ministry of Education specifically promoted the BES document (Ministry of Education, 2012) which introduces different teaching practices that have been shown to accelerate learners' progress in New Zealand schools (Education Review Office, 2013). The BES exemplar focussed on the way that the practice of developing communities of mathematical inquiry has helped to reduce bullying practices, which is another area of concern in New Zealand schools and has also been

highlighted as an issue in other countries by international research (Mullis, Martin, Kennedy & Foy, 2007).

Hattie (2002) argued that the evidence revealed that composition effects (such as streaming across classes or grouping by ability) have little effect on achievement; he contended that it is the nature of the teaching practice that is important. However, perhaps utilising streaming practices (across classrooms) for our mathematics learning has possibly resulted in practices which have discriminated against some learners and has not promoted equitable opportunities for all students. This may have been due to a range of factors, including the difficulties of knowing learners, inflexible timing of lessons and the lack of an integrated approach to learning. An international study by the Organisation for Economic Cooperation and Development (OECD) concluded that ability grouping across classes for students should be avoided until at least upper secondary school as it is not an equitable practice and does not improve achievement (OECD, 2012). There is also the issue of whether strict ability grouping encourages a fixed mindset or a growth mindset approach. Dweck (2006) considered that those learners who have a fixed mind-set, believe that the only progress they can make is due to their innate ability; and in opposition to this, the development of a growth mindset promotes the belief that everyone can achieve a goal and that it is the effort and perseverance that is vital. The limitations of a fixed mindset have vast implications for all our learners (and for teachers and parents) and this aspect has been considered later in this literature review.

What works in mathematics learning?

Common features of effective learning in mathematics

It is universally acknowledged that there are a number of common features that are likely to be seen in successful mathematics learning environments. Anthony and Walshaw (2009) summarise these points with reference to ten key components; "an ethic of care, arranging for learning, building on students' thinking, worthwhile mathematical tasks, making connections, assessment for learning, mathematical communication, mathematical language, tools and representations, and teacher knowledge" (p. 5).

All of these aspects contribute to the development of positive learning experiences that enhance achievement, enable thorough understanding of concepts and promote enjoyment and challenge, which is considered an essential aspect if we want students to pursue mathematics learning through to higher levels (Haylock, 2005). There are many researchers

who believe that an enriched, accelerated curriculum that provides interest and challenge (which is generally the norm for 'high achievers') is the best curriculum for all students (Bloom, Ham, Melton, & O'Brien, 2001; Burris, Heubert & Levin, 2006; Levin & Hopfenberg, 1991). Therefore, providing a 'remedial' programme for low streams will limit the opportunities for students to progress (Boaler, 2000, 2009). Boaler, Wiliam, and Brown (2000) found in their longitudinal study that too frequently less able students were exposed to "a continuous diet of low-level work that the students found too easy" (p. 637).

According to Reys et al., (2012) there are four main concepts to be considered when looking at what constitutes success in mathematics learning. They believe it is important to be familiar with the developmental stage of the learner, to clearly involve students, to transfer learning from the concrete to the abstract, and to use communication to boost understanding. While these main concepts may seem like rudimentary pedagogical practices, we could consider that when we look at our own previous mathematical learning experiences (and perhaps those we see in classrooms today) these four relatively simple notions have not always been acknowledged or adhered to.

What does effective numeracy teaching look like?

Askew, Brown, Rhodes, Wiliam, and Johnson (1997) were interested to find out exactly what the essential components of effective numeracy teaching were. They studied a number of primary schools in the United Kingdom which were already identified as being effective in that they were considered to be performing well on national numeracy assessment scales. For the purpose of the study sample it was also considered that these needed to be schools which performed well on the measure of 'value-added', which is an important aspect as it considers the progress made by students. This team looked at a range of school types, including small, large, urban, rural, state and private schools. Three types of mathematics teachers were identified; those that supported a discovery approach, those that utilised a transmission approach, and those that modelled a connectionist approach. The discovery notion was demonstrated by those teachers who believed they should expose students to activities in which the students would discover mathematical concepts. The transmission approach was more traditional and fostered more of a delivery mode of teaching. Lastly, there was the connectionist approach. In all of the schools that were studied, the most effective teachers were those that had a connectionist style which acknowledged two aspects; "making connections within mathematics … and making connections with children's methods -

valuing these and being interested in children's thinking but also sharing other methods" (Askew, 2012, p. 35).

According to Bobis, Mulligan and Lowrie (2013) effective teachers of mathematics also provided an environment which maximised students' learning opportunities, encouraged independence and promoted active engagement in mathematics activities that were valued. An understanding of a range of assessment processes and the application of these is also necessary and can benefit teachers in ensuring that the work that is planned for their students is relevant and worthy of focus. There is also the need for constant teacher self-assessment to enable teachers to conclude whether their practices have been successful (Jorgensen & Dole, 2011). In addition, it is important that effective mathematics teachers have a thorough comprehension of fundamental mathematical concepts (Haylock, 2005).

Grouping of students in mathematics

Grouping of students for general instruction occurs commonly in schools for various reasons. Usually, it is to cater for the situation that within any classroom or school there is a wide range of knowledge, skills, developmental stage and learning rate that the students bring to the classroom (Slavin, 1987). Theoretically, grouping on the basis of ability should allow for a reduction in the diversity that a teacher is faced with in any classroom (Wilkinson & Fung, 2002). However, this ability grouping does not allow for teachers to capitalise on the diversity within a classroom by using the students as a resource to support learning and there may also be other potential disadvantages.

Working in small groups is universally seen as being beneficial for learning e.g. (Anthony & Walshaw, 2007; Jorgensen & Dole, 2011; Slavin, 1995; Van de Walle & Lovin, 2006). The meta-analyses by Slavin (1987) and Kulik and Kulik (1982) showed that students who were grouped for instruction performed better than students who were taught in totally ungrouped classes where the primary mode of teaching was whole-class instruction (Wilkinson & Fung, 2002).

Doyle, (1988) provided a theoretical grounding for the ways in which effective groups operate; these ways placed great emphasis on how participant roles (such as listening, writing, contributing and questioning) were understood and implemented. Cobb, Wood, Yackel and McNeal (1992) delivered examples of how students were able to extend their own framework for thinking through working with others. With a focus on small group discussion

followed by whole-class dialogue, importance was placed upon the central idea of mathematical learning being a social experience. Encouraging the use of scaffolded group discourse with established norms benefited all learners within a group (Gregory & Chapman, 2013). White (2003) found that students with limited English language proficiency, who were placed in English medium classrooms, were more inclined to share their thinking with a friend rather than with the whole class; these findings seem to have considerable implications for New Zealand with its growing multi-cultural population.

Bobis, Mulligan and Lowrie (2013), looking at the Australian experience, have referred to whole-class instruction as being the most familiar instructional mode in mathematics classes. Group instruction is then used when teachers wish to focus on a small group of children with similar needs. They believe that "it is through the use of small groups of children working collaboratively that desirable outcomes…in accord with current curriculum documents may be achieved both academically and attitudinally" (p. 317). (Gregory & Chapman, 2013) proposed that homogenous small group arrangements can be useful when focussing on targeted skill development.

Mathematics has often been the subject area in which grouping for ability most commonly occurred and was most often supported by teachers (Jorgensen, Dole & Wright, 2004). There are many studies which have shown that most teachers of mathematics have a positive attitude toward ability grouping (Linchevski & Kutscher, 1998; Oakes, 1990; Zevenbergen, 2005). This was perhaps because mathematics was perceived as being linear, or cumulative, making it difficult to work with groups of students with a wide range of knowledge and mathematical abilities (Linchevski & Kutscher, 1998; Ruthven, 1987). Frequently, mathematics was seen merely as a learned set of skills in which it was impossible to progress unless all the skills were acquired and retained. There was a great reliance on memorising large amounts of procedural information and on the acquisition of routine knowledge and these were seen as essential pre-requisites before students could progress to anything more challenging. This perspective has provided a very narrow view of what mathematics actually is.

In New Zealand, classroom grouping was described as a key pedagogical strategy in the Numeracy Development Project whereby teachers were specifically requested to "either cross-group ….between classes or compromise by putting together students from close strategy stages to reduce the number of teaching groups" (Ministry of Education, 2005, p. 3).

More recently, this was revised to suggest "a balanced numeracy programme…should involve the use of a variety of grouping situations" (Ministry of Education, 2008b, p. 12). This advice from 2008 provided a more flexible approach, with suggested structures including whole-class instruction, ability groups, mixed-ability groups, and individual work (Ministry of Education, 2008b).

Between 2000 and 2009, with Numeracy Development Project professional development offered to virtually all primary and intermediate schools in New Zealand (Young-Loveridge, 2009), most schools elected to follow the early guidelines which suggested that teachers group their children according to strategy stage (in effect, to ability-group children within one class). In some cases, this became a fluid grouping with teachers noticing, responding and changing group composition according to student need. However, in many cases, the assumption was made that the optimum approach was to abide by strict ability grouping which, in some schools, developed further into cross-grouping (streaming across classes). Cross-grouping (as defined in Chapter 1) is considered to be the practice of grouping only for a specific subject area (Education Review Office, 2013). At times, this grouping became a very fluid practice, with children reassessed regularly and moved according to their changing needs. In other situations, students remained in a certain group most of the year, supporting the evidence provided by Boaler (2000) that such a system places limits on what students are taught or 'allowed' to learn. Boaler's (2000) research supported the view that by placement of students into streamed classroom groups, teachers were more likely to act upon their preconceived expectations, rather than take note of individual differences or capabilities.

Linchevski and Kutscher (1998) reported that "the placement of students in ability groups, in and of itself increases the gap beyond what would be expected on the basis of initial differences between them" (p. 534). Van de Walle and Lovin (2006) believed that all ability grouping (even within a class) is pointless and stated "Avoid ability grouping! Trying to split a class into ability groups is futile" (p. 30). Linchevski and Kutscher (1998) referred to the findings of researchers who supported the potential of cooperative learning, encouraging the development of looking at ways to cope with the diversity within a classroom rather than encouraging movement across classes. Slavin, Lake and Groff (2009) summarised a large number of reports and also concluded that co-operative learning has an extremely powerful effect on achievement.

Some countries (such as France and Germany) have made use of grade retention in an effort to reduce the diversity within any one class level. Beaton, Martin, Mullis, Gonzalez, Smith and Kelly (1998) referred to data from the Third International Science Study (TIMSS) which suggested that less than 1% of students in the United Kingdom were taught outside their age group, whereas in France and Germany approximately 25% of students had to repeat at least one year before they turned 14. In New Zealand, it has been perceived that it is important that students are placed with their own age group and therefore, very few children are 'held back' or 'accelerated' (McAlpine & Moltzen, 2004). However, perhaps our recent streaming practices have resulted in the same sort of issues that the standards system promoted in Victorian England (McSherry & Ollerton, 2002); in that situation, equity of opportunity was impacted (particularly in regards to social class) and teaching became very narrow and directed towards assessment.

In the Third International Mathematics and Science Study (TIMSS), the country with the highest achievement level was Korea, which was also the country that utilised ability grouping the least (Boaler, 2009). In Japan, another country which had high mathematical achievement, there has been an expectation by educationalists that all children will grapple with challenging problems (Boaler, 2009). In Japan, it has been accepted that struggle in mathematics work is a positive aspect which will build resilience and confidence. In response to this philosophy, it has been recognised that being 'good' at mathematics does not necessarily mean knowing the answer instantly to items of knowledge. Instead, there has been an acknowledgement that being able to develop lines of reasoning and showing an ability to use the knowledge which has been gained in a problem-solving situation, is a more highly-valued skill (Boaler, 2009). Haylock (2005) discussed the fact that in contrast, in many Western societies, mathematics has habitually been seen as an area that demands rote learning, rather than existing as a subject which can be expected to make sense.

There is a substantial body of research over many years which has looked at the positives and negatives of streaming (Boaler, Wiliam, & Brown, 2000 ; Kulik & Kulik, 1982; Slavin, 1987, 1995). Most of these studies revealed that in regards to achievement, the net effects, when considering all learners, are seen to be negligible. Slavin (1990) points out that, ironically, the arguments for and against streaming have essentially been the same for 70 years. Turney (1931, cited in Slavin, 1990, p. 473), when summarising results from the 1920's, listed the advantages and disadvantages of ability grouping.

The advantages were as follows:

- It permits pupils to make progress commensurate with their abilities.
- It makes possible an adaption of the technique of instruction to the needs of the group.
- It reduces failure.
- It helps to maintain interest and incentive, because bright students are not bored by the anticipation of the dull.
- Slower pupils participate more when not eclipsed by those much brighter.
- It makes teaching easier.
- It makes possible individual instruction to small slow groups.

The following were the disadvantages:

- Slow pupils need the presence of the able students to stimulate them and encourage them.
- A stigma is attached to low sections, operating to discourage the pupils in these sections.
- Teachers are unable, or do not have the time, to differentiate the work for different levels of ability.
- Teachers object to the slower groups.

Slavin (1990) noted that two additional important points that had arisen were that ability grouping also discriminated against students from minority and lower socio-economic groups and that the students in low streams were likely to receive instruction of a reduced quality. In addition, (Boaler, 1997a) found that "social class had influenced setting decisions, resulting in disproportionate numbers of working-class students being allocated to low sets" (p. 592). Hallam (2012) referred to data from the Organisation for Economic Co-operation and Development (OECD) which indicated that in countries where early educational selective practices operated (such as ability grouping) there was likely to be higher rates of social segregation.

Boaler & Wiliam (2001) consider that "we don't have evidence that ability grouping works but we have a lot of evidence that it lowers achievement" (p. 79).According to Boaler

(1997a) the market mechanisms currently existing in education in many countries such as the United Kingdom, USA, New Zealand, Australia, parts of France, Germany, and Sweden have resulted in policies which encourage the selection of students as either high or low achievers, often very early in their schooling. Boaler, (1997a) wrote that this "will almost certainly dictate the opportunities they receive for the rest of their lives" (p. 594).

Boaler, Wiliam and Brown (2000) found that students in all sets (high, medium and low) can be disadvantaged by ability grouping, for a range of reasons. Ability grouping was associated with curriculum polarisation, with students at all ranges of the spectrum finding their opportunities to learn limited. Ireson, Hallam and Plewis (2001) suggested that those in the highest attaining groups gained somewhat in achievement measures whereas those in lower sets generally did less well. .

However, some researchers such as Boaler (1997b) have voiced concerns in regards to evidence that the majority of top-set students were not enjoying their mathematics lessons; "Sets 1 and 2 between them contributed over two-thirds of the 'never' (enjoying mathematics lessons), from sets 1 to 8" (Boaler, 1997b, p. 173).When asked about their favourite mathematics lessons ever, a majority of students chose coursework lessons, when they were able to work at their own pace and discover things for themselves, with a less hectic style of teaching (Boaler, 1997b). Boaler (2009) referred to a longitudinal research project whereby she observed practice over three years. One school promoted traditional teaching practices (the teacher teaching from the front with a large number of exercises completed) in ability grouped classes. In this school, most of the students disliked mathematics and the approach fostered a passive approach to learning. Haylock (2010) suggested that it is important for children to enjoy learning mathematics and believes that for this to happen, children need to understand mathematics.

Hattie (2002) looked at the outcomes of streaming in regards to two areas; achievement effects and equity effects. In regards to achievement, he concurred with earlier research that there was virtually no impact on overall gains. As noted by Slavin (1990) "study after study, including randomised experiments of a quality rarely seen in educational research, (demonstrated) no positive effect of ability grouping in any subject or in any grade level, even for the high achievers most widely assumed to benefit from grouping" (p. 491). Reference was also made to the Joplin plan, (which was utilised in the United States) in which streaming was applied with successful outcomes (Hattie, 2002). This appeared to be

largely due to the fact that within this system, students were closely monitored and assessed with very regular adjustments made and varying materials were utilised, regardless of the year level of the students.

The second point referred to by Hattie (2002) was equity and reference is made to "the damning effects related to equity that too often seem to accompany between-class grouping" (p. 474). This is largely seen as a consequence of inconsistent teacher and student expectations that have been seen to vary when classes are grouped homogeneously. Hattie (2002) considered the opinions of many who believed that "tracking can often… lead to minority and lower-class students being more likely relegated to lower-ability tracks" (p. 451).This viewpoint was supported by researchers such as Oakes, Hunter Quartz, Gong, Guiton, and Lipton (1993) who reported that decisions to utilise tracking in United States schools frequently provide disadvantages for poor and minority students with differences in classroom practices and expectations. Hattie (2002) preferred to see greater focus placed upon ensuring that classroom practices were enhanced with "more careful curriculum specification, higher quality teaching, and higher expectations that students can meet appropriate challenges" (p. 473). Hattie (2002) considered that the debates and concern placed upon compositional effects neglected the aspects that should have much greater focus, (such as teaching and learning) and greater attention should be placed upon how best to improve those vital concerns within any classroom.

General considerations

The meaning of 'ability' and developing a "growth" rather than a "fixed" mindset

The discussion which has surrounded student ability has brought many issues of its own. It has been problematic when deciding how students are to be grouped, as it has often not been clear what is meant by 'ability'. In many cases the terms ability and achievement have been used interchangeably when what is actually being referred to is some fixed measure of achievement. Achievement can be seen as occurring at a fixed point at any one time (Wiliam, 2011). Schools seem to have differed widely in the decisions made in regards to whether there is a fixed view of ability or whether this is what a student is able to do at a particular time or on a particular test (Wiliam & Bartholomew, 2004). This lack of consistency has been a concern for a number of researchers and means that often decisions within schools are based on differing premises (Wiliam & Bartholomew, 2004). The notion of fixed ability has

been seen to jeopardise the education of many when these conclusions were made very early in a child's educational life. Boaler (1997b) believes that many schools have accepted that streaming is a necessity of schooling and they have also accepted that the manner of selection has been a reasonable process, without questioning its role.

It has been seen that the ambiguity of ability placement is evident in the following excerpt:

> Although ability is supposedly the major criterion for placement in subject and examination levels, ability is an ambiguous concept and school conceptions of ability can be affected by perceptions that pupils are members of particular social or ethnic groups and by the behaviour of individual pupils. Factors related to class, gender, ethnicity and behaviour can be shown to affect the placement of pupils at option time, even those of similar ability. (Tomlinson, 1987, p. 106)

White, Gamoran, Smithson, and Porter (1996) investigated the decisions made in regards to placement and found that there was a high degree of misplacement of students in streams which at times resulted in some 'low-track' students being placed in 'high-track' classes. They reported that if they were misplaced into the highest groups, there was an incredible 91% completion rate for their pre-college course whereas if they were in the 'low-track' class their chance of completing the course was 2%.

Mathematics has commonly been seen as a difficult subject and therefore there has frequently been a belief that only "clever people" (Haylock, 2010, p. 5) would be able to achieve well in this area. In many Western societies, there does not appear to have been a widely held viewpoint that everyone has the potential to achieve well in mathematics whereas countries which have performed well in international mathematics assessments have had a philosophy that all students can prosper in mathematics (Boaler, 2009).

Devlin (1998) has noted that being good at mathematics is part of being human and points out that the gene for mathematics and language development is the same. However, this runs contrary to what has been seen in common practice in many Western societies with the common acceptance that everyone will be able to speak but they will not necessarily be able to achieve in mathematics. Dehaene (2011) has considered that there is substantial proof that we can all learn mathematics and that "very little evidence exists that great mathematicians and calculating prodigies have been endowed with an exceptional neurobiological structure" (p. xxi). Clearly however, some learners do gain mathematical skills and concepts more easily than others but this is now being attributed more to factors such as self-belief, teacher

belief, socio-economic status, types of mathematics activities utilised and school structures (such as streaming) (Siemon et al., 2011). In other words, 'ability' as an absolute quality is not the deciding factor as to whether people can succeed in mathematics (Boylan & Povey, 2014).

The existence of 'ability' in mathematics has been brought into question by Marks (2013) who has looked at the persistence of fixed ability thinking in Year 4 mathematics classes. The aim of the study conducted by Marks (2013) was to examine how ability was conceived and the effect that this had on teaching and learning. The comments collected from students were revealing about how they interpreted fixed ability practices. Marks (2013) quoted students who stated very clearly how they viewed the way they had been grouped: "Mrs Ellery puts us into different groups like maths groups, and she moved me from here to here. This means that you're good at maths, this means that you are half at maths, the blue table means that you don't have a clue" (Marks, 2013, p. 35). Additionally, the teacher expectations were seen to be very different for the various 'ability' groups and at times it was seen that children who exhibited exactly the same type of responses were treated differently, depending to which group they were in. Both teachers and pupils behaved as if all individuals arrived with a fixed ability; and expectations and experiences were constrained according to these preconceived ideas. The pupils in this study were able to define ability and identify their own position within the class. Children saw that these abilities were not only inborn but there was no way in which they could do anything to change the position that they were in (Marks, 2013); and this reflected earlier findings by McSherry and Ollerton (2002). If this is the case within a classroom it suggests that this would be even more of an issue when students are moved across classrooms, yet moving across classrooms has been more likely to happen in mathematics than any other curriculum area; which implies that mathematics must be a subject different to anything else that we learn about. Marks (2012, 2013) found that to move away from restrictive, fixed ability practices was very difficult and change did not occur easily (for either students or teachers).

Dweck (2006, 2012) looked at the importance of being aware of the idea of learning being linked to a 'fixed mindset' as opposed to a 'growth mindset'. Children (and adults) who have a fixed mindset are convinced that their achievement is linked to a fixed notion of ability. In Dweck's research (2006), when students with a fixed mindset came across challenges as they entered junior secondary classes, they explained their poor achievement by comments such as

" "I am the stupidest" or "I suck in math" (p. 57) … or they "covered their feelings by blaming someone else" (p. 57). At the same time, students with a growth mindset were seen to be more likely to take charge of their own learning and were motivated to put in a great deal of effort to overcome any challenges they encountered. Dweck (2006) referred to one study where all the students were taught about famous mathematicians; half of the students were given the message that these were geniuses who easily came up with their discoveries. "It sent the message: *There are some people born smart in math and everything is easy for them. Then there are the rest of you*" (Dweck, 2006, p. 173). For the other half of the students the discussion focused around the mathematicians being passionate about maths and making discoveries. The message these students took away was "*Skills and achievement come through commitment and effort*" (p. 173).

Vollmeyer and Rheinberg (2006) studied teachers with very different mindsets. They found that teachers with fixed mindsets believed that the students entering their classrooms came in with very different but fixed abilities and that they (as the teacher) could have very little impact upon this. This 'fixed-ability' mindset was seen to be likely to lead to low expectations (Vollmeyer & Rheinberg, 2006). This factor has also been referred to in the Ministry of Education, (2012) BES exemplar when one of the focus teachers explained "I thought I had high expectations … I have realised I (had) low expectations" (p. 3).

When considering fixed abilities, Hunter and Anthony (2011) referred to the practice of redefining competency. The connection was made that when a community of mathematical learners was established (with teachers and students both being active players in constructing competence) there was an obligation for all learners to be part of the combined mathematical classroom interactions. This shifted the onus from competence being a fixed attribute that individuals either have (or don't have) to being one that is developed. This links directly with the research regarding developing a growth mindset (Dweck, 2006). According to Hunter and Anthony (2011) such practices develop "general obligations that concern the distribution of authority and the ways that students are able to exercise agency" (p. 101). Gresalfi, Martin, Hand and Greeno (2009) referred to the "opportunities for students to be understood as being competent depend on the task that they are assigned to work on, and on the agency and accountability with which they are positioned to do that work" (p. 67).

Testing and moderation

Testing has always been a feature of a schooling system which provides education for all (Weeden, 2002). In recent years, there has been a huge shift in the potential to utilise data and test results to improve student learning and refine teacher practice (Weeden, 2002; Wiliam, 2010). A number of western societies (such as the UK, USA, New Zealand, Australia, parts of France, Germany, and Sweden) have recently promoted a standards- based philosophy of education (Wiliam, 2010). The consequent swing in focus has had wide-ranging implications for schools today (Robinson, 2001). It has been acknowledged that the potential of individualising student experience based on need and supported by achievement data is vast, yet this is an area that has remained underutilised in many cases (Wiliam, 2011). The difficulty in collecting and making sense of all the data available has been a major challenge for school leaders (Earl & Fullan, 2003). Further to this, with a number of countries showing a return to a standardised assessment model (Marzano & Kendall, 1996) there has, at times, been a link made to performance pay for teachers (Holt, 2001). The standardised assessment ideology has brought many issues with it; critics of this system have referred to the fact that if there is sufficient pressure to perform, or achieve highly on a test, there will be issues such as teaching to the test, and dishonesty may be fostered (Sleeter, 2005). Boylan and Povey (2014) discussed the host of issues that may impact on test scores and considered that what can be achieved in everyday life can be very different to that represented in a test situation. There has also been critique that a standards- based approach to education will develop a narrowed focus on literacy and numeracy which does not then accept that other aspects of the curriculum have a vital role to play in the development of a child (Diamond, 2010) . Another feature that has constantly confronted educators in schools is whether there should be a greater focus on achievement or progress. Common sense would probably suggest that the progress made in the learning is a more reliable measure of successful teaching practice than achievement scores.

Many schools appear to have accepted that students must be labelled as low attainers, which has implied that their future has been pre-ordained (Boaler, 1997b). These decisions seem to have been made as much by class, race and gender as by achievement levels (Boaler, 1997a). Boaler (2009) also considered the evidence provided by human development theorists that children develop at different rates and stages and to label them as low achieving in the early years of primary school can be extremely damaging. Consequently, as long as standardised

student achievement (according to the 'date of manufacture' ideology) remains firmly rooted, change will often be resisted in spite of its rationality (Robinson, 2001).

With the considerable increase in assessment that has been seen in schools (Broadfoot, 2012), moderation has increasingly become an issue when deciding which ability group a child should be placed into for specific curriculum areas. Unless there have been robust procedures in place it has been possible that differing opinions have been brought to bear upon a student's work, resulting in different conclusions (Hipkins & Robertson, 2011). Sadler (1998) has referred to three points where there are opportunities for different decision-making by teachers. Firstly, there has been the teacher taking note of the student's work. Secondly, an assessment has been made against a standard, and finally there has been the point where the teacher has made a response; for example, assigning a grade or deciding on a grouping decision. At all of these points, there has been the possibility of a difference in teacher opinion and hence a difference in the grade assigned (Sadler, 1998). Unless robust moderation strategies are embedded in any school groupings there is a substantial likelihood of inaccurate decision-making. It has been acknowledged that considerable professional development is required to assist schools to develop moderation practices, and it takes several years of assessment practices to develop consistency of practice (Hipkins & Robertson, 2011). Wyatt-Smith, Klenowski, and Gunn (2010) reflected on the viewpoint that there are many complex factors which add to the differing opinions which teachers may bring to any occasion when they are making a judgement in relation to student achievement.

Moderation practices have had a particular impact on the students who are "judged to be on either side of a borderline for group placement" (Boaler & Wiliam, 2001, p. 77). The decisions that are made to move students up or down can have far-reaching implications. Depending on the ability group in which they find themselves, students can then be prepared for totally different assessments, with the students who are prepared for a higher level of assessment being given greater opportunities to learn at an advanced level. Expectations have also been seen to be quite different. This has exposed the potential inequities and random nature of ability grouping (Boaler & Wiliam, 2001).

When mathematics ability- grouping decisions are made, judgements have often been based upon limited assessment data and can reflect language issues (Zevenbergen, 2001). This provides numerous difficulties. A focus on limited assessment tools can provide insufficient evidence and has not considered the other impacts that may affect a student on any particular

occasion (Marsh, 2008; Zevenbergen, 2001). In addition, Connolly, Klenowski and Wyatt-Smith (2012) report that there has also been the issue that teachers are going to draw upon their unspoken knowledge for judgement purposes. This has meant that at times, other aspects (such as personal knowledge of students or prior evaluative experiences) have resulted in teachers possibly discounting evidence from assessment and disregarding the validity of the moderation process (Connolly et al., 2012). As a result, some students have been placed into specific groups which have limited the ability to progress. The expectations of such 'lower' groups have impacted negatively upon the learning opportunities available to the students (Linchevski & Kutscher, 1998). Zevenbergen (2001) considers that social, cultural and geographical disadvantages provide added complex considerations that can impact upon students' ability group placement, and if this occurs early in a schooling experience, there is little prospect of providing equity of opportunity.

Gender

There has often been a gender bias which has resulted in different beliefs about 'ability' in relation to females and mathematics (Hersh, 2011). Bartholomew (2000) reported that girls, who were performing as well as boys, actually believed that they were in fact struggling with the work. This resulted in their class members also coming to believe that the girls were less capable. Girls have been more likely to see that their success in mathematics is due to innate ability and less convinced of the need to pursue mathematics learning (Booker, Bond, Sparrow, & Swan, 2010). Ireson, Hallam, and Plewis (2001) conducted research which found that boys often had a much higher self-concept than girls even when they were achieving in an equivalent manner in academic terms. Sam and Ernest (2000) report on their work in which they conducted a general survey of 500 adults and this revealed that mathematics was believed by many to be a male domain.

Beilock, Gunderson, Ramirez and Levine (2010) discussed the impact that mathematics anxiety had on mathematics achievement. At the beginning of a year, they found that there was no relation between the mathematics anxieties of teachers and the achievement levels of their students. However, it was found that female teachers with high mathematics anxiety seemed to be specifically affecting girls' mathematics achievement. This, in turn, then influenced girls' gender-related beliefs about mathematics.

Marks (2012) noted that girls were particularly inclined to value understanding over speed and had difficulty feeling confident in the type of culture that has often been fostered in top-

stream classes. Boaler (1997b) reported that high-achieving girls were particularly affected adversely by streaming practices; they disliked the pressure of being in a 'top' set, and were keen to explore the understanding of a concept rather than focusing solely on correct answers. The issue of the potential impact upon girls can be seen to have far-reaching consequences. There are fewer girls than boys gaining General Certificate of Secondary Education (GCSE) A grades in mathematics in the United Kingdom, despite the fact that this trend has been reversed in other subject areas (Boaler, 2009). This is seen as one possible reason that females are less inclined to pursue mathematics to a university level, which has huge implications for the life opportunities available to them (Boaler, 2009). Boaler (1997b) believed that "High pressure, anxiety and speed all militate against understanding and it seems that bright girls find it very difficult to persevere with a subject which they do not fully understand" (p. 180). Boaler, Wiliam and Brown (2000) noted that although boys were often unhappy with the pressure exerted upon them, they did not want to move from the top set, apparently because they were more confident than the girls and enjoyed the prestige of being in that position. Dweck (2006) also referred to the negative stereotyping issues faced by girls in mathematics classes; "In a math class, (female) students were told they were wrong when they were not (they were in fact doing things in novel ways) … we were able to give and receive support amongst us students" (p. 77). This was seen to have even greater implications for learners with fixed mindset beliefs, as they struggled with the typecasting behaviours they were subjected to and, as Dweck (2006) puts it, they "felt a shrinking sense of belonging" (p. 77).

Paecher (2001) has considered that there are concerning implications of girls not pursuing mathematics to higher levels. Firstly, it has an impact upon females as individuals as they are not able to access higher status and more highly-paid careers such as those available through science and engineering. Secondly, there are wider economic implications for any country in that immediately there will be fewer students who potentially may go on to study in wealth-producing fields.

Impacts upon teachers

Teacher practice, expertise and beliefs

Despite regular efforts to reform education, many politicians have found that the administrative practices that are introduced have not resulted in the desired changes. In fact, an area that has perhaps been more necessary for ensuring on-going improvement is adapting

teacher practice but this has been seen as undeniably difficult to change (Wiliam & Bartholomew, 2004). Teacher practice is also linked with personality and pre-conceived ideas about what students 'need' can be difficult to change.

As observed earlier, Hattie (2002) contended that it was the nature of what actually happened in the classroom which had a much greater impact than the classroom composition. However, Oakes (1990) noted that streaming practices do impact upon the student experience as when teachers worked in tracked or streamed classes, a more restricted range of teaching strategies was employed, with different pedagogical approaches being adopted, according to the way that teachers viewed these learners. The pre-conceptions held by teachers had a major impact upon the learning opportunities that students experienced.

Concurring with this, Wiliam and Bartholomew (2004) found that teachers utilised different styles of teaching depending on the group that they were working with - teachers frequently over-estimated the capability of students in the top set, provided difficult work and demanded quick responses, whereas students in the lower sets were given repetitive, boring work. There was also a tendency to treat the class as a cohesive whole, thinking of all the students as having an indistinguishable capability with little provision for any differentiation (Wiliam & Bartholomew, 2004). Boaler, Wiliam and Brown (2000) stated that "setted lessons are often conducted as though students are not only similar, but *identical* - in terms of ability, preferred learning style and pace of working" (p. 640). As a contrast to this, it was seen that mixed-ability classes experienced a wider range of approaches and a greater allowance of individual difference (Wiliam & Bartholomew, 2004). Boaler et al. (2000) found that teachers used a much more restricted assortment of practices when working with supposedly homogenous groups. Boaler and Wiliam (2011) and Ireson, Hallam and Plewis (2001) reported that pedagogical practices were more limited when teachers taught ability- grouped classes, with high set classes experiencing high expectations and low set classes consistently experiencing low expectations. In lower streams there were limits on collaborative group tasks, which have been acknowledged by many as the type of task which actually lifts achievement for all students (Boaler, 2009).

Within-class grouping was also looked at (with students working on different materials and at different speeds) and, as a contrast to setting or across class ability grouping; evidence was provided that this flexibility "allows teachers to ensure that students are given appropriate work, and, more importantly, that the level of assigned work is altered if and when this

becomes appropriate" (Boaler, Wiliam & Brown, 2000, p. 645). Further to this, teachers who used within-class grouping were more inclined to use open tasks which could be tackled at a variety of levels; these tasks were regarded extremely favourably by students (Boaler et al., 2000).

Another factor considered by many researchers (Boaler, 1997a; Hoffer, 1992; Oakes, 1990) was that teachers with the least knowledge and confidence in teaching mathematics have often been the teachers who have worked with the 'low' streams. Clarke and Clarke (2008) reported that there is a difficulty in finding teachers with sufficient mathematical content knowledge and this has contributed to the problem of the least capable mathematics teachers teaching the lowest streams. In addition, a New Zealand report (Education Review Office, 2013) identified that our neediest students were frequently working with teacher aides (who are not qualified teachers although they may have other qualifications). Zevenbergen (2003) considered student opinion and found that students believed that their teachers were very different in quality and said that "the higher group students said that they felt they had the best teachers in the school…In contrast, there was a strong sense among the lower group students that they were not given the best teachers" (p. 7). However, there were some schools in which lower group students believed they had been given the best teachers and the students were appreciative of this (Zevenbergen, 2003).

Teacher beliefs about learning and learners have a strong impact on learning outcomes. Rosenthal and Jacobson (1968) conducted a well-known study titled *Pygmalion in the Classroom* whereby students were randomly assigned academic rankings at the beginning of a year which, by the end of the year, were the actual rankings. It was seen that the students had responded and met the teacher expectations. In more recent times, a large-scale study from Askew (2012) revealed that the most effective numeracy teachers were those that believed that all students could learn mathematics. The implicit beliefs and opinions that teachers hold have a major role to play in influencing how mathematics is actually taught (Askew et al., 1997). Gamoran (1992) found that teachers of low-track classes largely believed that teaching academic material was not important and there was a greater focus on the goal of keeping students well-behaved, interested and maintaining achievement at a C-Level.

Teacher perception also had an impact in that there has been a positive view of high-track students with a corresponding negative view of low-track students (Boaler, Wiliam & Brown,

2000; Gamoran & Berends, 1987). Teacher expectations are important and Hallam (2012) reported that teachers of high-ability groups were likely to expect a great deal from their pupils. Ireson et al. (2001) identified that when entire classes were ability grouped in mathematics there was frequently a different curriculum offered and more whole class teaching was evident when teachers saw the group as having the same needs.

When considering teaching as inquiry in the New Zealand curriculum (Ministry of Education, 2007) learning is seen as a cyclical process, whereby teachers are continually questioning how their students are progressing, relevant data is gathered and considered, with actions then reviewed or altered accordingly (Cochran-Smith & Lytle, 2009). The permission this gives a teacher to ask what is important for their students and, therefore, what is needed next to improve learning, is crucial in the learning process.

In 2011, ERO prepared a report on the progress that schools had made in implementing the eight principles of the New Zealand curriculum and establishing teaching as an inquiry process (Education Review Office, 2011). ERO found that 72 percent of the schools involved in their study had processes in place that were "both highly or somewhat informative and supportive in promoting teaching as inquiry" (Education Review Office, 2011, p. 2). ERO (2011) also saw that some teachers and schools had taken this process even further by continually adopting an inquiry approach, ensuring that this was an integral part of their practice. A strength seen throughout some schools was the establishment of a school culture whereby learning and effective teaching practice was seen as the norm rather than the exception. Teaching as inquiry drove decision-making and always placed the student at the centre of the learning (Ministry of Education, 2007).

Cochran-Smith and Lytle (2009) refer to "inquiry as stance" (p. 118) in which practitioners are essentially involved in positioning themselves to utilise observations, interpretations of data and to continually question the meaning of these pieces of information. This was considered at times to be an unsettling notion as there was always likely to be some conflict and some disruption. Instead of considering that the "competent practitioner is self-sufficient, certain and independent" (Cochran-Smith & Lytle, 2009, p. 114) there is an emphasis on the fact that whilst these aspects may be present, an inquiring practitioner poses problems and questions their practice on a regular basis. This approach is considered to be further enhanced when it is undertaken as a collective approach to teaching and learning instead of one individual inquiring into their practice (Cochran-Smith & Lytle, 2009).

Impacts upon students

Student self-efficacy

McSherry and Ollerton, (2002) noted that applying notions of 'high', 'average' or 'low' was applying a limit as to what was then perceived to be possible. Streaming was regularly seen as a system by which low expectations were reinforced for students and teachers. There was also an impact on the way that students saw themselves as learners which was likely to have an impact on their enjoyment of school (Hattie, 2002). Gamoran and Berends (1987) observed that "Whereas high-track students tended to accept the schools demands as the normative definition of behaviour, low-track students resist the school's rules and may even attempt to subvert them" (p. 427).

Zevenbergen (2003) argued that placing students into ability groups had a self-fulfilling affect and provided students with a very narrow view of the way in which they saw themselves as mathematical learners. Similarly, Clarke and Clarke (2008) were convinced that the common practice of ability grouping was a major impediment to mathematical learning and positive self- belief of students in our schools. Zevenbergen (2003) believed that placing students into class ability groups had an important influence on the way students saw themselves as learners of mathematics, which in turn, had far reaching implications for future learning opportunities. Zevenbergen (2003) conducted a study of 96 Year 9 and 10 students from six Australian schools and found that placement in a higher group encouraged continuation of mathematics learning whereas participants in lower groups were exposed to practices which supported rejection of the subject. The grouping practices were not initially a focus of the study but through a grounded theory approach, this aspect was noted as significant in building self-concept and impacting upon achievement and future opportunities. It was noted that "Terms such as "brightest" and "smart" are used to describe the students in the upper groups, whereas the lower group students are described with terms such as; "lazy"; "just muck around"; "dumb"; "idiots"; and "bad" (Zevenbergen, 2003, p. 9).

Even top-stream students can suffer from self-doubt and lack confidence. When Boaler, (1997a) provided questionnaires to Year 9 students asking them whether they believed that they were 'good', 'OK', or 'bad' at mathematics none of the girls and only 2 boys in set 1 believed that they were good at mathematics. Clarke and Clarke (2008) were also convinced that the common practice of ability grouping was a major impediment to the mathematical learning and self-belief of students in our schools. Boaler, Wiliam and Brown (2000) found

that, for varying reasons, the majority of students were unhappy with their streamed placement.

The labelling of children at a very young age can easily transfer into the self-belief (or lack of) that many adults have in regards to their own mathematics ability. Haylock (2010) worked with students who were teacher trainees and found that many of them self-identified as lacking confidence and acknowledged that they were extremely anxious about their own mathematical abilities. As these students had been accepted for a university degree course, they must have achieved relative success in school, yet they still felt insecure with mathematics. Many students recalled school experiences with mathematics that had resulted in long-lasting feelings of fear and anxiety. Haylock (2010) reports that "their comments are sprinkled liberally with such words as frightened, terror and horrific, and several recalled having nightmares!" (p. 6). An additional aspect that frequently caused concern for individuals was the expectations of teachers or parents; at times these appeared to have resulted in long-lasting impacts. Sometimes, adults did not believe in the mathematical ability of the students or, alternately, there was an expectation that students should and have always been able to understand immediately. Haylock (2010) found that there appeared to be little encouragement for the idea that grappling with a problem may be a positive aspect or that questioning ideas or answers could be a good option. This appeared to link with the way in which most teacher trainees had been taught at school; many recognised that they had mostly been taught by rote. As children, they had soon realised that when they had questioned to try to develop personal understanding of a concept, this was considered to be annoying rather than a positive response (Haylock, 2010). Swain (2004) reported that many adults who were attending numeracy classes viewed themselves as failures and felt that they had been seen as hopeless cases very early in their schooling experiences.

Socially, in many Western societies, it has often been considered acceptable to be a poor mathematician (Haylock, 2010). Many parents (and teachers also) have been heard to declare that they were always weak at mathematics (Gates, 2001). Marks (2013) wrote about the acceptance that some individuals are "born to do maths" (p. 31). This belief has existed in schools and in society generally. There has been little conception of the possibility that mathematics could be seen as a creative subject; it has regularly been seen as being very narrow and disconnected from other subject areas. Ironically, when we move into the 'real world', mathematics is clearly one subject area that demands attention every day and people

are frequently solving complex mathematical problems in commonplace situations. It is almost as if there has been a total divide at times between 'school' mathematics and 'real' mathematics. There has often been a very narrow view of what it looks like to be successful at mathematics; perhaps because this has regularly been measured in the ability to complete pages of equations. Many adults who have believed all their lives that they are weak at mathematics are actually dealing with highly complex mathematical situations every day in their workplace or home situation (without actually considering this as mathematics). An example of this could be a farmer who is required to calculate the diameter of the urea spray on their paddocks or the yield of crops. We need school mathematics (and teachers) to prepare our students for mathematics in their futures by assisting them to develop an appreciation for mathematical thinking (Jorgensen & Dole, 2011).

Speed

Speed has often appeared to play a major role in the way that students have viewed their expertise in mathematics. There has been a difficulty in the pace of lessons as well as issues with the ways in which teachers have judged their own efforts to cover curriculum content. Often teachers have judged their own teaching ability on whether their students have been able to complete textbook work which has often accompanied direct instruction. Boaler (1997b) observed a classroom situation where a teacher who was passing through a classroom, discussed with students the amount of mathematics textbook work that had been completed.

> Where are you up to?' then says 'Tell Mr Losely to slow down. My lot are ahead at the moment and I don't want you to catch up!' This is said as a joke, but reinforces the idea that mathematics is all about finishing as many exercises as possible in as short a time as possible.
> (Boaler, 1997b, p. 169)

An aspect of 'top set' placement that has been noted to cause concern is the pace of instruction. In a study conducted in a mixed 11-18 years comprehensive school in the United Kingdom, Boaler (1997b) observed that many 'top set' students were faced with conflicting feelings about competition and a focus on working quickly with little time to process ideas and to think; she reported that all lessons were taught "with a sense of urgency" (p. 172). Students themselves noted that the lessons in a 'high ability' class were frequently focussed on the speed with which students worked through questions or problems; there appeared to be a focus on getting the answer rapidly. When students were orally questioned, they were

expected to answer within a second or two; if they did not manage this, the teacher moved on to another pupil (Boaler, 1997b). This is directly opposed to the belief that 'wait time' is absolutely vital to allow learners to process ideas and to recognise the fact that thinking is a crucial part of the learning process (Loughran, 2002; Rowe, 1986). Ironically, Boaler (1997b) found that top-set pupils (who are supposedly the pupils most advantaged by setting), often students expressed "considerable disaffection, particularly because of the speed of lessons and the pressure they experienced" (p. 174). Marsh (2013) also discussed the fact that students in a streamed class were expected to all work at the same pace.

In the New Zealand curriculum (Ministry of Education, 2007) thinking is a key competency which is considered to be a vital aspect when developing life-long learners. Mathematics is a curriculum area where thinking should be highly valued and yet at times we see a preponderance of black line masters and textbooks used in mathematics classrooms; often the thinking aspect has been disregarded. Encouraging students to record their own ways of thinking can provide rich insights into student thought processes and allow for less focus on "filling in boxes" (Siemon et al., 2011, p. 79). Distinctions are made between types of mathematical thinking and consideration is given to the viewpoint that much of what most people see as mathematical thinking is concerned with exercises, whereas other aspects such as problem-solving and investigations are as important Siemon et al. (2011). Working with these facets demands time. To constantly expect rapid responses in mathematics is undervaluing the usefulness of working through problems and appreciating that challenging tasks (and thinking) involves considerable perseverance (Schwartz, 2005).

Behaviour

In lower streams there has appeared to be a greater focus on behavioural expectations than there has been in other streams (Boaler, 2009). In a research study by Boaler (1997a) it was revealed that many students believed that their group placement was more determined by their behaviour than their ability. Boaler (1997a) cites Tomlinson (1987) who provided evidence that behaviour had considerable influence on the group placement of pupils; it was noted that when class placement was decided between children of so-called equivalent ability, decisions were frequently made based on student behaviour. In work by Boaler (1997a) statements were collected from students which clearly demonstrated how they felt about this factor.

> ‘Yes but they’re knocking us down on our behaviour, like I got knocked down from second set to bottom set and now, because they’ve knocked me down, they’ve thrown me out of my exams and I know for a fact that I could’ve got in the top A, B or C.’ (Michael, Amber Hill, Year 11, set 7) (Boaler, 1997a, p. 587).

Boaler (2009) referred to The Early Primary Review of 2008 which found that “the allocation of pupils to groups is a somewhat arbitrary affair and often depends on factors not related to attainment” (Boaler, 2009, p. 97). Alternatively, in regards to behaviours, there have also been issues noted in regards to the children who were not as assertive in demanding that teachers noticed their capability in mathematics. Young-Loveridge, Carr, and Peters (1995) noted that at times very quiet children, who were capable mathematicians, managed to keep this capability concealed from their teachers whereas some children who were less able, but very outgoing, were assumed to be adept mathematicians. This also has implications for female participants, who may not be as vocal in the classroom setting and are consequently disadvantaged by the nature of their gender (Bartholomew, 2000), and for students from some other cultural groups.

Conclusion

The Numeracy Development Project was intended to build teachers’ conceptual understandings and to foster student understanding of mathematical concepts by moving away from traditional procedural mathematics learning (Holton, 2009). However, the grouping process that came with initial training in schools fostered some inflexible within-class ability grouping to be organised, which may, unintentionally, have been a damaging practice. The extension of this, from ‘within-class grouping’ to ‘cross-grouping’ across classes, may have led to even greater negative consequences for both students and teachers. Boaler, Wiliam and Brown (2000) found that students in all sets can be disadvantaged by ability grouping across classes for a range of reasons. Ability grouping across classes has been associated with curriculum polarisation, with students at all ranges of the spectrum finding their opportunities to learn limited (Boaler & Wiliam, 2001). It has also been found that teachers are likely to employ a more restricted range of teaching strategies, with different pedagogical approaches being adopted according to the way that teachers viewed their learners (Ireson et al., 2001; Zevenbergen, 2001). Some specific groups (particularly high-achieving girls) have been affected adversely; they disliked the pressure of being in a ‘top-set’ and were keen to explore the understanding of a concept, rather than focusing on correct

answers (Boaler, 1997b). This has been seen as one of the possible reasons that females have been less inclined to pursue mathematics to a university level (Boaler, 2009).

The emphasis on the use of ability grouping as a pedagogical practice in the United Kingdom, in United States high schools, and in Australasia has been in distinct contrast to class organisation in Japan, Korea and a number of other countries. Boaler (2009) highlighted the approach taken by Japan and some other countries (which have consistently ranked highly in international comparisons of mathematical achievement) where the main priority is to promote achievement for all. Teachers in many of these countries have avoided ability grouping and instead have focused upon "providing all students with complex problems that they can take to high levels" (Boaler, 2009, p. 99). Promoting practices which will be more likely to contribute to this aim are an important consideration for all schools.

Chapter 3: Research Design

Introduction

This chapter introduces the research approach that I used to investigate the research question: What impact, if any, does cross-grouping in mathematics have on teacher practice? A qualitative design was used to investigate this.

This chapter begins with an outline of the paradigm used; it is followed by some discussion in regards to the research approach with a justification of the general methods used and an acknowledgement of the literature. Following this, there is a description of the specific methods employed for data collection; namely, individual semi-structured interviews, then an overview of the process used for data analysis and a discussion regarding ethical issues. The chapter concludes with a brief summary.

Research approach

The methodological approach adopted reflects my assumptions and beliefs. "The approach represents a worldview that defines, for its holder, the nature of the "world", the individual's place in it, and the range of possible relationships to that world and its parts …" (Denzin & Lincoln, 1994, p. 107). Inquiry paradigms depend on the researcher's view of the nature of reality, the relationship between the researcher and the reality that they are dealing with and the methods that can be utilised to ascertain what the researcher wishes to find out (Punch, 2009).

According to Punch (2009), the crucial idea in empirical research is "to use observable data as the way of answering questions" (p. 3). In this research I used an interpretivist paradigm which is frequently associated with qualitative methods (Punch, 2009). Interpretivism is concerned with the meanings that people bring to situations and the actions which they use to comprehend their world. When an interpretivist paradigm is used, there is an endeavour to comprehend the personal world which each individual is living within, without the imposition of an external structure (Cohen, Manion, & Morrison, 2011). Interpretive approaches focus on the process of action, in that interpretive researchers begin with individuals and attempt to understand each individual's interpretations of the world. The data is then employed to divulge the meanings and commitments of the people who are at the source of the research (Cohen, Manion & Morrison, 2011).

In this qualitative research I used interviews and aimed to "uncover the lived reality or constructed meanings of the research participants" (Mutch, 2005, p. 43). I was studying this topic by endeavouring to make sense of the beliefs and interpreting the phenomena in terms of the meanings that teachers brought to this area of practice (Denzin & Lincoln, 2000). The interpretive approach was used to investigate a phenomenon which has often been taken for granted as necessarily being a valuable option for teachers to utilise in their classrooms (Cohen, Manion & Morrison, 2011).

Research design

In this research, a pragmatic approach was taken from the outset, in that I had identified some questions that were worth investigating based on my experience, the existing literature and the need for New Zealand-based research to inform teaching practice. Utilising such a pragmatic approach can be positive in that the researcher ensures that by establishing what it is they wish to find out, they will then select the appropriate method. This ensures that the focus of the research then remains on the substance of the topic rather than trying to fit the questions to meet the method which has been selected (Punch, 2009).

This approach led me to the decision to draw from narrative inquiry as a means to focus on the stories that teachers have to tell. As explored by Farquhar (2010) "the term narrative implies the business of storytelling" (p. 23) and in this research there will be recognition given to the experience of the participants (Farquhar, 2010). Narrative can explore the ways in which participants use language to portray their own interpretation of a situation or experience. There is development of the ways in which humans create logic, make connections and then utilise these to make sense of their own reality. There is a necessity for the researcher (and the reader) to then make their own interpretation of this and also to link this with their own experiences (Farquhar, 2010).

My narrative analysis was developed to make sense of the stories which the participants provided through their interviews. This process provided a sense of realism and ensured that the values and authentic voices of the participants were considered and provided for (Cohen, Manion & Morrison, 2011). It has been said that "narratives are powerful, human and integrated; truly qualitative" (Cohen, Manion & Morrison, 2011, p. 554).

Data collection methods

Most research involves sampling as it is not usually possible to include everything and everyone (Miles & Huberman, 1994). The sample method used in this research was snowball sampling (Cohen, Manion & Morrison , 2011) , with the participants being purposefully selected to include a certain sector of the population. As Cohen, Manion and Morrison (2011) have pointed out, my purpose was to "acquire in-depth information from those who are in a position to give it" (p. 157). The sampling was deliberate and aimed to provide me with a range of participants who would then provide information that would be sufficient and necessary to offer understandings of my area of investigation.

Another reason that this approach was deemed to be a suitable method in this project was that there have been times in which cross-grouping in mathematics has not been seen as a positive practice and participants may have felt uncomfortable sharing their opinions. However, it has been noted that interpersonal relationships feature highly in snowball sampling (Cohen, Manion & Morrison, 2011), and these participants were all keen to work with me and provide their personal viewpoints. I noted that snowball sampling can be subject to various biases due to the influence of the initial contacts; however, as the initial contacts were working at different schools and did not know each other, it was noted that this bias was reduced considerably. As discussed later, ethical considerations were carefully considered and assurances were provided to all the participants that their confidentiality would be respected at all times.

Participants

At the beginning of my research project, my intended sample size was ten teachers. The initial three participants were teachers who were working in mathematics cross-grouped situations and were known to me. These teachers were invited to participate. Informed consent was sought after they agreed to be involved. After the interview, these initial participants were then questioned as to whether they were aware of other teachers who were working in mathematics cross-grouped situations who may also be interested in sharing their stories. Thus, snowball sampling was used with potential participants being invited based on participant recommendations (Cohen, Manion & Morrison, 2011). This method of sampling meant that only the required numbers of participants were approached.

Initial contact was made by email to all proposed participants. This email included two attachments; an information sheet (Appendix A) and a written consent form (Appendix B). The information sheet contained a brief summary of the research project, and provided contact details for the research supervisor if potential participants required further information. Upon response to this initial overture, teachers were either contacted by email or telephoned to arrange times for an interview. All the participants in this study opted to be interviewed in their own workplaces and most opted to be interviewed after school hours. All the participants signed the consent form prior to the interview.

During the data collection process, I realised that data saturation point was going to be reached prior to the completion of ten interviews. Saturation is reached when it is perceived that no new understandings or insights will be reached upon conducting any further interviews (Cohen, Manion & Morrison, 2011). It is acknowledged that there is always the possibility that further categories could be gained from additional data but in this case there was an acceptance that theory was able to explain the current data sufficiently. One consideration that provided support for this decision was that I was hoping to have participants who were working at a range of year levels and also a range of perceived 'ability' levels. This was deemed to be an important factor as I was interested to see how (or if) practices differed depending on the age of the children or the perceived 'ability' group taught. Both of these aspects were met after conducting eight interviews. Thus, after discussion with my supervisors, we agreed that the initial plan of conducting ten interviews should be revised and the number was reduced to eight.

Quality criteria

In all qualitative research it is important to ensure that the research is "trustworthy and credible" (Mutch, 2005, p. 114). However, as Denzin and Lincoln (1994) claim, "Any gaze is always filtered through the lenses of language, gender, social class, race and ethnicity. There are no objective observations, only observations socially situated in the worlds of the observer and the observed" (p. 24). There are however, some measures that can be taken to provide a greater degree of validity and reliability.

Validity should be seen as a matter of degree rather than an absolute definite state (Cohen, Manion & Morrison, 2011). One aspect that can be attended to in regards to validity is to ensure that the research actually addresses the intended issues determined when the research was planned. In this case this was ensured by constantly keeping the research questions on

hand and continually reviewing the transcripts which were the outcome of the interview process. This contributed to the research remaining authentic and honest, with the participants' views and statements being carefully considered. The opportunities that were provided for participants to contribute anything further at the end of their interview provided me with confidence in the validity of the data.

Reliability largely refers to the potential of the research conducted to be replicated with a similar group of respondents with similar findings (Cohen, Manion & Morrison, 2011). In qualitative research, it is patently impossible to replicate the research exactly and be assured there will be very similar findings, as it is evident that the findings from any study are specific to the group of participants who were involved in that particular research. Qualitative data has a greater focus on internal validity (as opposed to external validity) in that it does not seek necessarily to generalise; I acknowledge that these findings are only representative of this group of teachers. However, the descriptions of the settings and the practices adhered to, may provide others with opportunities to see the potential transferability of my research findings. Throughout this project I endeavoured to show a truthful representation of how these teachers perceived their practice to be impacted upon when working in a cross-grouped situation. Their viewpoints and opinions have been captured in the extensive use of their own voices. Clearly, however, notions of reliability need to be applied somewhat differently to quantitative and qualitative pieces of research.

There are some other aspects, which also need to be considered in qualitative research. Denzin and Lincoln (1994) referred to three considerations. The first deals with the stability of observations which refers to whether the researcher would have made the same interpretations if the phenomena had been observed in a different time or place. Secondly, there is the notion of parallel forms whereby consideration is given to whether the researcher would have made the same observations if attention had been given to other phenomena which may have been present. Lastly, there is interviewer inter-rater reliability which refers to the notion of whether another observer with the same theoretical framework would have made the same interpretations. In this piece of research I have endeavoured to take note of these considerations by revisiting the data on numerous occasions. I have also become immersed within the data to allow reflective insights to be considered and incorporated within the themes identified; and these insights have been drawn upon in my discussion of the findings.

In qualitative research, reliability also refers to the commitment to real life, honesty and the depth of response that participants are able to give, as well as the consideration of how meaningful the research is to the participant (Cohen, Manion & Morrison, 2011). As this piece of research utilised semi-structured interviews, this was a way of providing some measure of reducing the bias which may at times be an issue in regards to reliability with qualitative research. The questions were open-ended as I intended to convey the belief that I was looking to describe rather than judge their individual teaching practices. The questions were also formulated in such a way as to allow for open responses from the participants. Open-ended questions can allow respondents to provide their own unique way of viewing the world (Cohen, Manion & Morrison, 2011).

With any piece of qualitative research there is always a possibility of researcher bias; one way that this possibility was reduced was to have the interviews recorded and transcribed. This method ensured that all the details were captured for analysis and small details were not omitted or forgotten as they might have been, if the researcher had relied upon notes which were then added to or transcribed later. As Cohen, Manion and Morrison (2011) note, when recording written notes and responses to an interview "it is likely to induce greater bias because the delay may lead to the interviewer forgetting some of the details" (p. 208).

Credibility refers to the measures that have been taken to ensure that the findings can be related to by others who are likely to be familiar with the setting or situation. In this research my findings were returned to the participants to ensure that they fit with their understandings of the phenomenon and this provided a further credibility check (Mutch, 2005). This was one of my main goals in undertaking this project; as there was a keen interest in ensuring that this research would be accessible to many and also have applicability for other teachers in reflecting on their own classroom practices.

Data collection procedures

As noted previously, I had willing participants who worked in cross-grouped situations in primary school classrooms and were keen to be participants in this research. The teachers interviewed were teaching in Year 4-8 classes, and they all had at least three years' experience teaching in New Zealand classrooms. They were familiar with both the Number Framework (Ministry of Education, 2004) and the New Zealand curriculum (Ministry of Education, 2007). I was not concerned with the schools' decile ratings, however, due to the

geographical area that the participants and the researcher were living in, all of these schools were considered high decile (decile eight and above).

Each teacher was interviewed once for approximately forty-five minutes, using open-ended questions and a semi-structured questionnaire. These questions are included as Appendix C. The interviews took place at a time convenient to the participants and all of the participants elected to be interviewed in their own school environments. The interviewees were asked the same basic questions in the same order (Cohen, Manion & Morrison, 2011) although, where required, other probe questions were utilised.

Interviews can have an advantage over written questionnaires in that the interviewer can clarify meanings and queries; and it is likely that the researcher will gain "a more in-depth understanding of the topic or issue from the participant's perspective" (Mutch, 2005, p. 127). Mutch (2005) goes on to identify three types of interview formats. *Structured interviews* which follow a very set format, *semi- structured interviews* that allow for some flexibility, and *unstructured interviews* which begin with an open-ended question and the interviewee provides the direction of the questioning that follows. My selected format of a semi-structured interview allowed for some commonalities when analysing the transcripts, as consistencies in the order of responses and opinions permitted easier analysis of the data. The use of semi-structured interviews also allowed for interesting insights to be explored and gave me the opportunity to seek further elucidation and invite the participants to explain their answers more fully (O'Toole & Beckett, 2010).

The interviews were audio recorded and transcribed (Creswell, 2007). I utilised a professional transcription service and the two transcribers completed and returned confidentiality agreements.

Data analysis

As previously noted, the eight interviews were audio recorded by me and transcribed by a professional transcription service. Upon receipt of these transcriptions, I read through the interviews and made some minor corrections in regards to spelling of some items, which were specific to education. There were also a few instances where the transcriber had difficulty in hearing what was said; and again, I was able to confirm the majority of the words or abbreviations used. Often the difficulty in interpretation was due to the specific educational nature of the conversation.

A Computer Assisted Qualitative Data Analysis (CAQDAS) programme, NVivo, was utilised to provide support with the data analysis. It needs to be remembered that any such programme is only a tool to assist with the analysis; it cannot actually do the analysis. My input as researcher remained absolutely central to the entire process (Punch, 2009). However, as qualitative research often amasses very large amounts of data very quickly, a computer software programme can be useful to assist with the process of analysis.

Coding (using NVivo) was used to identify common themes. NVivo allows for the creation of nodes which are 'containers' for the ideas from the data that is being analysed. Nodes can be seen to represent the themes or categories which are identified by a researcher. This coding process (with the creation of nodes) allowed me to identify patterns within the data (Cohen, Manion & Morrison, 2011). Initially I had established some themes which were largely based around the questions and were descriptive in nature. However, after the first analysis of the transcriptions, many nodes were merged and a number of new parent and child nodes were created. These later nodes were more analytical, while some of the initial nodes were retained as descriptive nodes. In establishing the nodes, I was careful to ensure that a description was provided at the start. This was important as it allowed me to constantly check the definition of each node to ensure that points were correctly coded in the appropriate place. I also made use of the coding strip function within NVivo to ensure that on subsequent readings of the transcriptions, important points had been connected to a node. At times data was assigned to multiple nodes and the coding strip function was useful in this regards also.

Ethical considerations

Empirical research in education is likely to have concerns with ethical issues as it involves collecting data from people and about issues that they have interest in (Punch, 2009). The ethical procedures issued by the Auckland University of Technology Ethics Committee (AUTEC) provided a framework to work from and in accordance with these guidelines, privacy and confidentiality were fully respected throughout the research process. Participants received copies of the Participant Information sheet (Appendix A) which was then explained further as required. All participants signed a consent form (Appendix B) which acknowledged that their participation was voluntary, that any questions had been answered and that they were aware that they were able to withdraw from the research at any time up until the data collection phase, if so desired. The participants were also asked if they wished to see a copy of the findings and all indicated that they would be keen to do so.

The participants selected their own pseudonyms at the beginning of the interview process. However, when reporting the findings and throughout any later references, I changed some of these pseudonyms again as there may have been a possibility that the pseudonyms selected were possibly 'nicknames' that may have made it possible for the participants to be identified.

AUT document safety protocols were followed throughout when managing the data.

Conclusion

The purpose of this qualitative research was to gather evidence about the impact that cross-grouping had on teacher practice. There were eight participants, from schools where cross-grouping in mathematics was adhered to. The research paradigm utilised was interpretivism and the research approach was that of narrative inquiry.

Eight semi-structured interviews were conducted using purposive snowball sampling in order to find suitable participants. These interviews were transcribed by a professional transcriber. I then analysed these transcriptions, utilising NVivo software to support this process.

Reliability and validity were considered throughout the research process but there was an acknowledgement that in any piece of qualitative work there are some issues in regards to replicating any specific research. This research was however, seen as being an honest reflection of these particular participants and their viewpoints. Ethical considerations were taken note of at all times throughout the entire research process and AUTEC guidelines were adhered to.

Chapter 4: Thesis Findings

Introduction

My analysis of the research data gathered from face-to-face interviews is presented in this chapter and the research question posed in Chapter 1 is reiterated and addressed. Some background information on the schools and teachers involved is provided to supply further context to the findings. Following this are my findings from the eight individual face-to-face interviews which were conducted between April and June, 2014. This analysis is based on the experiences of my eight participants and generalisations will not be made as these experiences may be unique to this group.

This research was with primary school teachers who were working in a cross-grouped (streamed or tracked) class for mathematics. (For definitions of these terms, see Chapter 1). Eight teachers, from five different schools, were interviewed. They were working in a range of year levels with students of age 8 to 13. There were some similarities that came through from these schools. All of these schools were considered high decile state schools (schools in high socio-economic areas, according to census data). All the schools had students with varied backgrounds; however, in every case, the majority of the student population were New Zealand European /Pakeha (ranging between 68 and 75 per cent). The teachers who volunteered to take part in this research were all experienced practitioners with a minimum of three years teaching experience. Some of the participants had also taught in other countries around the world; these experiences added a different dimension to their viewpoints and perspectives.

This qualitative research utilised an interpretive paradigm. The research method was narrative inquiry (Farquhar, 2010). The research questions were directed towards the teachers' personal perception of their teaching practice and looked at whether this practice was impacted in any way by the manner of teaching in a cross-grouped (streamed) class for mathematics. The background to the adoption of cross-grouping in their respective schools was explored and the assessments or methods utilised in each school to assign children to groups, was investigated. Teachers commented on what they saw as the positives and negatives of the cross-grouping practice for teachers and for their students. Questions were also asked about how teachers believed students and parents felt about cross-grouping. I also

investigated whether the practice of cross-grouping (or streaming) added to or detracted from their personal teaching as inquiry process whilst teaching mathematics.

All the teachers who participated had worked previously in non-streamed situations for mathematics. This was important; it meant that the participants had some other experience to compare with their current practices. The circumstances of the cross-grouping arrangements varied considerably from school to school; two schools in particular were structured more as a team-teaching environment and the opinions and views of the teachers working in this type of situation were explored. The enhanced communication and likelihood of greater collegial trust appeared to be a positive aspect in these cases and this characteristic was explored. This is an interesting feature in that there is a link to the current Ministry of Education drive to develop more Modern Learning Environments in New Zealand schools (Ministry of Education, 2014).

The teachers who participated in this research were interviewed through individual, semi-structured interviews; these interviews were transcribed and analysed using NVivo software. As the interview process generated qualitative data, the analysis involved looking at common themes and ideas across the data (Punch, 2009). The eight transcripts provided rich data; initially, they were read and edited to ensure accuracy of language and spelling. They were then read again to extract some general themes and then reread numerous times to extract verbatim responses, which were coded into appropriate nodes. Subsequent to the first reading of the transcripts some parent nodes were developed; these were largely descriptive terms and the language often came from the interview questions (Gibbs, 2007). The interviews themselves generated a great deal of thought and as noted by Gibbs (2007) it is recognised that the process of analysis happens throughout the interview process and not just at the conclusion of the interview procedure. As the transcripts were analysed further, the nodes were at times renamed, merged and regrouped. The nodes that were finally developed were a mixture of analytic and descriptive themes. The findings which follow have been presented in thematic groups which have generally been taken from the analytical nodes in NVivo.

Themes

Sense of responsibility

The teachers interviewed expressed a definite sense of responsibility for their students; this included their home-room and also their mathematics groups. Teachers were often concerned

that they were struggling to meet the varied needs that they faced in their everyday classrooms. At times this caused conflicting emotions, due to the fact that they wanted to meet the needs of both their own home-room students and their mathematics students. The relationships established with the other teachers in a team and the communication that was fostered had an impact on how teachers felt about cross-grouping. According to the teachers, decisions about cross-grouping (which were often made by management) were accepted, on the whole, with little questioning from teachers, students or parents. There was an acceptance of the reasons that had been put forward for adopting cross-grouping in the school. At times, teachers were able to voice their viewpoints as part of the decision-making process but at times, it was just seen as 'the way that it was'. These two teachers below expressed their viewpoints about the decisions to cross-group in their schools.

Alice: *Head of Departments and senior management made the decision and we've always done it as long as I've been here. I mean, there's no choice, so this is what happens here.*

Dylan: *I know that the decision was given to us, this is what we're going to do.*

One of these teachers, Dylan, recalled that he had been adamantly opposed to the idea when it was first proposed and wrote a critique of the cross-grouping practice, outlining his concerns. Ironically, he now found it very difficult to recall the reasons behind his opposition.

Dylan: *When we started off this programme ... I was quite resistant to it. I sat down and thought why don't I like this, and I wrote up a sort of critique of what I thought about it. But then I've gotten over that entirely. I deleted that. I should have kept it. But you know, disadvantages for the kids? If you had asked me like a year ago, I would have been really clear on what those were.*

However, despite not always having much decision-making power, the teachers were largely in favour of cross-grouping for mathematics. When questions were posed about the impacts upon achievement, some teachers believed that cross-grouping had been beneficial.

Claire: So it's definitely shifted all their levels up. We have a huge focus on knowledge. If you went towards National Standards you wouldn't see it. Cos they were 'well below' ... and got 'below'. Some of them were 'below' and got 'at'. Some of them 'below' and stayed 'below'. But within the class and their knowledge and their learning and within the profiles it was incredible ... but it wasn't enough, you know, they were so far behind but within their confidence and their personal growth and their ability in themselves and, you know, their knowledge. Fantastic.

It was also noted that the impact on achievement was not something that schools had always collated comparable data for.

Anna: That would be an interesting question actually.

One of the main reasons that the participants were in favour of cross-grouping linked very much to this sense of responsibility that the teachers felt towards their students. This manifested itself in many ways and is explored in table 4.1 (next page).

There was a feeling that coping with the ranges of abilities and achievement levels could not be managed successfully in their own home-room mixed ability classes. The demands of planning and requirements for meeting student needs were much more readily met when the class had been grouped with children of similar achievement or ability levels. There was a concern expressed by a number of teachers that students would struggle in the next stage of schooling and there was a real personal responsibility to assist in any way possible to allow their students to 'cope'. At times, it almost appeared as if teachers believed that expectations between different school sectors such as primary (up to age 10), intermediate (ages 11 and 12) and secondary (13 +) were totally different. It was believed that cross-grouping enabled teachers and schools to utilise resources and additional support staff (such as teacher aides) for the greatest advantage. Most of the teachers mentioned that another positive aspect was the commitment to actually teaching mathematics each day. There was also a belief that cross-grouping provided a positive environment for the children involved with a number of teachers mentioning that children felt more confident when they were working with peers who were similar to them in achievement levels.

Table 4.1: Sense of responsibility

Concerns	Quotes	Perceived implications
Fears that children would not cope at next level of schooling	*Cam- I get really, really, kind of almost panicky, because they're going off to high school and they are only stage five.*	Students are ill equipped when they leave primary or intermediate school
Lack of teacher confidence in dealing with capable mathematicians	*Cam- I mean I'm not saying I couldn't do it but I would probably be more stressed.* *Dylan- When I was asked to do the extension group this year I was a little concerned that I may not have enough material or personal knowledge to extend them.*	Teachers needed specific mathematics content knowledge to teach more able students
Reporting to parents about meeting the needs of high achieving students	*Cam- At least now I can say to parents whose kids are really good at maths, well they're being catered for, there's no doubt about it.*	Capable children were not being extended or that their needs were not being met
Commitment to teaching mathematics on a regular basis	*Alice- ... to ensure that maths is being taught well … taught so it happens every day.*	At times in the past mathematics had not been a priority for many teachers
Use of personnel and staff resources to meet the needs of lower ability groups	*Claire: my class is smaller … I have two teacher aides.* *Wendy: I am co-teaching the maths class … I had the bottom class and I had five, and then my co-teacher had I think 15, so we decided that we would put them together so that the five didn't feel like they were truly the bottom of the bucket.* *Anna: We would make it easier on our range of resources.*	Able to prioritise teacher aide support and reduce class sizes Not enough resources within a school to cater to the need for effective differentiated learning for the range of ability groups

There was a feeling of being 'torn' as teachers felt a sense of 'ownership' over their home-room students. At times, differences in pedagogy or teaching approaches meant that some teachers felt concerned about what their students were learning in other classrooms. On occasions, some teachers ran 'extra' workshops with their own home-room students or ensured they had a 'check-up' in their own class about how the learning was progressing in the cross-grouped classes.

Claire: *We have a discussion 'shark' and they can put things in it that they are concerned about … and decimals has popped up quite a lot. So I said, well, if I run little workshops will you come and they did. So that's fine.*

Wendy: *Whereas being their home room teacher, I feel a sense of responsibility and I want to make sure that they are moving … we have a lot to cover in a short time … So this morning I got kind of an indication really of where my home room is, despite whether they are in my class, what they are learning.*

As noted in table 4.1, there were viewpoints expressed by participants that a major reason to 'impose' cross-grouping was to ensure that mathematics teaching actually occurred regularly.

Karen: *I also think the fact that it commits us to taking maths is really good because there are teachers who do not like teaching maths and in this situation they cannot get away with it.*

Wendy: *More accountability that maths is taught every day.*

Teacher expertise and confidence

In all cases, the teachers were taking an achievement group that they were happy to take and they felt it was an appropriate match for their skills and expertise. Sometimes this was in response to personal content knowledge and confidence in working at a particular curriculum level. At other times, it was due to the fact that specific teachers had been up-skilled and gained additional expertise or knowledge to meet the precise needs of students. In one school, a teacher who had a degree in mathematics (whilst also being primary trained) was working with the extension students in order to meet the content knowledge demands of Year 8 students.

Karen: *I think that the other teachers find this one the hardest to do, the extension side of it. And it's a passion for me. I've had a lot to do with gifted and talented students over the years.*

Alice: *I didn't feel confident … taking the upper year eight.*

Anna: *I have a background in teaching low ability students … I've gone on a few courses in the time that I've been here.*

Claire: *I also take care of the behaviour management and all of those lower kids are behaviour management children … it does make it more challenging.*

This last comment links with the connection to student behaviour and demonstrates that children in the 'lower' classes are generally perceived to have behaviour needs that require

greater teacher support and demand expertise in certain areas. This can clearly be a challenge for schools and teachers.

One teacher (Anna) was excited to explain that her recent teaching as inquiry focus had been focused on the learning of basic facts.

Anna: *For example, I've had a whole group of children that just couldn't learn their basic facts, so what is the problem there and why is that happening and what is my baseline data and that's where my Salisbury Site Facts came about, because I thought what can I do about this, and it is a memory problem, it's not really a maths problem, it's a memory problem. So my teaching as inquiry has been about how to improve their memory and what can I do to do that.*

The focus of Anna's inquiry had moved beyond the mathematics aspect of the students' learning; her deeper analysis of the issue had led her to discover that the students she was working with had a problem with memory which was also having impacts in a range of other curriculum areas. Therefore, it became not just a 'mathematics issue' but a memory problem, which took the singular focus away from these students being 'weak' at mathematics. This also meant that this was an area that was constantly being refocused on and resources and materials appropriate to the needs of the students were being regularly sourced to support this group of learners.

However, Dylan explored the way that teaching the 'top group' potentially impacted on his teaching as inquiry within the classroom.

Dylan: *Does it extend, does it generate teaching as inquiry? It does and it doesn't, you know. It limits it in some ways and it extends it in others. It could work in the opposite direction, in that I'm working more in a silo if you like, than expanding,*

In connection with this, Dylan was very aware that on some levels this was limiting his progression as a teacher in that he did not need to keep investigating new ways to approach a topic or concept. He also made note of the fact that by taking the 'top' group this enabled him to foster his sense of inquiry in that he now was being given the opportunity to specialise in a field.

Dylan: It's also encouraging me to specialise as an extension sort of specialist.

Claire, who was working with a 'bottom' group, appreciated the challenge of always looking for new ways to meet the needs of her learners; it was *'great fun'*. Wendy had inquired into her own practice and had initiated visits to the high school as she was concerned about the needs and continuity of the learning across different age groups. She had also initiated an innovative Master Chef challenge for her home-room (which was a team teaching situation of approximately sixty mixed ability children) which involved a great deal of mathematics and also utilised a collaborative approach for the teachers and the students.

Wendy: At the end of each term I like to do something quite out there, so we did a Master Chef competition. So I gave them a budget, they had set criteria. They did such a great job. Renee said to me "This is not going to work Wendy. This is going to be a mess". They were just amazing. Renee said "It's really proven to me that they can cope with the challenge".

Wendy also referred to the fact that she had elected to take a different 'ability' group this year to challenge her own practice; she had changed from taking one of the 'top' classes to the 'lowest' group.

Wendy: I decided it was time to change and you know, I suppose, adapt my teaching and learning to see how I could work differently.

Planning

As discussed earlier, all teachers were generally positive about cross-grouping for mathematics. Many teachers referred to the difficulties of coping with the wide range of achievement levels in their home-room classes. One aspect that contributed to this was the planning aspect. Every teacher in the interview group stated that planning and the time it took (including the thinking that was involved) was one major reason why they were in favour of cross-grouping. This linked with the sense of responsibility that teachers felt towards their pupils, in that in order to cater for the many varied needs within their home-room, they would have to plan for many more groups than they were currently planning for. An example of the type of comment made is the one below from Karen.

Karen: If I had my class, I would probably have 12 groups!

All of the teachers saw the group they now had for mathematics was more homogeneous but they also saw that there were groups within this. Many participants continued to utilise a

rotation in their practice to allow teacher time with smaller groups within the classroom. This was no different to the organisational practice they had used when teaching a mixed-ability cohort. There was a difference, however, in the amount or number of resources that were then utilised to meet the needs of their cross-grouped class.

Dylan: Really very time saving and mental energy saving … just the one level of stuff.

In many cases there were differences in the types of activities that were utilised for work in the classroom. The teachers working with the 'lower ability' groups were more likely to utilise knowledge activities with a variety of resources to support the classroom learning while the teachers working in 'top' classes were more inclined to use problem-solving or rich tasks.

Claire: (bottom class) I spent the first 7, 8 weeks of the term on knowledge. Because if they don't have the knowledge, they're not going to be able to do the strategies.

Dylan: (top class) I like rich tasks and complex problems and those sorts of thing.

Karen: (top class) I do a lot of problem solving. I really like problem solving approaches. Lots of thinking and lots of using what they know and seeing the relevance of learning what they're learning.

Karen noted that she probably would use the same sort of tasks with a standard home-room class but would need to provide differentiation for more levels.

There were varied understandings as to the concept of teaching as inquiry as explored in the New Zealand curriculum (Ministry of Education, 2007). However, despite the fact that some teachers saw teaching as inquiry as a student led process, a number of teachers appeared to be, through the evidence that they provided, practicing teaching as inquiry in their own classrooms and teaching experiences. They were reflective about their classroom practices and this reflection led into planning adaptations.

Wendy: We have to really regroup, the teacher and I, at the end of every week and say where are we going to go next week?

Cam: I have finally sorted out where they are all at. I've got them into the groups I want them in, now I've got to figure out what I want to teach them for the next ten weeks or the term or whatever's left, so we can move on. Because we do things differently as well ... because I will cater to the needs of the children.

Winnie: I've always believed in, you know, every student has a different way. And you've just got to keep trying and trying to find a way that really suits that student.

In all classes, there appeared to be limited opportunities for curriculum integration and most of the teachers saw mathematics as being quite isolated from other curriculum areas. There was general agreement that there was less cross-curricular integration than when they had taught their own classes. The teacher who was working in the Modern Learning Environment (defined in a later section) noted that integration was more likely to happen in this environment.

Anna: I think that's actually down to ... teacher beliefs about it has to stand separate ... the teacher I'm teaching with is very inquiry focussed and it's like we're doing double maths, because we are doing dinosaurs. She says there's so much maths in dinosaurs, but it's authentic to the inquiry.

Linear progression

Mathematics was often seen as a linear progression of skills and number knowledge objectives to be mastered. This belief was clearly linked with the assessment practices and connected to teachers seeing curriculum levels or numeracy stages as silos. There was a variety of assessment practices and tools used (as expected) in these schools. This varied from one school which largely utilised one assessment tool as the main method for grouping students, to schools that combined a number of measures from varied assessment tools (diagnostic interviews and written assessments). The type (and number) of tools utilised often appeared to link with the teachers' linear perception of mathematics. In four of the five schools, mathematics was the only curriculum area in which cross-grouping occurred; the only school which also cross-grouped for literacy was the school which had developed a Modern Learning Environment (MLE). Mathematics was generally seen as unique in this way, in that cross-grouping was a very useful method of dealing with the diversity and

student achievement or ability range in this subject. Teachers found it much more manageable to focus on a 'smaller' range of objectives or stages.

Claire: I think … focussing on one or two stages makes it a lot, a lot easier. I'm probably the only one with two stages actually.

Dylan: So I'm not worried about a child working with someone who is, you know, two stages below or anything like that, where that person is at. So there's that sort of homogeneity for the group … I think that it allows us to move faster and … cover, probably cover more because we are all sort of in the same place together, rather than checking that there's some people in widely different areas.

Winnie: We actually reverted to just doing a year-seven programme, year-eight programme with top kids going for extension, so therefore I take the middle group because I've done both year seven and eight, so I'm familiar with both curriculums … we are going in more to get them ready for year nine with the algorithms and things and that's where we found that … you've really got to start at … really low and build them up so that they gain confidence.

Wendy: I think they struggle with maths the most out of all the subjects.

There were some concerns (from one teacher in particular) who questioned whether the process of acquiring a huge number of skills or a vast bank of procedural knowledge components was really necessary for their senior years and instead felt greater emphasis should have been placed upon understanding. This teacher had visited high school classrooms and noted the concerns of mathematics specialist teachers in the senior part of the school.

Wendy: They said you just need to consolidate, let us build on number knowledge, let us build on, you know, a certain amount of knowledge in your strands, don't take all of that in because they are going to come with nothing otherwise.

Mindset and movement across groups

There was a general acceptance that ability grouping was definitely a beneficial way of working for everyone. Teachers genuinely felt they were meeting the needs of their students by working with classes that had been 'streamed'. There was a belief that the students were happier working in an ability-grouped class and were benefitting from this arrangement in that the students felt more comfortable there (regardless of which stream they were in).

Cam: *(currently teaching a 'bottom' group) - I honestly don't think that that ever bothers them. They know that they are the bottom group … it's also a lack of self-confidence in themselves to know that they've got the ability to actually be there (the top group).*

Winnie: *(currently teaching a 'middle' group, but referring to previous experiences with a 'bottom' group) - I don't know what it was. They just said "Can't do it. I'll never be able to do this because I can't do it now". I found that a lot of these lower level kids had really just given up on maths.*

Karen: *(currently teaching a 'top' group) - These kids in particular, I throw stuff at them and they know that I actually expect them to know stuff. Well first of all they're all good at maths, they all know that and occasionally I remind them that even though they are good at maths they still have a lot to learn and they need to be applying themselves and thinking. But I think being able to work with like-minded students is really good.*

Dylan: *(currently teaching a 'top' group) - I've seen those other classes in operation, it compares to mine … there generally seems to be a lot more cohesion, people are enjoying, the kids are enjoying the maths, the kids that I see in the low group which is right next door to me, they seem to be enjoying what they're doing and they are all able to engage at the same level and the kids in here are also enjoying what they are doing and engaging in the same level.*

All the teachers interviewed said that there was opportunity for movement between classes but they noted that in reality, there was not much movement at all. There was also the issue that the 'top' classes moved much more quickly, which meant that potentially the gap became wider, rather than narrowing.

Claire: *They will stay within this class unless they're kind of outstanding.*

Anna: *The core of your group would stay the same*

Karen: *There are kids that are knocking on the door of stuff that we are doing but I find that my class tends to move a lot faster than the other class and the one below.*

According to one teacher, parents appeared to believe that mathematics 'ability' was a given. Basically, the premise was that mathematical ability is something that you have just inherited and little could be done to change this. Very few parents raised questions about the decision to cross-group their children and were reported to be happy with the decisions that were being made.

Cam: *They are not surprised that their child is in the bottom maths group because their parents don't feel that they themselves were very capable.at maths when they were at school.*

As some teachers noted, there would be some parents who did not know that the children were being cross-grouped for mathematics. There is a great deal of trust in the school making the right decisions for the students.

Dylan: *I mean even the most proactive parents are not sure who this person is they are dealing with. For the least proactive parents communication is then unlikely to happen at all.*

Anna: *There is no evidence to show that it is affecting the results (negatively). The results are improving and the teachers are happy doing it as well.*

Reporting, communication and developing relationships

Reporting to parents was an aspect that potentially could have provided some difficulties. In most schools the grades and /or comments in written reports were inserted first by the mathematics teacher and then the reports were ready to be completed by the home-room teacher. There were differences in the way in which teachers ensured that parents were encouraged to initiate or maintain contact with the mathematics teachers, with some home-room teachers following up to gain additional information about attitudes and providing email addresses. The onus was very much on the home-room teacher making arrangements for the mathematics teacher to be part of the home-school relationship. On the whole, however, it did not appear to be seen as a problem that could not be overcome; it was seen as more of a challenge that was still being worked on.

Dylan: *That reminds me of probably the strongest critique point ... I think the weakest part of the programme is parent feedback or parent contact with the maths teacher ... not only does the parent have to get to the school but they've got to find the maths teacher, who they don't have a relationship with otherwise.*

Key aspects for all teachers were the relationships that were developed and there were many layers within this. Teacher-student relationships were seen as being essential and this was one of the reported reasons that had, in previous years, caused some issues. It was noted by some teachers that if the students did not want to go to a particular teacher, that had been an issue that caused conflict but in most of the group that I interviewed, this was not a problem at the present time. Some teachers also pointed out that cross-grouping was beneficial in that it

allowed teachers to build relationships with more students and provided variety in the students' day, as they went to one teacher who focussed purely on the mathematics learning.

Alice: *I mean obviously students sometimes clash with another teacher so that can have an impact. Yeah there definitely have been issues like that where they have clashed.*

Wendy: *So if there's authority without … relationship sometimes, you know, there's an element of fear or a lack of confidence to be able to say I don't know … So I think the disadvantages (can be) that they haven't got a relationship of trust where possibly they can feel safe to take risks.*

Winnie: *Well, I've found that it's always been a positive in that the students actually get used to having a different voice.*

Wendy: *We get to have an opportunity to develop relationships with different students which I particularly enjoy … again it comes back to the teacher philosophy because I believe … the thing that is most important is the relationship you have with your students.*

Anna: *To be mixed up and work with the children that aren't in their classroom, it can be quite refreshing for them to go to another room … that teacher they go to only focusses on their maths.*

This last comment noted that environmental change was beneficial for some students and it also suggested that mathematics learning would then become associated with a particular teacher. Some teachers were very confident in their colleagues' abilities and felt that their home-room children were being well supported in their learning. It was acknowledged that the communication aspect was an area that could be improved upon in some cases and it really depended on the collegiality and trust within the school.

Wendy: *I still think there are some ways that we could work better to ensure that we can communicate where the student needs and learning is with their home room teacher who is primarily their main teacher.*

Previous experiences of teaching own home-room class

The concern of meeting the varied needs within their class was the major reason that teachers were keen to cross-group and all the teachers interviewed had previously had experience working with their own class. They now saw that there were some benefits to that system of working but there were a number of challenges that had provided frustration in the past.

Alice: *I quite liked having my own class in primary school. But I think at intermediate level, definitely it (cross-grouping), is good.*

Anna: *When I taught a mixed ability class I always felt like I was probably failing the top ones or the bottom ones.*

Winnie: *It was a decile one school and there were a lot of students with really specific needs … it was a comfort level thing with a lot of the students … then we found that we were obtaining better results by having our own grouping in our classroom … it meant that you kept more of a handle … you could actually integrate better, you could cross over into other subjects. We actually found the results improved by keeping your own class.*

Claire: *Whereas if you've got a range of stages within your room … they have to stay there whether they've got it or not because they can't jump up a whole stage or back a whole stage … They used to just copy the person that knew what to do.*

One teacher (who was now working more in a team-teaching situation) had become frustrated with some previous cross-grouping experiences. There had been differences in pedagogical practices, the students were not always keen to go to different classes and there was a lack of flexibility in regards to times. In that situation, the cross-grouping had been abandoned.

Other themes which were not specifically linked to the research question

Modern Learning Environments (MLEs)

An aspect that had clear implications for teaching and learning and yet was not directly linked to the original research question was the use of the MLE (Modern Learning Environment). MLE's are not simply open-plan classrooms with the walls and corridors removed but there are some similar features. The intention is to encourage flexibility in learning and teaching, allowing teacher and student collaboration. Ergonomically-designed furniture is another aspect which is common to these designs. MLE's were being used in one school and were being partially implemented in two others. They appeared to result in a much more flexible use of space, teacher time and resources. There appeared to be a greater flexibility of grouping as the children were seen as being one larger group instead of being physically separate groups. Teachers gave the impression that there was a greater collective responsibility between and amongst teachers. Cross-grouping may be a practice which schools see as being an integral part of the MLE concept.

Cam: *I think we should try it, just you and me. I can't speak highly enough about actually knowing your children. We moved in here … specifically for us to start team teaching.*

Anna talked about one aspect which she believed was a disadvantage for cross-grouping when teachers are in isolated single cell classrooms and that was the fact that the 'lower' groups are not exposed to the ideas or thinking of the other children. Anna felt that it was fortunate for the children in the MLE to have the opportunities to share and for everyone to be exposed to the wider range of thinking that was possible.

Anna: *Where it isn't sort of beneficial is perhaps because the children that I teach in my low ability group, they don't get to see somebody displaying higher strategies … But actually in the environment that I teach in at the moment (which is a three teacher classroom) they do get to see it because we have sharing times where we share maths, the three classes all share together what they are doing. So my little group is advantaged but my other year three teachers who are out there doing the same thing in a single cell classroom … they never get to see that.*

Digital technology

The increase in the use of digital technology was at times seen as a real asset which provided variety, the ability to revisit the teaching and increase the opportunities for individual ownership of student learning.

Anna: *I have an interactive whiteboard and all my lessons are presentation style lessons and I link in a lot of You Tube clips, songs, Khan Academy and videos. We use the e-ako maths programme. They've all got individual programmes on that and the study ladder as well.*

Alice: *We use a lot of online resources.*

Winnie: *Our students are all digital. So that has opened up a world for them. I record my teaching so that then once it's done I'll explain everything. You can put it up in drop box and then put a link to it on our class ultranet page and then if they want to they can just go backwards and forwards and listen and find out. So from them on after we've done the teaching and you've got the tasks, whether they be … downloadable sheets or … we've got all our textbooks digitalised so that they can go on and use it.*

However, there had also been some difficulties which some teachers acknowledged. One aspect that concerned one teacher in particular was the way in which the technology seemed to dominate all the learning conversations for teachers, parents and students. This was deemed to be true for all learning areas and not just mathematics.

Wendy: We have a strong directive to have a flipped class approach now with our teaching. I think that there is so much of an emphasis on one to one device use that most of our inquiries or parent feedback at the moment is on that. It has overshadowed everything else.

The use of digital technology was definitely a characteristic in which there were differences in teacher approaches and pedagogies, an aspect which appeared to be highlighted as a result of cross-grouping. At times, behaviour issues had arisen in response to this. It was an area that was constantly being revisited, revised and reviewed.

Wendy: Digital devices can be a huge distraction, and when you own this, there is a sense of entitlement. So probably most of our digital issues have been in cross-group maths where students have been caught, because they are not with the teacher and they might be in a different culture or expectation. I know it might seem a little bit crazy, but they are trying to move us away from having so much conversation, so much discussion, that they are working more self-directed.

Conclusion

This chapter began with a review of the process used to gain the data for my research project. There was clarification of who was involved in this research and the methodology utilised was reviewed briefly

The findings were then presented in themes that had come through from analysis of the transcriptions. Participant voice has been presented to provide authenticity and as evidence. The latter sections looked at other issues that arose from the research but are not directly linked to the actual research question. They are aspects, however, that are likely to impact on the teaching and learning that occurs in schools. In the next chapter these findings are discussed and links to literature are made.

Chapter 5: Discussion of Findings

Introduction

This chapter considers the essential themes that arose in response to my research question "What impact, if any, does cross-grouping in mathematics have on teacher practice?" and draws upon various subjects in relevant literature to explore specific findings. The discussion in this chapter is structured into five main sections reflecting the major thematic groupings that emerged in Chapter Four. These are: the teacher sense of responsibility, teacher expertise and confidence, difficulty in planning (reflecting a linear approach to learning mathematics), the development of a fixed mindset and reporting (including communication and developing relationships). Indications have been provided of the instances where my findings reflected earlier studies in the literature and mention made of where the findings have differed, providing new insights which are likely to add information to the current body of knowledge. My assumption was that the cross-grouping would impact the practice of teaching as inquiry, partially due to the fact that this method does not foster a holistic view of the learner. I also expected that there may be potential problems with the integration of mathematics into other curriculum areas and some challenges in the ability for teachers to be flexible in meeting the needs of their mathematics students.

Two further areas of interest that arose out of the interviews (yet were not directly related to the research question) are mentioned briefly towards the end of this chapter. These are the growth of Modern Learning Environments (MLE's), and the increased utilisation of digital technology in classrooms and the possible issues that some teachers see with this. These two aspects will also be considered briefly in the final chapter when looking at implications and suggestions for further research.

The interpretivist paradigm, with extensive use of interviews, was used to "uncover the lived reality or constructed meanings of the research participants" (Mutch, 2005, p. 43). This approach then drew from narrative inquiry as a means to focus on the stories that teachers told. My research provides a New Zealand-based piece of research which will allow New Zealand teachers to consider the potential impacts of cross-grouping on teacher practice and hopefully encourage teachers to question their beliefs about students' and their learning in mathematics.

Sense of responsibility

This theme of responsibility presented itself in a number of different ways but all the participants were primarily concerned with considering ways to improve the mathematics learning of all their students and maintain student well-being. Teaching to a wide range of mathematical abilities was considered to be a major challenge for most of the teachers in my interview group and cross-grouping was seen as a solution which would support teachers (and students) in this aspect. All of the teachers interviewed were adamant that the practices adopted were for the betterment of the students. In this aspect, all teachers were considering the 'ethic of care' (Anthony & Walshaw, 2007, p. 7) which was seen as a vital component of successful mathematics teaching and learning. However, in all of the interviews conducted, current research was not referred to when discussing the reasons why cross-grouping had been adopted in the schools. This lack of reference to research is an aspect which has been noted in the literature (Hallam & Parsons, 2013). At times the decision-making was based upon previous school experiences and there was mention of academic gains but there did not appear to be consistent comparable data (particularly longitudinal). There was also no mention of data being collected in regards to teacher or student attitudes. In a number of the schools the cross-grouping had been established for some considerable time and was just accepted without question. This has implications for schools considering the ways in which they ensure that teaching as inquiry is a central part of their review process. This unquestioning acceptance of an established school practice (which does not reflect the widely held understandings from current international research findings of cross-grouping or streaming) would suggest that this is an area that needs to be revisited and critiqued.

Some participants had some minor concerns about cross-grouping but there was a general acceptance that this was a practice that worked for everyone and was meeting the needs of teachers and students. This attitude towards cross-grouping supports previous findings such as those of Forgasz (2010) in which most teachers accepted ability grouping in mathematics as a general practice but then sometimes questioned some aspects. In my research, one teacher, Dylan, had been adamantly opposed to cross-grouping prior to the implementation in his school. He had initially written a critique outlining his concerns, but now believed these to be largely unfounded. In fact, he had difficulty remembering what his initial concerns were *"I wrote up a sort of critique of what I thought about it. But then I've gotten over that entirely".* Marks (2012) has noted that when teachers are given sufficient time to reflect on and respond to practices of streaming, they do sometimes start to consider some of the

options available to them. Reed (2008) believes that there needs to be opportunities provided for teachers to be provoked about their beliefs, many of which may be long-held and reflective of their own learning experiences in mathematics. Another aspect that concerned some participants was consistency of practice across classes.

All of the teachers in this research had previously struggled to meet the varied needs of a mixed-ability class in mathematics. They saw that meeting the needs of a mixed-ability class was more problematic in mathematics than in any other curriculum area. Mathematics was the only streamed subject in four of the five schools. This links with current research which shows that mathematics is frequently seen as a linear progression of skills which lends itself to the view of teaching to ability groups (Chen & Goldring, 1994; Linchevski & Kutscher, 1998).This view that mathematics is different to any other curriculum area is an aspect that would benefit from further investigation. It would be useful to know why teachers believe it is so different to anything else and learning about this may unearth information about some intrinsic beliefs that teachers have about mathematics and what success as a mathematician looks like.

One facet that arose from a number of interviews was that having a set time for mathematics ensured that mathematics was actually taught on a regular basis. It was suggested by some of my participants that in the past, mathematics had not been taught regularly and this was one of the major reasons to implement cross-grouping. Ashcraft (2002) refers to mathematics anxiety and believes that this is one reason for teachers avoiding mathematics. As one participant in my research, Karen, pointed out, *"The fact that it commits us to taking maths is really good because there are teachers who do not like teaching maths and in this situation they cannot get away with it"*. This viewpoint was echoed by a number of other teachers who were also concerned about the consistency of time given to mathematics. There is very little research data on the amount of time given to mathematics teaching in schools and this has perhaps been an area that remains 'hidden' as most teachers in schools are not likely to admit that they do not teach mathematics on a consistent basis. Anecdotally, this appears to be an issue in some schools. Perhaps this dislike of mathematics and consequent avoidance is a continuation of general acceptance that anyone who chooses to teach or enjoy mathematics is a little "peculiar" (Gates, 2001, p. 7).

Another feature which was commonly referred to was the use of personnel and resources. Frequently class size numbers were reduced in the classes which were most needy (the

'bottom' classes) and teacher aides were drawn upon to support these classroom teachers. This was seen as a distinct advantage and can be considered a sensible way of using limited resourcing in a school.

Student voice (from the teacher perspective) was referred to at times. Some participants believed the children were more likely to participate when they were with a group of students that they felt they were more akin to in regards to mathematics achievement. This links with some earlier findings that there can be benefits from being grouped with similar students (Kulik & Kulik, 1982).There was an acknowledgement that in previous cases of working with mixed ability groups, there were times when children could 'hide' behind the children who knew the answers and this was no longer the case within the context of cross-grouping; students needed to actively engage with the learning, as they were much more at the same level of learning. This perhaps connects with the idea that to develop a real community of mathematical learners requires careful scaffolding and support to ensure that all members of the community have a valuable part to play (Hunter & Anthony, 2011; Ministry of Education, 2012). Bobis, Mulligan and Lowrie (2013) refer to the fact that developing capabilities to work in any type of collaborative group requires routines to be developed and explicit teaching, practice, feedback and reflection of how to utilise social skills that are specific to this aim. In light of my research, professional development demonstrating the benefits (and possible processes) of collaborative mixed-ability learning in all mathematics classrooms would be beneficial.

Teacher expertise and confidence in teaching mathematics

The second theme that emerged was that of teacher expertise and the findings mirrored the current literature in that many teachers lack confidence in their own mathematics content knowledge (Haylock, 2005). Ofsted (as cited in Askew, Brown, Rhodes, Wiliam, & Johnson, 1997) has reported that primary school teachers' lack of mathematical content knowledge is a concern. Ball, Thames and Phelps (2008) refer to two important aspects of mathematics teaching, which are subject knowledge and pedagogical subject knowledge; they believe that both of these aspects are necessary when endeavouring to teach mathematics successfully. Goulding, Rowland and Barber (2002) have reported that teacher content knowledge has an impact on planning and teaching in numeracy and in their research, they found that there was a link between insecure content knowledge and poor planning and teaching.

When Askew et. al., (1997) interviewed 'effective' numeracy teachers it was found that in regards to content knowledge, it was the ability of teachers to make connections between mathematical concepts that was vital. According to Askew et al. (1997) the teachers who utilised a "transmission" (p. 33) or "discovery" (p. 35) style were not as effective as those who exhibited a "connectionist" (p. 32) approach. The "transmission" (p. 33) style of teaching was very much one of delivering material for students to absorb, whereas the "discovery" (p. 35) style focused on providing activities which would hopefully allow students to discover the meanings for themselves. Both of these teacher styles placed a focus on rote learning and memorisation of knowledge. Alternately, "connectionist" (p. 32) teachers encouraged a range of strategies, discussion amongst students, emphasised the importance of estimation and, where necessary, explicitly taught efficient strategies. "Connectionist" (p. 32) teachers believed that children at all levels of attainment should be challenged. The teachers who utilised a "transmission" (p. 33) or "discovery" (p. 35) approach often did not see the connections between mathematical concepts. This was perceived to be an issue with teacher content knowledge and often resulted in a very fragmented approach to teaching mathematics ideas (Askew et al., 1997).

In my research, I did not look at measuring teacher content knowledge. As noted by Askew et al. (1997) this can be very difficult to measure; Askew and his colleagues were aware that any mention of a test could set off "panic" (p. 55) amongst their teacher participants. However, in my research I found clear evidence in regards to teacher confidence in teaching particular mathematics levels. All of the teachers interviewed were teaching an ability group that they felt comfortable with. Teacher confidence was particularly an issue when working with students who were seen as high achievers in mathematics. This was cited as a reason for teachers being in favour of cross-grouping, as some teachers doubted their own ability to meet the needs of these students. Cross-grouping was also a mechanism which teachers felt allowed parents to feel comfortable that the needs of high-achieving students were being met; it could perhaps be considered that the parents of high achievers were also the most vocal in a school situation. This has potential implications for the equity of all students in that some groups within a school setting may have less opportunity to have their voice heard. Even teachers who were capable mathematicians and were working with the 'top group' (such as Dylan) doubted their own capability to extend and motivate these students. Likewise, some teachers, such as Alice and Cam, did not feel that they were capable of providing the extension work that they felt the 'high' ability children required. At times, they felt they

would have difficulty in being familiar with the curriculum content that was required. Haylock (2005) and Jorgensen and Dole (2011) suggest that many teachers feel they have a limited ability to understand or remember all the content they might require; this perhaps connects with the belief that mathematics is a matter of content delivery rather than fostering understanding of concepts. This links with the earlier point that it would be worthwhile to explore teacher ideas about what successful mathematics learning looks like.

Some of my participants also mentioned the upskilling that they had received which had enabled them to better meet the specific needs of some learners. This was particularly the case in regards to working with children in 'lower' groups; as Anna noted *"I've gone on a few courses in the time that I've been here and I have a background in teaching low ability students"*. This provides a different picture to that seen in some overseas research, which has found that teachers working with the lowest groups were often the least skilled (Boaler, 1997; Clarke & Clarke, 2008).

The teachers in my research had gained confidence in the area they were working in and had become more familiar with that particular level and the content demands that came with it. As Dylan noted:

> *"I am more deeply familiar with this one area where we are working as opposed to several different areas. I think that allows me to develop follow-on activities that are more in-depth than if I had two or more groups that I had to develop different areas".*

Karen also spoke about this:

> *"I think that teacher knowledge and teacher comfort level is really, really important because so many teachers are not confident at teaching maths because they had a raw deal when they were at school. A lot of them dropped it at the end of the fourth form. So they don't have the understanding. I think if you can narrow the focus that they have to work on, they do get that deeper understanding of what they're actually teaching and as a result I think they are better at it".*

These comments suggested that teacher content knowledge was an issue and teacher confidence was linked to this aspect. This feature is an area of concern and one for pre-service providers to consider in their degree courses or as part of the pre-entry requirements to university. There are also clear suggestions that further professional development within schools would be beneficial. As Haylock (2005) points out "A major task for initial and in-

service training is the promotion of positive attitudes towards teaching mathematics in this age range" (p. 10). It has been seen that Numeracy Development Project professional development did initially assist teachers to build confidence in teaching mathematics (Bobis et.al., 2005) but further development in regards to developing successful mixed-ability teaching and learning practices was now required. My research suggests that, as noted in earlier research, developing teacher content knowledge in mathematics remains a challenge in primary schools (Haylock, 2010; Siemon et al., 2011).

Planning and demands of meeting varied student need

The third theme which emerged was the workload required to meet planning demands. This links with the beliefs about what effective mathematics teaching actually looks like. My findings confirm the widely held belief, which has been reported in existing literature, that mathematics is often seen as a linear progression of skills and objectives (Jorgensen & Dole, 2011; Linchevski & Kutscher, 1998). Prior to 1960, mathematics curricula focused on arithmetic and operations (Jorgensen & Dole, 2011). Brown, Askew, Baker, Denvir, and Millett (1998) considered that with the introduction of 'New Mathematics' in the 1970's and 80's, a hierarchical approach to mathematics learning was implemented. This way of learning mathematics, which was not research based, according to Brown et al. (1998), placed an emphasis on drill before application with the result that this was the experience that many teachers in Western societies have then replicated in their own practice.

Many of my participants (who were working in cross-grouped mathematics classes) appeared to believe that mathematics is comprised of a series of linear objectives and that it is necessary that these are learnt in a hierarchical order. This belief has, in many situations, been fostered by the initial Numeracy Development Project guidelines from the Ministry of Education (2004) which suggested that teachers grouped according to strategy stage. However, this direction was later revised to ensure greater flexibility (Ministry of Education, 2008a). In more recent times, mathematics professional development in New Zealand has moved into a new phase whereby mixed-ability problem-solving (incorporating the understanding of numeracy stages) has been promoted (Ministry of Education, 2012). My participants often talked about only having one 'stage' or 'level' in a class but acknowledged that there were still groups within any one group and the learners were not considered 'the same'. This differs somewhat from international findings where streamed classes were often considered to have the same needs (Wiliam & Bartholomew, 2004).

Planning was considered to be an issue in that teachers felt obligated to plan extensively for all learners when they had previously worked with mixed-ability classes and this required detailed planning for each 'level' or 'stage'. This clearly is not sustainable and the expectation that teachers would (or could) do this successfully seems to have (or may have) added to the reasoning behind teachers being in favour of cross-grouping. This links with the need for continued professional development to assist teachers in finding ways that will make mixed-ability teaching manageable and successful. Constructing meaningful communities of mathematical inquiry does not happen by chance and there is a need for collaborative, supportive work in schools to foster these ideas. Hunter and Anthony (2011) discuss the key role that teachers have in structuring classroom mathematical discussions and developing discourse norms which allow students to have multiple opportunities to "explore, clarify and connect with key mathematical ideas" (p. 204). The application of these ideas and practices is likely to be beneficial in all curriculum areas.

It can be considered that there is often a pedagogical shift in focusing on life-long learning and attitude rather than a short term 'fix' to cover a lot of content and gain a great deal of knowledge. Boaler and Staples (2008) reported on the success of a longitudinal research project undertaken in the United States, whereby heterogeneous classes were taught using a reform-oriented approach. The results demonstrated that, over time, students learnt more, demonstrated a greater enjoyment of mathematics and progressed to higher levels of mathematics learning. Boaler (2009) has discussed similar findings from Great Britain, which looked at the long-term results whereby young adults who had experienced mixed-ability mathematics classes were more likely to be in professional jobs. Those who had experienced set mathematics classes saw that their "ambitions were 'broken' at school and their expectations were lowered" (Boaler, 2009, p. 113).

A number of the teachers that I interviewed (particularly in Years 7 and 8) saw the mathematics programme as one which had a huge amount of content and the aim was to cover all the set objectives. There appeared to be a focus on coverage rather than depth. This was concerning to some of my participants but they accepted it as being an unfortunate but necessary evil and an aspect that the students would have to get used to. This contrasts with fostering an "ethic of care" (Anthony & Walshaw, 2009, p. 7) which was discussed earlier, and perhaps reflects some of the challenges that some teachers faced in that they clearly wanted to meet student need but struggled with appropriate ways to do this. At times they

appeared to feel constrained by school processes and assessment schedules which they felt they had no control over. The mathematics learning sessions were in set blocks of time and despite the desire to sometimes extend the learning time, this was generally not possible. There was little integration of mathematics with other subject areas which meant that mathematics was frequently seen as an isolated subject area which did not have much connection with other subjects or the real world. It has been acknowledged that connections with the real world are a vital part of developing meaningful mathematics curriculum which are then likely to encourage students to pursue mathematics to a higher level of education (Anthony & Walshaw, 2007; Jorgensen & Dole, 2011).

For most of the teachers in my research, their practices in a cross-grouping situation were not perceived to be very different from previous practices that had been utilised with a mixed-ability class. Many teachers were still operating a rotation of groups with a mixture of teacher-led sessions, and practice activities with worksheets, textbooks (either paper or online) and online computer games or activities. However, when practices were described, there appeared to be a greater use of knowledge focussed materials or resources with lower achievement groups and rich problem-solving tasks were more likely to be utilised with higher achievement groups. It was seen that acquiring a strong knowledge base was essential before moving to any problem-solving work. This is similar to other findings in this area (Askew, 2012; Boaler et al., 2000; Ireson et al., 2001). 'Top' classes were much more likely to receive problem-based work and rich tasks. This reflects different teacher expectations for various levels and is similar to what has been found in international research (Bartholomew, 2000; Boaler, Wiliam, & Brown, 2000). As Anthony and Walshaw (2009) state "Effective teachers set tasks that require students to make and test conjectures, pose problems, look for patterns, and explore alternative solution paths" (p. 13). Problem-solving is seen to foster engagement and is a beneficial way to promote mathematical learning for all students. One teacher, who was a strong proponent of a problem-solving approach in mathematics learning, believed that she used a similar approach but did not need to differentiate the problems to such an extent as when she worked with a mixed achievement class.

However, teachers have been encouraged (either implicitly or explicitly) to consider that gaining mathematical knowledge is necessary before problem-solving in mathematics. Changing teacher viewpoints (and those of professional leaders) is challenging and yet the

potential is available to make the planning demands much more manageable with mixed-ability mathematics classes.

A fixed mindset versus a growth mindset and movement across groups

The fourth theme that emerged from the teacher narratives looked at the development of a fixed mindset as opposed to a growth mindset. A fixed mindset seems based on the premise that ability is a fixed attribute which is not likely to change (regardless of the input) whereas a growth mindset works on the principle that ability is not a fixed entity and that learning anything involves a process of effort and perseverance (Dweck, 2006). As Boaler (2013) puts it, "When students with a fixed mindset fail or make a mistake they believe that they are just not smart and give up" (p. 143). My findings appear to reflect the current literature in that there is a belief amongst many (teachers, parents and students) that people (adults and children) have a natural ability in mathematics which cannot be altered (Boaler, 2009; Clarke & Clarke, 2008; Dweck, 2006). It can be difficult to shift this belief and the implications for teacher, student and parent expectations seem fixed. These views have implications for those at all 'ability' levels and some of the students who are most impacted by these beliefs are high-achieving girls (Boaler, 1997b; Dweck, 2006, 2012). Such students have often been praised from an early age for being 'clever' or 'smart' and when these students eventually fail at a task, if they have a 'fixed' mindset, they are inclined to believe they are not smart after all. The understandings gained from my research are only implicit as teachers were not asked directly about their perceptions of ability (as a notion of fixed-ability) versus achievement but the use of ability grouping in mathematics does appear to foster more fixed-ability thinking in teachers. Boaler (2013) and (Dweck, 2006, 2012) both believe that the practice of ability grouping communicates fixed-ability thinking. Learning to take a risk in mathematics learning is essential to allow experimentation and positive problem-solving attitudes; this can be difficult to foster in a subject which is so often seen as being one that only has correct or incorrect answers. To do this, students need to feel safe in a classroom environment which will allow them to feel confident in their ability to take "intellectual risks"(Anthony & Walshaw, 2009, p. 7).

Consideration should be given to the idea that learning is a continuum and that given sufficient time and input, everyone can make equivalent progress in both their weakest and strongest areas (Vispoel & Austin, 1995). Clarke, Timperley and Hattie (2003) consider the impacts of linking perceived ability with learning rate; unfortunately, it is often perceived that

if a child or adult learns something quickly then this necessarily indicates that the individual has greater ability. However, experience often shows that in fact some people later excel at a topic in which they initially struggled or progress at different rates in various subject areas. Martin (2003) looks at the influence of motivation amongst students which includes self-confidence, and the ability to overcome challenges or recover from academic setbacks. Dweck (2006) considers it is vital that educationalists endeavour to develop a growth mindset in their pupils, in which effort is valued and acknowledged (rather than a focus on ability). Askew et al. (1997) saw that one of the most important influences on mathematics learning was the extent of teacher belief that all students could learn mathematics. This was seen as a key component that was common to "connectionist" (Askew et al., 1997, p. 32) teachers, who were seen as the most effective numeracy teachers (referred to in an earlier section).

There was some suggestion in my findings that the majority of the teachers in this sample set perceived that their students in any given 'ability' group were likely to have a set ability level. There appears to be evidence of fixed ability thinking in teachers and students. For example, Karen noted that with her 'top class' they were expected to know things and were therefore definitely able to tackle challenging tasks. Cam pointed out that her class knew they were the bottom group and even when two children were going to be moved out to the 'top class' they felt they would not be able to cope and needed a great deal of encouragement to believe in themselves. Their placement had impacted upon the students' self-belief and they saw themselves as part of the 'bottom' group.

Clarke, Timperley and Hattie (2003) have referred to a pattern which can develop of learned helplessness when students believe that there is actually nothing they can do to change the situation they find themselves in. Askew et al. (1997) considered that the teachers who focused on a "transmission" (p. 33) style of teaching and felt that they needed to break down every aspect of the learning fostered a sense of teacher dependency. This is perhaps much more likely when there is a whole class of 'low' achievers working together. This could then become a self-perpetuating issue with students accepting the limits placed upon their own abilities.

The teachers interviewed agreed that although there was allowance for movement, in reality this did not happen frequently, except for a few students who really stood out. One teacher noted that there was change when the children were regrouped according to strand testing but this only occurred once a term. It suggests that in this school there was no opportunity to

respond to varying rates of development or varying needs as they arose and also suggested to the students that there was little possibility of moving from the group they had been placed in. This also links with current research that has found that there is little movement between ability groups (Clarke & Clarke, 2008; Davies et al., 2003; Gates, 2001). MacIntyre and Ireson (2002) found that in any mathematics ability group there was a high likelihood of misplacement. Student self-concept was impacted by the manner of the group that they were situated in and students have been seen to meet the expectations of the group that they have been positioned in (MacIntyre & Ireson, 2002). Research from overseas supports the view that teachers have demonstrated that they have different expectations of different ability groups (Bartholomew, 2000; Clarke & Clarke, 2008; Marks, 2012; Ruthven, 1987) .The fact that there was limited movement has implications for teaching as inquiry which promotes the belief that teachers should be constantly re-evaluating what their students need and then adapting teaching practice (including grouping processes) to meet that need.

Developing relationships, reporting and communication

My fifth theme concerned developing relationships, reporting and communication. On the whole, most of the teachers in my research saw cross-grouping as a positive practice in building relationships with children other than those in their home-room. They saw the benefits of having opportunities to work with children they would not normally associate with. There had been occasions when there had been teacher-student clashes but these had been resolved or, on one occasion, when there was a total difference in teacher philosophy, that cross-grouping experience had been abandoned. Clearly, for this teacher participant, positive relationships with the other teachers involved were essential. There were quite different ways of arranging the cross-grouping situation in each of the schools, ranging from grouping across two classes to across eight classes.

Learning to take a risk in mathematics classes is essential to allow experimentation and positive problem-solving attitudes; but this can be difficult to foster in a subject which is so often seen as being one that only has correct or incorrect answers. Siemon et al. (2011) mention that "(positive mathematics) environments are characterised by trust, engagement, and collaboration, and maximise the opportunities of all students" (p. 63). This was acknowledged by some of my participants who mentioned that this was an essential aspect of their personal philosophy. At times some participants were concerned that this could perhaps be an issue when students moved classes for mathematics. Wendy had noted some potential

issues with this aspect "*they haven't got a relationship of trust where possibly they can feel safe to take risks, if they don't feel confident to put their hand up".*

It was seen by a number of my participants that developing relationships with parents/whanau was the most problematic part of the programme, as it was often difficult to build connections with parents/whanau who were not associated with their home-room class. This was progressively more difficult with older children as parents and caregivers are less involved than in the early years (Hornby, 2011; Porter, 2008). Busy classrooms, teachers, schools and parents meant that limited time was available to foster these important communication channels. A number of teachers felt that parent and whanau communication was an aspect that would benefit from further refining as they believed that there were problems in the current systems. It has been acknowledged that parental or whanau involvement in student progress has a crucial role to play in promoting positive outcomes for all students (Bull, Brooking, & Campbell, 2008) Information from parents as to how they viewed this aspect was beyond the scope of this research but would be worth investigating further.

The actual writing of reports did not appear to be a problem, largely due to the computerised nature of the report comments which meant the time taken to complete these was not onerous. It was noted that during parent-teacher interviews, most teachers did not usually see the parents/caregivers of their mathematics students (unless they were in their home-room class) which suggested that this is certainly an area that could be considered a weakness.

Many of the teachers I interviewed believed that collaboration across teams was enhanced by the nature of working collectively as a team. Karen believed that the cross-grouping practices had supported collaborative practice: *"Because we do have to communicate about our kids and we have target groups within the team. We actually meet and report on our target children at least twice a term as part of our team meetings".* My findings appeared to suggest that cross-grouping could be seen as a positive way for teachers to take collective responsibility for the learners in a group; however, this varied and was dependent on school and teacher situations. Hattie (2012) believes that it is what happens with individual teachers that makes a difference to learning and where there is a very collaborative team working together cross-grouping could have positive impacts upon student achievement. This notion also links with the notion of fostering teaching as inquiry (Ministry of Education, 2007) in our schools, whereby teachers work individually and collaboratively to see what is working for individual children and groups of children.

The findings echoed, to some extent, those of the ERO report (Education Review Office, 2011) which identified a need for the Ministry of Education to further support school leaders and teachers to undertake "robust and effective teaching as inquiry practice" (Education Review Office, 2011, p. 39). In this 2011 report, ERO recommended that school leaders and teachers build deeper understandings of the process of teaching as inquiry through relevant contexts and that this aspect should be utilised to create opportunities for professional development (Education Review Office, 2011).My research supports ERO's finding as it suggests that there is still a considerable number of teachers (and potentially school leaders) in New Zealand who are unfamiliar with the teaching as inquiry process. As noted by Timperley, Wilson, Barrar, and Fung (2007) it is vital for site-based leaders to help teachers translate new understandings into practice and sustain the professional inquiry process.

My question which was directed towards teacher understanding of teaching as inquiry and the impact of cross-grouping on teacher practice was somewhat problematic. For those teachers who were not familiar with the teaching as inquiry process, it was impossible to reflect on whether cross-grouping impacted upon their practice in this regards. Two teachers who were aware of the purpose of fostering teaching as inquiry had a 'bottom' group. Both of these teachers felt that working with 'low' achievers assisted their teaching as inquiry process, as they were constantly challenged to find new ways of meeting their students' needs. Another teacher (who had a top group) believed that in some ways, taking this extension group inhibited his development of teaching as inquiry; all the activities appeared to be successful and the only way that teaching as inquiry was fostered was in the sense of being able to now specialise in teaching extension mathematics.

One teacher, (Anna), who had a confident grasp of teaching as inquiry, recognised the need to inquire into her own mathematics practice after looking at student data and needs. She then realised that the solution involved much more than just focussing on a mathematics learning problem. This experience appears to model teaching as inquiry as it was intended in the New Zealand curriculum (Ministry of Education, 2007). ERO (2011) highlighted the actions of schools which were highly informative and supportive in regards to teaching as inquiry (this was in 26% of schools) and their findings demonstrated that there was a focus in these schools of collaborative work with the inquiry happening in multiple and concurrent ways. Anna had noted *"We are pretty collaborative across the team, it's almost like moderating in-between the teachers as well".* This aspect of collaboration is noted by Cochran-Smith and

Lytle, (2009) who consider that a collective approach to inquiry can be the most productive and can genuinely result in benefits for all.

However, some of the teachers I interviewed (who had the viewpoint that teaching as inquiry was student-led inquiry) were enacting teaching as inquiry processes. They discussed their reflective practices and from the evidence they provided, had clearly inquired into their own teaching actions. Many of these teachers had looked at various ways to impact upon the learning for their mathematics students. One of these teachers had elected to teach a totally different ability group as she *"decided it was time to change and I suppose adapt my teaching and learning to see how I could work differently"* (Wendy). Aitken (n.d.) defined two phases of teaching as inquiry, with the first looking at the impact of teacher actions on student outcomes. This was reliant on teachers collecting relevant data and exploring the reality of the learning for the students in the classroom. Secondly, steps are then taken by the teacher (or teachers), based on research and experience, to implement actions that will effect change. On a micro level, many of my participants were involved in a teaching as inquiry processes but at times on a macro level, there appears to have been limited discussion about whether the cross-grouping practice was beneficial for all learners. For those teachers who were working more in team-teaching situations, there seemed to be greater flexibility and perhaps more student movement responding to learning needs as they arose.

There appeared to be little integration across other curriculum areas and mathematics seemed to be seen as an isolated subject area, and this had impacts for teaching as inquiry, which would suggest that teachers and students would benefit from the capacity to make links between curriculum areas and connect with areas of student interest as they arise. This was noted by some individuals as an aspect that they tried to foster with their homeroom class but there was little promotion of the interconnectedness that exists between many curriculum areas. This perhaps also links with perceptions that school mathematics and mathematics in the real world are two unrelated areas and as noted by Jorgensen and Dole (2011) it is important for schools to foster the belief that learning mathematics is relevant to real life.

Modern Learning Environments (MLE's)

Modern Learning Environments (MLE's) are becoming increasingly promoted as a way forward in New Zealand education (Ministry of Education, 2014). Designers claim significant benefits for student learning (Uline & Tanner, 2009). The current focus of the New Zealand Ministry of Education is to provide "new modern learning environments that

benefit from new teaching methods" (Ministry of Education, 2014). There was considerable mention made of this approach by some of my participants and they held varying views. Some teachers who were interviewd were concerned that at times practices and some resourcing (such as furniture) had been adopted without due consideration of research findings. Other teachers felt that there were some real benefits to working in their new environments and they were able to work more collaboratively as a result. This appears to be an aspect of education in New Zealand that will clearly be the focus of much discussion in the next few years and will generate additional research into the benefits and disadvantages for teachers and students. MLE's were an aspect that at times appeared to dominate the teaching and learning discussions in the schools.

Digital technology

This theme focuses on changes that are occurring in schools in regards to the adoption of digital technology. As this is a recent, constantly changing phenomenon, new research has been emerging all the time. In my research, some teachers found the technology had resulted in many benefits. For example, Anna utilised many varying aspects such as You tube clips, videos and appropriate apps for use with digital devices such as IPAD's. Winnie had utilised opportunities to record her teaching sessions which allowed the children to access these multiple times and also utilised Khan Academy and other websites.

However, there were some issues which arose in response to the use of technology. One participant, Wendy, was concerned that there was less discussion and *'making sense'* of concepts. As noted in the literature, teachers who encourage students to discuss and make sense of their thinking are likely to have greater achievement effects (Anthony &Walshaw, 2007; Askew et al., 1997). It has been found that if discussion and sense-making is encouraged in the early years and fostered throughout, then the ability to make connections across mathematical areas of work is enhanced.

Some participants in my group felt that pressure had been applied throughout the school to ensure that much of the work students undertook was online and total student independence was being encouraged to make sense of online texts. This was not seen as a productive way of working for all learners. There were some additional concerns in regards to the physical issues (such as posture, lack of physical activity and radiation) and at times it was believed that the drive to implement digital learning had overtaken all the learning conversations within the school environment. The discussion about cross-grouping in mathematics was

overridden by concerns that focussed on the use of digital technology. This finding suggests that perhaps further concentration on teaching as inquiry would be beneficial to allow school leaders and staff to question what is really important for students and what impacts various policies are having upon the key focus of teaching and learning.

Conclusion

In this chapter I have looked at the main themes that came out of my research and made reference to the current literature on these themes. The main reason that schools and teachers opt to teach cross-grouped classes in mathematics is due to the sense of responsibility teachers feel towards meeting student need and the difficulty of meeting the range of mathematical ability in any one class. This parallels many international studies such as those by Boaler and Staples (2008), Boaler et al. (2000), Boaler (2009) and Davies et al. (2003) and is seen as a more challenging task in mathematics than in literacy or other curriculum areas. Generally, the decision to cross-group is not research based but schools consider that ability grouping across classes will be a suitable method to best meet the learning needs of students. No comparable data appears to have been collated. Schools may find it useful to have one class undertake the practice of developing a community of mathematical inquiry (utilising mixed-ability groupings) in order to gain data, as teachers (and school leaders) are likely to need evidence another way may be beneficial. In addition, professional development is likely to be required to provide support or scaffolding for teachers to see potential benefits of changing their approach to teaching and learning mathematics.

Teachers perceive there are a number of advantages with cross-grouping: mathematics is taught every day, resources (including staffing) are used appropriately and teachers gain greater confidence in teaching a particular level of mathematics. Some teachers also found that cross-grouping improved their collaborative practices and this can be seen as a positive outcome, with teachers taking collective responsibility for the learners in any group. We also need to consider the viewpoints of Hattie (2002, 2012) who has noted that various composition components affect only the probability that teaching practices vary and that these influences are indirect; it is the individual teacher practice within each class that matters.

However, my research and other existing literature suggest that ability grouping (particularly across classes) supports the view that mathematics is a linear progression of steps in which children at the lower end should be subjected to a largely skills based programme (Boaler et

al., 2000; Davies et al., 2003; Hoffer, 1992) whereas those students in the upper groups will benefit from more problem-solving activities. In addition to this, ability grouping practices contribute to the development of a fixed mindset (Boaler, 2013; Dweck, 2006) for teachers, students and parents.

The impact of cross-grouping on teaching as inquiry was difficult to assess as teacher understanding of teaching as inquiry was not consistent across all the participants. This finding suggests that further professional development is required by school leaders to ensure that a full understanding of the intent of teaching as inquiry (as noted in the New Zealand curriculum) (Ministry of Education, 2007) is embedded in all schools. An aspect of this that would be beneficial for school leaders and staff members is to question whether the perceived benefits of cross-grouping are perhaps outweighed by the disadvantages (as reported by current research). From the small number of participants who were fully aware of teaching as inquiry, there was a suggestion that the teachers who had 'low' ability groups had developed strong teaching as inquiry profiles as these teachers were constantly forced to reassess their own practices to meet the needs of their students.

My initial premise (which still holds) was that within-class grouping in mathematics (utilising mixed-ability grouping as well as targeted homogeneous grouping) is a more positive practice than cross-grouping as it allows for flexibility and adaptability within classroom practice. This is supported by Kutnick, Sebba, Blatchford, Galton and Thorp (2005) and Lou, Abrami, Spence, Poulsen, Chambers and d'Apollonia (1996). Within any classroom organisation however, it is vital to promote mixed-ability group work, utilising problem-solving and positive discourse practices, rather than focusing on staged ability groups. Additionally, the challenge for school leaders is to ensure that classroom practice is consistently strong as it is individual teacher practice that makes a difference, an aspect clearly acknowledged by Black and Wiliam (1998) and Hattie (2012).

Chapter 6: Conclusion

Introduction

In this research, I investigated teachers' perception of changes in practice when teaching mathematics in cross-grouped primary school classrooms (known as tracked, streamed or setted groupings in other countries). This information was utilised to develop a picture of teachers and schools rationale for cross-grouping being adopted and maintained. Information was gathered in regards to teacher beliefs relating to the perceived advantages and disadvantages of cross-grouping for teachers and students. I also considered the impact that cross-grouping had upon teachers when endeavouring to foster a teaching as inquiry cycle within their classrooms and schools (Ministry of Education, 2007). The intention was to give voice to teacher beliefs and also to investigate whether these beliefs support the current literature in regards to cross-grouping in mathematics. The current international literature suggests that ability grouping is not a positive practice in regards to achievement or developing student self-efficacy (Boaler, 2000, 2009; Slavin, 1995). However, there has been little research or evidence collated in New Zealand in regards to this issue.

This chapter summarises the conclusions of the research and offers recommendations for utilisation and further study.

Conclusion - Cross-grouping

The findings of this research show that all the teachers interviewed were largely in favour of cross-grouping in mathematics. This is an identical pattern to international study findings by Clarke and Clarke (2008), Forgasz (2010) and Reed (2008). However there were moments where teachers indicated disfavour e.g. limited opportunities to integrate other curriculum areas, difficulty in monitoring home-room achievement and issues with fostering parent and whanau communication. Every teacher felt a strong sense of responsibility for all their students (both in their mathematics classes and their home-room classes) and this was the main rationale behind their positive approach to cross-grouping. When comparing current teaching to their previous experiences of teaching mixed-ability classes, teachers acknowledged that they had previously found it challenging to meet the varied needs of a mixed-ability class. This is widely recognised in the literature (Avramidis & Norwich, 2002). This challenge was perceived to be greater in numeracy than in literacy or any other

curriculum area but this comparison with other curriculum areas was not within the scope of this study. This would be a useful aspect to consider in further research.

The teachers interviewed appeared to often see mathematics as a linear progression of skills, and discussed the learning and progress in terms of curriculum levels or numeracy stages. This view of mathematics as a linear progression has commonalities with international findings (Linchevski & Kutscher, 1998). This belief fosters the idea that that skills and knowledge are necessary acquisitions before students can be challenged with rich tasks or activities that promote challenge and thinking. This understanding may replicate the experiences that many teachers were likely to have been exposed to in their own schooling and may be reflective of most teachers. In a small number of cases in this research, cross-grouping was an embedded practice within a school and there was little critique or analysis of the reasons behind adopting this process. Management supported (and at times directed) that this was a necessary approach. The main reasoning behind the support and promotion by leaders within schools was to meet the varied learning needs of students. However, the decision to adopt cross-grouping was not generally based upon research findings. There were comments that achievement improved but little comparable data had been collected. As pointed out by Hattie (2012) all interventions are likely to have an impact on achievement, but it is important to be mindful of the measure of the effect size.

Another aspect that was noted by the majority of the teachers interviewed was that cross-grouping was a mechanism which ensured that mathematics was actually taught on a regular basis, which suggested that when teachers had taught their own classes, mathematics was often a neglected area of teaching. This was an aspect that I have heard discussed and reported anecdotally but it has been difficult to collect actual evidence of this, due to ethical reasons. The teacher comments in my research perhaps support the idea that this was a concern across schools and it may be worth investigating why teachers avoid teaching mathematics.

At times, some teachers believed that mixed-ability classes were more favourable in mathematics for younger students or for students that were in lower decile areas. The reasoning for these viewpoints was connected with the establishment of relationships and the ability to know the learners. There was also some mention of times when cross-grouping had been abandoned due to difficulties with timing, conflicting teacher practices and on one occasion, student dissatisfaction.

The weakest aspect of the cross-grouping practice was perceived to be issues in regards to communication and fostering relationships with parents and students. It was recognised that at times it was difficult to build a relationship with the parents of the children in the mathematics group (if they weren't in the home-room class as well). As one teacher acknowledged, some parents would not even know that their children went to another teacher for mathematics. My recommendation in regards to this critique (which is linked to relationships and communication) would be to encourage schools and teachers to question the impact of cross-grouping on their students and the relationships that are promoted in the classroom. Additionally it would be beneficial to consider and explore the impact that cross-grouping may have on fostering parental and family relationships, which are acknowledged as a key component of developing effective teaching in mathematics (Anthony & Walshaw, 2007).

Teaching as inquiry was understood to be student led inquiry learning in many cases. The understanding of the meaning of teaching as inquiry was clearly linked to the school which each teacher was based in. It has been recognised that developing a full understanding of teaching as inquiry is an area that needs further exploration and support in many New Zealand schools (Education Review Office, 2011). My research suggests that since these findings in 2011, teacher understanding of this concept has not necessarily improved in many schools. It would be a useful teaching as inquiry process (which could be undertaken on a macro level) for the schools which have utilised cross-grouping for many years, to question and inquire into this practice and consider whether current practices are based on research and evidence.

Recommendations

My aim with this research was to investigate teacher beliefs in regards to cross-grouping, a feature of mathematics practice which appears to have become more common in New Zealand primary schools in recent years. Despite overseas research which suggests unequivocally that this manner of grouping students does not lead to improved student achievement or self-efficacy, ability grouping has increasingly been promoted by government directives in a number of countries (particularly Britain). In New Zealand, cross-grouping for mathematics in primary schools is not specifically promoted or directed. However, as per the New Zealand curriculum (Ministry of Education, 2007) schools are self-directed and are able to select the approach that they believe best meets their learners' needs. A number of schools

are choosing to utilise ability grouping across classes (especially in mathematics) for teaching purposes. All of the teachers interviewed felt a huge sense of responsibility to their students and we need to look at why teachers find it so difficult to meet the needs of a mixed-ability class for mathematics. This is more apparent in this particular curriculum area than any other. In some countries, such as Finland, ability grouping is banned (Wilby, 2013) and the achievement and educational opportunities are considered to be outstanding in educational terms.

In New Zealand, the strong directive from the Numeracy Development Project that "teachers should group according to strategy stage" (Ministry of Education, 2005, p. 13) has often been interpreted to mean that by extending this across classes there will be an even greater benefit. This initial ability grouping suggestion has since been reviewed but the message that was conveyed appears to be embedded in many schools. This process has often become an inflexible classification process which has linked to the understanding that mathematics should be seen as a linear sequence of objectives and understandings. Support needs to be provided for schools and teachers to find other ways which will make it possible to teach mathematics successfully, considering and valuing the varied needs within any one classroom. The increased pressure to meet standards and achieve short term goals has potentially exacerbated this situation (Snook & O'Neill, 2010). Teachers appear to see that it is possible to cover more material when working with an ability grouped class, but this sometimes brings into question whether coverage is being valued over understanding. There are also queries about the attitudes that are developed and whether life-long learning is being promoted. Boaler & Staples (2008) reported on the results of a longitudinal study whereby a reform-oriented approach with mixed ability practices and successful group work resulted in greater long-term interest and success in mathematics.

Teacher confidence is also an issue which has two aspects; confidence in the area of content knowledge and confidence to meet students' needs. At times there still seems to be a lack of self-belief in teachers own personal mathematics content knowledge. This connects with the findings from Haylock (2010) in which it was seen that many prospective teachers lacked confidence in their ability to teach mathematics well. The placement of all students into streamed mathematics classes suggests that there is an acceptance that we need to scaffold all the steps for learners in their mathematics learning and simplify the tasks that they will be

faced with. However, it is recognised internationally that providing struggle and challenge is a positive aspect which should be valued in the mathematics classroom (Askew, 2012).

On the basis of this small piece of research, it can be seen that there are still misconceptions in some schools (and with some teachers) in regards to teacher understanding of teaching as inquiry. This indicates there is still a need for further professional development in this area. All of these teachers were experienced practitioners who had been teaching for some years and therefore there may be a different picture if there was a wider range of teachers interviewed. It may be found that more recent graduates have a firmer understanding of the teaching as inquiry concept.

My recommendation would be to encourage schools and teachers to question the impact of cross-grouping, in regards to achievement and attitudes. There are many accessible pieces of international research which may help teachers and school leaders to question and reassess some embedded practices. It would be beneficial to consider and explore the impact that cross-grouping may have on parent/whanau relationships, which are acknowledged as a key component of developing effective teaching in mathematics (Anthony & Walshaw, 2007). It may be beneficial to trial alternative measures to cross-grouping in mathematics (supported by professional development if necessary) and collate data in regards to both achievement and attitudes.

I suggest that schools should work towards ensuring accountability in the mathematics learning area through fostering positive mathematics practices, encouraging a total community of learning whereby mathematics is a focus and supporting teachers who need additional support in this area. It may also be useful to adopt a process such as the Japanese lesson study model, whereby teacher practice is deprivatised and planning is much more co-operative (Fernandez, 2004).

Limitations of the research

There were some limitations to this research. As this is a very small piece of research with only eight participants, it can be difficult to generalise from these findings. Additionally, this research was based on teacher interviews regarding teacher self-perception and reports of their own practice. There was no data collected from observations of practice in any of the classrooms. Additionally, much of the work collected overseas has looked at student rather than teacher perceptions and impacts on student self-efficacy (Attard, 2012; Boaler, 1997a,

2000; Marks, 2012). This was an aspect that was not considered in this research and may provide additional insights as the value of considering student voice has been increasingly recognised (Robinson, 2011). Parent perception was another characteristic that was not reflected on in this research; any information that was gathered was second-hand and heard through the teacher voice. In this respect it was seen that most parents appeared to trust the school (and teachers, as the experts) to make valid decisions in regards to their children's schooling. Schools (and teachers) may have introduced cross-grouping to assuage parent concerns about high achieving students not being extended; this was an aspect that concerned many of the teachers who were interviewed and this could provide further interesting insights.

Another facet that was not considered in this research is the demographic details of the students in the various ability groups. This information would have provided rich information in regards to ethnicity, gender and possibly socio economic status, which has been widely referred to international research such as that reported on by Boaler and Staples (2008); Oakes (1990); and Wiliam and Bartholomew (2004). On investigation, this may have revealed additional insights as to whether cross-grouping perpetuates fixed mindset views and reinforces possible teacher preconceived views and beliefs about students and learning. Collection of this data would have provided a much broader picture of the students in the various ability groups but was beyond the scope of the research.

This research was also positioned in high decile, large, urban schools. It would be interesting to contrast a range of schools and consider the perceptions of teachers in mid to low decile schools.

Suggestions for further investigation

As noted above in the limitations, it would be useful to observe teacher practice in classrooms to gather data about the actual practices that are exhibited on an everyday basis. This could then be matched with perceived teacher practice and beliefs and see the connections between the beliefs and the everyday reality. It would also be beneficial to investigate why teachers believe that mathematics is the one area in which ability grouping across classes is most beneficial.

While this study serves to initiate the discussion of cross-grouping from the teachers' perspective, future studies may enhance our understandings through greater use of

quantitative data in regards to the composition of ability groups. Gathering of this additional information may have far-reaching implications for promoting possible positive practices which are likely to benefit priority learners as identified by the Ministry of Education (Education Review Office, 2012).

Modern Learning Environments (MLE's) are being heavily promoted by the Ministry of Education in New Zealand (Ministry of Education, 2014). In this research, a number of the teachers who were working in this type of environment believed there was greater grouping fluidity amongst their students. Additionally, there were greater opportunities to share thinking and strategies across achievement level groups. This was seen as a distinct advantage over the practice of cross-grouping into single cell classrooms. As the research into Modern Learning Environments is just beginning, it will be interesting to see the results of perceived (or actual) benefits for teaching and learning. Currently much of the research around Modern Learning Environments is concerned with design concerns and the link with flexibility for grouping and teaching options would be worth investigating in future studies.

Initially I had questioned whether grouping within a class was any different to cross-grouping but I believe that in-class grouping provides greater flexibility and allows for more varied teaching and learning opportunities. In-class grouping arrangements can allow for more targeted support which can be differentiated and varied as well as the opportunity for developing a collaborative mixed-ability approach (Good, 2000; Lou et al., 1996). However, the quality of the class instruction is vitally important (Hattie, 2002) and as noted by Marks (2012) ensuring teachers work with mixed-ability classes does not necessarily provide collaborative mixed-ability approaches, equity of opportunity or encourage growth mindsets for teachers and students.

Concluding notes

This chapter has provided conclusions to my research project showing that cross-grouping in mathematics classrooms is perceived by most teachers to be beneficial for teachers and students. All of the teachers interviewed were passionate about the teaching and learning of mathematics and were concerned about their ability to meet student needs. However, through some of the teacher responses, it was seen that some of the issues that have been noted in international research also emerge in the New Zealand setting. It was seen that the decisions to adopt cross-grouping for mathematics have not been based on research evidence.

It has been an on-going debate for many years about the various methods or programmes which should be utilised to improve the teaching of mathematics in schools. This debate has included discussions about achievement and attitudes. Comparisons are constantly provided with other countries in the OECD and PISA results are scrutinised carefully. The measurement of achievement in children is increasingly able to be analysed and there have been some improvements in the ways in which we teach mathematics. There is often much more enjoyment of mathematics in primary school classrooms today than in the past which has some impact on the self-efficacy of students (Dowker, Bennett, & Smith, 2012).

Hattie (2002) questions whether class composition actually makes a difference and refers instead to the quality of the teaching practice within any classroom. However, in Hattie's meta-analysis (Hattie, 2012) it is noted that streaming actually has a minimal effect and therefore does not appear to be a practice that should necessarily be promoted. When other considerations, such as possible issues with student self-efficacy, equity issues and the development of a fixed mindset are included, this adds concerns about cross-grouping that schools should consider.

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Appendix A

Participant Information Sheet

16 February, 2014

Project Title

The impact of mathematics cross-grouping on 'teaching as inquiry' in New Zealand primary schools

An Invitation

My name is Rose Golds and I am a lecturer at AUT University, on the Bachelor of Education programme. I teach mainly on papers that are concerned with mathematics education in New Zealand primary schools. As part of my Master's qualification, I am conducting research into the experiences of primary school teachers who are working in cross-grouped classes for mathematics. I am keen to hear your viewpoints and invite you to participate in my study. Your participation is voluntary and you may withdraw at any time prior to completion of data collection. Your choice to participate, or not, will neither advantage you nor disadvantage you in any way.

What is the purpose of this research?

This study aims to explore the impacts that cross-grouping in primary school mathematics has on teacher practice, particularly in regards to 'teaching as inquiry'. Cross-grouping appears to be an increasing trend in New Zealand primary schools and there is little, if any, New Zealand-based research looking at this phenomenon. This piece of research will result in the completion of a thesis, which will allow me to complete my Master's of Education qualification. It is anticipated that this research will be drawn upon to write research-based articles which will help inform teachers, principals and other interested parties about the findings of this research. I am keen to ensure that these articles will be written in a way which is accessible to teaching practitioners.

How was I identified and why am I being invited to participate in this research?

You have been recommended for participation in this study by a mathematics lead teacher in Auckland, who belongs to a Mathematics Leadership Community (MLC), which meet regularly, four times a year and are co-ordinated by Te Toi Tupu facilitators working for Cognition Education. You have been considered for the purpose of this study because you have had at least three years' teaching in New Zealand schools and you are currently working in a class that has been cross-grouped for mathematics. I would appreciate further participant recommendations.

What will happen in this research?

You have been recommended as a potential participant. However, you have the choice to participate or not. If you do consent to participate you will be interviewed by me at a time and place that is convenient to you. At the start of the interview you will be requested to provide a pseudonym to be addressed by during the interview and in written publications. The interview is expected to take no more than two hours and is in the form of a semi-structured interview. A digital audio recorder will be

used to record the interview that will be transcribed. Upon completion of the transcription, an electronic copy will be sent to you for verification. At this point you may choose to exclude information that you would not want to be published. Once the transcriptions have been confirmed by the participants, analysis of the data will commence.

What are the discomforts and risks?

The only anticipated risks or discomforts may arise through the identification of the participants and the way in which this will be alleviated or minimised will be explained below.

How will these discomforts and risks be alleviated?

To ensure anonymity, your name, your school and specific incidents that may be directly linked back to you or your school will not be used in any publications that arise from this study. A pseudonym is to be used during the interview and in the study reports that arise.

What are the benefits?

Your experiences in the school context will provide an understanding of the experiences and beliefs of teachers working in New Zealand primary schools where cross-grouping in mathematics is practiced. My intention is to publish articles from this study, so there is a potential for your experiences and beliefs to reach out to other New Zealand teachers, leaders, teacher educators and those who are working in professional development. Additionally, you personally may find that reflecting upon your own practices within your present context may be professionally beneficial. This research will provide the data for the primary researcher to complete her Master's thesis and the findings will be presented at MERGA (Mathematics Education Research Group of Australasia).

How will my privacy be protected?

As mentioned above, your contribution will be identified by a pseudonym, so your name will not appear on any report that arises from this study. Furthermore, once the transcription is completed you will receive an electronic copy of your interview transcript for verification. At this time you may delete any information that you believe to be unsuitable for inclusion in reports. All data will also be held in a secure place and then destroyed.

What are the costs of participating in this research?

The time required for your participation will be approximately two hours. The interview is scheduled for one hour approximately. Your review of the interview transcript is anticipated to take another hour. Furthermore, you will be reimbursed for travelling expenses with a $20 petrol voucher.

What opportunity do I have to consider this invitation?

Your decision to participate is voluntary. You may contact the research supervisor if you have queries about participation. Kindly confirm your decision to participate by 15th March, 2014.

How do I agree to participate in this research?

If you agree to participate in this research then you would need to complete the enclosed consent form and mail this to me in the prepaid envelope provided.

Will I receive feedback on the results of this research?

An electronic written summary of the findings will be sent to you.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Dr Jyoti Jhagroo, jyoti.jhagroo@aut.ac.nz, phone 921 9999 ext. 7913 or Mentor Associate Professor Andy Begg abegg@aut.ac.nz, 921 9999 ext. 7355

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext 6038.

Whom do I contact for further information about this research?

Contact Details:

Researcher: Rosemary Golds rosemary.golds@aut.ac.nz 09 921 9999 ext. 7940

Approved by the Auckland University of Technology Ethics Committee on December 9th, 2013

AUTEC Reference number 13/368.

Appendix B

Consent Form

For use when interviews are involved.

Project title: ***The impact of mathematics cross-grouping on 'Teaching as Inquiry' in primary mathematics classroom***

Project Supervisor: ***Jyoti Jhagroo***

Researcher: ***Rosemary Golds***

- ○ I have read and understood the information provided about this research project in the Information Sheet dated 16 February, 2014.
- ○ I have had an opportunity to ask questions and to have them answered.
- ○ I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed.
- ○ I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ○ If I withdraw, I understand that all relevant information including tapes and transcripts, or parts thereof, will be destroyed.
- ○ I agree to take part in this research.
- ○ I wish to receive a copy of the report from the research (please tick one):
  Yes ○ No ○

Participant's signature: .....……

Participant's name: .....……

Participant's Contact Details (if appropriate):

……..

……..

……..

……..

Date:

Approved by the Auckland University of Technology Ethics Committee on December 9th, 2013, AUTEC Reference number 13/368

Note: The Participant should retain a copy of this form

Appendix C

Indicative interview schedule

Pseudonym: _____

Baseline (demographic) data:

What is your age?

20-29	30-39	40-49	50-59	Over 60

Years of teaching (in NZ) _____

Year level/s taught _____

'Ability' group taught - top, middle, bottom

1. Background to the practice in your school.
    a. Why was this decision made in the school and who made this policy decision?
    b. Why are you teaching the group that you are working with?
    c. How are the decisions made about grouping the students and does change occur throughout the year?

    (Prompts: assessment, flexibility, leadership, choice, confidence)

2. Teaching activities used.

    a. What types of tasks do you mainly use in your teaching?
    b. Is this influenced by the group that you work with?
    (Prompts: knowledge activities, strategy, problem-solving, short or long time-span allowed, discussion)

3. Advantages and disadvantages for students
    a. Do you believe this type of organisation is beneficial to students?
    b. Why or why not?
    (Prompts: equity, attitude, achievement, student self-efficacy)

4. Advantages and disadvantages for teachers
   a. Do you believe this type of organisation is beneficial to teachers?
   b. Why or why not?

   (Prompts: integration, reporting, student/teacher relationships)

5. What do you perceive ‘teaching as inquiry’ to mean?

6. Have you had any feedback/comments/queries from parents about this practice?

7. Is there anything else you would like to mention about your experiences working in a cross-grouping situation for mathematics?