How are teachers in intermediate schools catering for the diverse learning needs of their students in Mathematics?

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Abstract

Increasingly teachers are finding that students within their classes represent a diverse range of abilities, experiences and backgrounds (Parsons et al., 2018; Tomlinson et al., 2003) Students in mathematics classes across New Zealand display diverse learning needs, and come to school with a vast range of prior knowledge, experiences, skills and understanding requiring teachers to find ways to cater for such differences within their programme. The Ministry of Education (2016) recognises the increasingly diverse population of New Zealand and calls for teachers to ensure that every child is provided with opportunities for educational success regardless of ethnic, cultural or economic background.

Within New Zealand, intermediate schools play a valuable role in bridging the gap between primary and secondary education. In the two years that students attend, teachers focus on developing the skills of emerging adolescents and preparing them for secondary education.

This study critically examines how teachers in intermediate schools cater for diverse learning needs of students in mathematics and explores the rationale for the methods they choose. At present there is little research in New Zealand intermediate schools that provides understanding of current beliefs and practices regarding catering for the diverse learners found in intermediate school classrooms. This study aims to provide further understanding, and to identify areas for further development.

In order to examine the research question "how are teachers in intermediate schools catering for diverse learning needs in mathematics", a qualitative multiple case study approach was used. Twelve teachers across three different intermediate schools were interviewed and each school was presented as a separate case, followed by a cross case analysis identifying common themes. Findings from the study showed that teachers primarily used different forms of grouping to cater for diverse learners in mathematics, rather than a focus on the content of lessons and tasks given to students. Concerns and pressures around assessment also played a big factor in shaping teacher attitudes towards grouping practices, and teacher capability and understanding around alternatives to ability grouping were also a common theme.

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Acknowledgements

Chapter 1: Introduction

Increasingly, teachers are finding that the students in their class represent a wide range of abilities, needs and backgrounds (Tomlinson et al., 2003; Parsons et al., 2018). In mathematics classrooms teachers are presented with students with a wide range of prior knowledge, experience and skills, at different stages of development (Anthony et al., 2019; Cheeseman & Klooger, 2018). Faced with these challenges, teachers need to be creative and adaptable in order to ensure they are meeting the needs of all students in their class and are meeting school and government expectations in terms of curriculum delivery (Anthony et al., 2019; Cheeseman & Klooger, 2018).

Catering for diverse learning needs in mathematics has long been an area of concern within New Zealand schools. Traditionally, ability grouping or across class streaming was used to differentiate learning for students. A growing body of literature focuses on the drawbacks of such a strategy highlighting issues relating to low student self-efficacy, lack of progress for students in lower groups and the social impact of grouping students by ability. According to the Ministry of Education's (2016) current Four Year Plan, New Zealand needs an education system which caters for an "increasingly diverse population and unique cultures" (p.10) and ensures that every child is able to achieve educational success, regardless of ethnic, cultural or economic background. The Teaching Standards set out by the Education Council of New Zealand (2017) require teachers to "teach in ways that ensure all learners are making sufficient progress, monitor the extent and pace of learning, focusing on equity and excellence for all" (p. 20).

1.1 New Zealand context

While many education systems around the world have middle schools to cater for the years between primary and secondary education, New Zealand's intermediate schools are unique in that students only attend for two years (Education Central, 2018). According to figures from the Ministry of Education, in 2020 there were 117 intermediate schools in New Zealand across the country, catering for over 55,000 students aged between 11 and 13 (2020). Students in New Zealand intermediate schools are generally with the same classroom teacher for core curriculum areas such as maths, reading, writing and inquiry, and attend specialist classes for more specialist areas such as technology, music and science. Intermediate schools focus on covering Level 3 and 4 of the New Zealand curriculum, although students may be working above or below this level. In New Zealand

education the curriculum is divided into eight levels that span over thirteen years of schooling. At each level there are descriptions within the curriculum documents about what should be achieved at each level. Table 1 plots the curriculum levels against school year levels.

Mathematics has been an area of increasing concern in New Zealand. According to the National Monitoring Study of Student Achievement (University of Otago & NZCER, 2018) mathematical literacy in New Zealand, as measured by the Programme for International Student Assessment (PISA), has steadily declined since 2003 causing schools and teachers to reconsider how best to cater for the range of learners found in their classes.

Table 1: New Zealand Years and Curriculum Levels
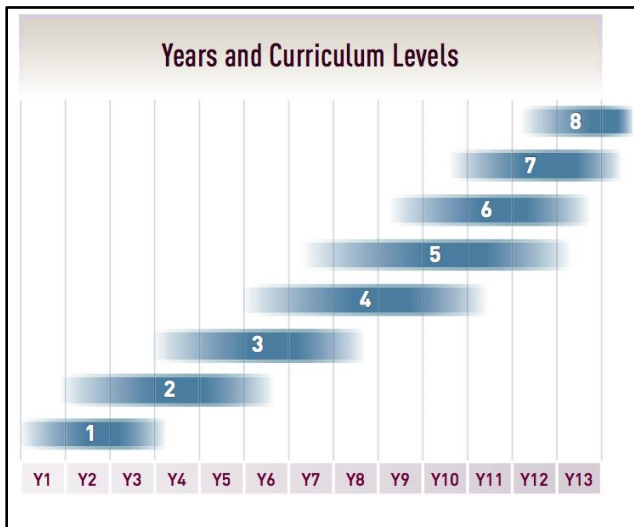
Source: Ministry of Education (2007)

1.2 Research focus

This thesis investigates how teachers in intermediate schools in New Zealand cater for diverse learning needs in mathematics, and their rationale for their approaches. While there has been New Zealand based research into mathematics teaching at both primary level and secondary there has been little looking into the current situation in intermediate schools that bridge the gap between primary and secondary.

1.3 Research aim and objective

The aim of the study is to highlight how different intermediate schools cater for diverse learning needs of students in their classroom. Providing an insight into current practice may help teachers and schools identify areas for improvement. Highlighting common difficulties that schools have might indicate what additional support schools need to help cater for diverse learners more effectively and may provide an indication of what professional development would be beneficial.

1.3.1 Research question and methodology

The initial research question was "how are teachers in intermediate schools catering for diverse learning needs in mathematics?". A qualitative research design was used to investigate this question and interpretivist paradigm was applied. A multiple case study approach was adopted, in which a total of twelve teachers from three different intermediate schools were interviewed.

1.4 Overview of chapters

In Chapter 2 current literature is reviewed and related to the research question. The literature is presented in four sections, each focusing on a different approach; ability grouping, differentiated instruction, complex instruction and culturally responsive/ sustaining instruction. Within each section the advantages and disadvantages of the approach are discussed.

Chapter 3 outlines the methodological approach taken for this research and justifies the use of a multiple case study approach.

Chapter 4 reports on the findings of the data collection. Each school is presented as a separate case. Themes that emerged from the data are discussed in each case, and these are followed by a cross case analysis examining similarities and differences across the three cases.

Chapter 5 presents a discussion of the key themes that arose from the findings with links to relevant literature.

Chapter 6 concludes the study and presents some of the implications for teachers, schools and students. There is also a discussion of the limitations of the study.

Chapter 2: Literature Review

2.1 Introduction

Current literature related to four different instructional models that are proposed as ways to cater for diverse learners in mathematics is reviewed, and advantages and disadvantages of each are examined and discussed. These models are: grouping students by ability (either in streamed classes or in ability based groups within a mixed ability class), differentiated instruction (Tomlinson et al., 2003; Tomlinson, 2014), complex instruction (Cohen et al., 1999; Cohen & Lotan, 2014) and culturally responsive instruction (Anthony & Hunter, 2017; Averill, 2018; Berryman et al., 2018). These models are considered regarding how they might support catering for diverse learners in New Zealand intermediate schools.

2.1.1 Challenge of intermediate schools

In New Zealand there are currently 117 intermediate schools catering for students aged 11 to 13, in Years 7 and 8 (Ministry of Education, 2020). According to figures from the Ministry of Education there were 56,807 students attending intermediate schools across New Zealand (Ministry of Education, 2020). Although other countries have a middle school system, New Zealand is the only country in the world in which students only attend for two years (Education Central, 2018). As aforementioned, there is little research available about how New Zealand Intermediate schools cater for diverse students, particularly in how they are grouped for mathematics. Of most interest to this study is the exploration of mixed ability grouping.

Hornby et al. (2011) conducted a small-scale exploratory investigation into policies and practices of ability grouping in intermediate schools in Christchurch, New Zealand in order to assess the extent to which practices were consistent with research evidence on this topic. They found that of the nine intermediate schools that participated in the research (out of the 11 intermediate schools in Christchurch), only two use mixed ability teaching in mathematics. The others all reported using ability grouping, either across classes or within class to cater for the diversity of learning needs among their students, despite being aware of the disadvantages of this practice (Hornby et al., 2011). Though this was a small-scale investigation, it points to issues that are likely to be found across New Zealand. However, the limited scale of the study points to the very real need for further research, to which this study will contribute.

2.1.2 Defining differentiation

In response to the challenges of teaching diverse ranges of students much of the literature is concerned with the importance of differentiation. Differentiation is a term that is often discussed within the literature as a means of catering for diverse learners, however the term is ill-defined, with little clear agreement on what this looks like in a classroom setting (Anthony et al., 2019; Bearne, 1996; Spina, 2018). Differentiation is broadly considered to be the practice of adjusting curriculum materials, tasks, teaching practices and support in order to provide equity of opportunity to a broad range of students with differing needs (Bearne, 1996; Denessen, 2017; Park & Datnow, 2017; Tomlinson et al., 2003).

De Koning (1973, as cited in Denessen, 2017) defines three different levels of differentiation; macro (different schools for different needs e.g. special needs schools, Māori immersion schools), meso (between classes e.g. accelerant classes, bilingual education), and micro (within the class e.g. streaming, ability grouping, adaptation of tasks). Macro level differentiation would usually be decided on by governments through the provision of different types of schools, while meso and micro level differentiation would be organised by schools and teachers, based on decisions made about the organisation of classes and how instruction within classes is delivered. How learning is differentiated to cater for diverse learners is often influenced by a variety of factors including decisions made at ministry level, school level, expectations from parents and the community, all of which have an impact on the way teachers organise and deliver their teaching programmes (Denessen, 2017; Macqueen, 2013; Park & Datnow, 2017). In the UK, where ability grouping is widespread from primary school through to secondary, Boaler (2005) points to Government policies promoting ability grouping as a way to deal with diverse needs within classes. Golds (2014) points to New Zealand Ministry of Education documents in 2005 that advocate the use of ability grouping, and later documents discussing mixed ability teaching.

2.2 Different models for catering for diverse learners

2.2.1 Ability grouping

In a traditional school setting students are divided into groups based on their age and time spent at school, with the curriculum stating what they should be achieving in each year while teachers are also expected to cater for the diverse experiences and abilities of

students in these groups (Cheeseman & Kloger, 2018). Ability grouping is often used as a way for teachers to differentiate instruction for these diverse students by grouping them based on academic ability (Gamoran, 2002; Macqueen, 2013; Park and Datnow, 2017). Ability grouping can be used to describe a range of practices from across-class ability grouping across a year level (known as streaming, setting or tracking depending on the country), grouping students into classes based on ability for a specific curriculum area such as mathematics (sometimes called regrouping), and within-class grouping by ability (often referred to as ability grouping) (Francis et al., 2017; Macqueen, 2013; Spina, 2018). Across-class grouping refers to the practice of sorting students into separate classes with students of a similar ability level for a particular academic subject, such as mathematics, whereas within-class ability grouping involves teachers creating small groups of students with similar academic levels to work together within their own class (Macqueen, 2013). The practice of grouping students by ability appears to have grown in recent years in the USA (Park & Datnow, 2017; Loveless, 2013), UK (Boaler & Wiliam, 2002; Francis et. al. 2017; Gamoran, 2002), Australia (Spina, 2018) and New Zealand (Anthony et al., 2017). The practice of grouping students by ability is widespread in mathematics teaching within New Zealand primary schools despite the fact that there is little evidence that this practice accelerates progress for priority learners (Education Review Office, 2013). The National Monitoring Study of Student Achievement (University of Otago & NZCER, 2018) reported that ability based mathematics activities are regularly used by teachers in New Zealand as an organisational strategy, with 58% of Year 4 teachers and 46% of Year 8 teachers saying they use ability based grouping every day or almost every day. For Year 8 teachers in low decile schools 58% of teachers reported using ability based grouping every day or almost every day, compared with 35% at mid decile and 47% at high decile schools (University of Otago & NZCER, 2018).

Ability grouping is still popular with teachers because many think it is easier to teach a homogenous group with similar needs as it narrows the range of abilities, meaning they can better teach to specific needs of the students (Boaler, 2006a; Gamoran, 2002; Golds, 2014; Spina, 2018). Golds' study into teacher perceptions of ability grouping within New Zealand primary schools found that teachers found that cross-grouping enabled them to become more confident in teaching a particular level of mathematics (2014). While this seems logical, there is considerable discussion in the literature about the problems caused by grouping based on ability, whether this is across-class or within-class grouping.

Traditionally there has been considerable parental support for ability grouping, particularly among those parents who believe their child would be in higher achieving groups (Denessen, 2017; Francis et al., 2017; Hornby & Witte, 2014; Macqueen, 2013). In some schools, between-class ability grouping is used as a way to attract and retain students whose parents may otherwise have sent them to non-government elite schools (Spina, 2018). There is evidence to suggest that some schools are reluctant to move towards more mixed ability teaching due to negative perceptions of the practice among parents (Francis et al., 2017).

Park and Datnow (2017) argue that the increased focus on data collection and accountability of teachers for student achievement has also contributed to the rise in the use of ability based grouping as teachers feel it makes it easier to target the needs of their students. Spina's (2018) study into the use of data and grouping practices in two Australian schools suggests that greater accountability by teachers for demonstrating the progress of their students through assessment data has normalised the practice of grouping by ability as a way to show how schools are catering for students of varying ability. Teachers feel under pressure from school leadership, parents and government to move students "up" and raise achievement levels (Francis et al., 2017). Francis et al. cite a 2005 UK Government White Paper that states that "grouping students can help to build motivation, social skills and independence; and most importantly can raise standards because pupils are better engaged in their own learning" (HMSO, 2005, p. 58, as cited in Francis et al., 2017). Standardised testing such as NAPLAN in Australia and PISA worldwide also contributes to the pressure to raise achievement standards (Mills, et al., 2017).

In New Zealand, initiatives such as the development of the Numeracy Development Project as the basis for mathematics teaching, which imply that mathematical learning is linear and can be divided into clear stages, may also have contributed to a rise in ability grouping (Anthony et al., 2017). Anthony et al. (2019) highlight how use of diagnostic testing in the Numeracy Development Project is reminiscent of Dutch models of teaching which involve grouping students based on the results of testing. Early Ministry of Education guidelines from 2005 around the implementation of the Numeracy Development Project explicitly told teachers to group students by ability, either across between or within classes, putting students of close strategies stages together in order to reduce the number

of teaching groups (as cited in Golds, 2014). Although later guidelines published in 2008 (Ministry of Education, 2008) suggested a more varied and flexible mix of ability grouping, mixed ability grouping, and individual work, Golds (2014) argues that many schools continued to follow the earlier guidelines and group students according to their strategy stage. Golds (2014) conducted research into cross-grouping in New Zealand primary schools, examining teacher perceptions about the ways in which cross-grouping impacts on teacher practice. This study found that many teachers supported ability grouping but that few teachers or schools had engaged in critical analysis of this as an approach for teaching maths (Golds, 2014). A report by the Education Review Office (ERO) in 2013 found that most schools used ability grouping, either within or across classes, despite having little evidence that this made a difference for priority learners (ERO, 2013).

Some research suggests that grouping students by ability can have some academic benefits for higher ability students, however, students in lower ability groups tend to show no benefit in terms of academic performance (Denessen, 2017; Gamoran, 2002; Hornby & Witte, 2014; Spina, 2018). Hattie's synthesis of studies into the impact of ability grouping found an effect size of 0.12 for the impact of ability grouping on student achievement, suggesting that ability grouping has little impact on achievement (Hattie, 2009). When looking at international comparisons, in the Third International Mathematics and Science Study (TIMSS), Korea is the highest achieving country, yet is also the country with the lowest levels of ability grouping, leading analysts to conclude that countries that group the latest and the least have the best academic outcomes (Boaler, 2015).

2.2.1.1 Specific issues with ability grouping
Impact of ability grouping on lower ability groups
There is considerable research evidence shows that ability based grouping negatively impacts lower and middle achieving students (Anthony & Hunter, 2017; Boaler, 2014; Francis et al., 2017; Macqueen, 2013; Spina, 2018). Evidence from studies around the world show that students in low and middle ability groups show lower rates of academic progress when placed in ability groups, and there is very little difference to the achievement of those placed in the higher ability groups (Boaler, 2014).

Studies conducted by Spina (2018) and Macqueen (2013) found that students in low achieving groups were often taught in smaller groups, provided with limited versions of the

curriculum and, in some cases, had the least capable teachers. The Education Review Office (ERO) in New Zealand reported that they found that learners who require the greatest assistance frequently are taught by the least experienced staff, with teacher aides often providing the majority of this support rather than qualified teachers (Education Review Office, 2013). Higher ability groups are more likely to have teachers who have specialised in that curriculum area meaning that those groups are exposed to more expert instruction (Boaler, 2005; Francis et al., 2017).

Students placed in lower ability groups often feel that there are limits on what they can achieve which causes them to become disillusioned and give up on mathematics (Boaler, 2013). During a study of six schools in England, Boaler (2015) found that students in low achieving groups felt that they were regularly underestimated, were given work that was too easy for them and felt that they were being held back by the lack of opportunities given to them in their mathematics classes. Boaler (2015) also discusses the issue of how ability grouping leads to fixed mindsets about what students can do, in both teachers and the students themselves. This can be limiting for students in low ability groups but this can be damaging for students placed in high achieving groups who can become fearful of making mistakes and begin to avoid more challenging work, particularly high-achieving girls (Boaler, 1997; William & Bartholomew, 2004). Boaler (2005) interviewed a student who had attended a school in which setting by ability was common practice. The ex-student explained that he felt that grouping students by ability put limitations on what they believed they were capable of saying:

> *"You're putting this psychological prison around them (...). It's kind of...people don't know what they can do, or where the boundaries are, unless they're told at that kind of age."* (Nikos, Ex-Amber Hill student cited in Boaler, 2005).

He went on to explain that being labelled as a particular ability made people believe that this was all they were capable of.

Difference in tasks and expectations
Lower ability groups are less likely to be exposed to higher order thinking tasks or have the opportunity to engage in tasks that require them to think critically; instead teachers often believe that these groups need to focus on memorisation of procedures for solving

problems and mathematical facts (Macqueen, 2013; Spina, 2018). This means that students considered to be of a lower ability are not taught to develop their mathematical thinking and reasoning skills, which often leads to disengagement with the subject (Boaler & Staples, 2008; Boaler & Wiliam, 2002). Spina's study (2018) into grouping practices in one primary and one secondary school in Australia noted the difference in pedagogical approaches between teachers of high and low ability groups with teachers setting higher order thinking tasks for students in higher sets but not considering these for all students. Students considered to be 'advanced' are more likely to be engaged with inquiry-based teaching practices (Anthony & Hunter, 2017; Denessen, 2017; Spina, 2018). These tasks are more likely to engage students, requiring them to participate in rich mathematical discussion to solve real world problems (Boaler, 2006; Spina, 2018). In Japan, a country which has consistently high achievement in mathematics in international comparisons, all students are provided with challenging tasks and the emphasis is on skills of reasoning and justification, rather than speed and memorisation of procedures (Boaler, 2009).

Concept of homogenous classes

Often the assumption among teachers of streamed classes is that students of the same ability will learn at the same rate and will have the same requirements, meaning that little or no differentiation is required (Boaler et al., 2000; Wiliam & Bartholomew, 2004). Though proponents of ability grouping would argue that it narrows the range of abilities they need to address, thus allowing them to be more effective and efficient, this assumes that learning is a linear process that requires the acquisition of discrete skills (Park & Datnow, 2017). When teaching groups that are considered to be homogenous in terms of ability level, teachers tend to use a more limited range of pedagogical practices than they do when working with mixed ability groups (Boaler et al., 2000).

Macqueen (2013) notes that teachers generally use standardised, school or class testing and possibly anecdotal observations in order to place students in broad ability groups but highlights that these are not without their flaws and that teacher perceptions often also play a role in group placements. Groups may be manipulated in order to provide greater balance between genders or take into account behavioural or motivational issues (Charlton et al., 2007, as cited in Macqueen, 2013). When assigning students to ability groups, teachers often rely on their knowledge of prior performance of pupils, however,

socio-economic background, class and race also often have an influence (Denessen, 2017; Gamoran, 2002).

Lack of movement between groups

Despite assertions that movement between groups is fluid and flexible, challenges relating to pacing, self-concept and group sizes often mean that this does not happen (Francis et al., 2017; Macqueen, 2013; Spina, 2018). Spina (2018) notes that movement between groups is often dependent on the collection of additional data from assessments and argues that if data is only being collected a few times a year, there is unlikely to be considerable movement between classes. Dixon (2002, as cited in Boaler, 2005) claims that 88% of children placed into ability groups when they are four years old remain in the same groups all the way through their schooling career, showing that movement between groups is minimal. As well as showing that little academic acceleration is achieved through ability grouping, the lack of movement between groups also means that social interactions are limited and there can be a lack of appropriate student role models within the groups from which other students could learn (Boaler, 2005; Spina, 2018).

Social justice issues with ability grouping

Researchers report that ability grouping disproportionately impacts students from lower socioeconomic groups (Boaler, 1997; Francis et al. 2017; Gamoran, 2002; Macqueen, 2013; Slavin, 1990; Spina, 2018). Students from lower socioeconomic backgrounds often make up the majority of lower ability groups of which teachers may have lower expectations and are reluctant to expose them to the higher order and critical thinking tasks that higher ability groups engage in (Boaler, 2005; Gamoran, 2002; Spina, 2018). Hunter (2010) suggests that in New Zealand, the ability grouping that has often been used during the implementation of the Numeracy Development Project has had a negative effect on priority learners, particularly Māori and Pāsifika students.

2.2.2 Differentiated Instruction

One of the key alternatives to ability grouping is differentiated instruction in which consideration is given to content, pacing and presentation of the curriculum in order to meet the individual needs of each student, taking into account their interests, skills and favoured learning style (Tomlinson, 2014). Though grouping may be used in this model, groups are flexible and based on more than just ability (Park & Datnow, 2017). Tomlinson

et al. (2003), argue that differentiated instruction is required to meet the needs of increasingly culturally, racially, socially and academically diverse students found in most classrooms. Tomlinson (2014) posits that this diversity can be accommodated by creating differentiated classrooms that allow teachers to cater for different levels, interests and learning preferences. This includes strategies such as adapting tasks and instructional strategies for students of different abilities or school readiness levels. In this model of instruction students who are considered as having less developed readiness to learn are taught using more direct instruction, whereas students who are considered to be more advanced should be provided with more complex, open-ended tasks (Tomlinson, 2014). In this sense, student differences are catered for by modifying what the student learns (content), how they learn (process) and how they demonstrate their learning (product) (Tomlinson, 2014).

Proponents of differentiated instruction argue that mixed ability teaching expects all students to be the same and learn at the same rate, whereas differentiated instruction requires the teacher to adapt to the needs of the student to ensure they can be successful at their own level (Tomlinson, 2014).

2.2.2.1 Issues with differentiated instruction
Tasks
Tomlinson's (2014) model of differentiated instruction states that lower ability students should be taught through direct instruction and that those students deemed to be of a higher ability are given complex, open and non-routine tasks. As with ability grouping, this means that students who are perceived to be of a lower ability are not provided with opportunities to develop mathematical reasoning skills and engage in more complex tasks. Bannister (2016) argues that students perceived to be of a lower ability also need to engage with meaningful, inquiry-based tasks which create real situations both for learning and developing social skills.

Differentiated instruction often involves some form of grouping by ability
Differentiation often promotes within-class ability practices as teachers are encouraged to create different levels of expectations for tasks and outcomes for students of varying levels of perceived ability (Anthony et al., 2019; Bannister, 2016; Park & Datnow, 2017). Differentiated instruction calls for tasks, instructional strategies and method of delivery to

be adjusted according to the abilities of each student meaning that it is likely that, in order to achieve this, students will be grouped according to their ability (Bannister, 2016). As a consequence, differentiated instruction creates some of the same inequality as ability grouping (Bannister, 2016). Denessen (2017) argues that while differentiation focuses primarily on academic outcomes of students, it divides students, teaching them to work only with others who are like them. "Children must learn how people differ from one another, but also how to be together and how to collaborate in a group with many differences." (Denessen, 2017, p.10). Students viewed as what Tomlinson (2014) refers to as having 'less developed readiness' are considered to need more direct instruction and routine practice, whereas those perceived to be more advanced engage with higher order thinking tasks (Bannister, 2016). Though not directly called ability grouping, this clearly still involves assigning students tasks based on perceived 'readiness' or ability.

Social justice issues with differentiation

Tomlinson (2014) discusses the issue of school readiness, attributing deficiencies to parents and home circumstances, arguing that students with lower school readiness need different instructional strategies and tasks than those with higher levels of school readiness. Bannister (2016) argues that students from lower socioeconomic backgrounds are often those labelled as having lower school readiness resulting in teachers having lower expectations for these students. As differentiated instruction calls for those who are considered to be less advanced to receive more direct instruction and routine practice, this means that students who are labelled less advanced or having lower levels of school readiness are placed at a disadvantage (Anthony, et al., 2019; Bannister, 2016). In New Zealand, deficit theorising around Pāsifika and Māori students has meant a culture of low expectations for these students among teachers (Berryman et al., 2018). Berryman et al. discuss the importance of having high expectations, and building relationships that support the well-being and mana of all students. As has been discussed however, differentiated instruction leads to different expectations and tasks for students based on perceptions about ability and readiness.

2.2.3 Complex Instruction

In traditional mathematics classrooms the emphasis is on quickly getting the correct answer through the appropriate procedure. Those who are able to do this thrive and are presented with more challenging problems, while those who cannot are often left behind.

Complex Instruction is proposed as an alternative way to deliver a classroom programme that meets the needs of all students (Cohen & Lotan, 2014). Tasks focus on big, central mathematical ideas which have multiple solutions or can be represented in multiple ways, and require collaboration in order to find a solution (Cohen, 1994, cited in Bannister, 2016). This approach moves away from differentiating students academically and instead values developing student responsibility, high expectations, effort over ability and learning practices (Boaler, 2006a). Use of open ended tasks which allow for multiple representations and have a number of possible solutions, enable more students to contribute their ideas and feel their contributions are valued (Boaler, 2006a).

Described as a multiple ability strategy, this approach moves away from memorisation tasks and teaching procedures, and instead promotes all students as competent learners of mathematics who are able to fully participate in group work tasks, supported by instructional strategies that promote inquiry and justification of ideas (Bannister, 2016; Cohen & Lotan, 1997). Students are taught that multiple skills are required in order to successfully tackle a task, and to understand that no one person in the group will possess all the necessary abilities, but that everyone in the group will have some of the abilities (Bannister, 2016; Cohen & Lotan, 1997). Valuing other aspects of mathematics aside from merely getting the correct answer quickly (such as asking questions, explaining their thinking, justifying their ideas, and being logical) means there becomes multiple different ways to be successful, allowing all students to experience success (Cohen et al., 1999; Boaler, 2006a).

This model also calls for teachers to highlight the specific contribution of low-status students (Cohen & Lotan, 1997). Low-status students may be students who lack traditional academic skills, are socially isolated or might lack proficiency in the language of instruction. These students often participate less in group work, have their ideas ignored, get less access to materials or are not given a turn or an opportunity to engage fully with the task (Cohen et al., 1999). Assigning competence to these students and highlighting the nature of their participation in group tasks helps to build their confidence and raise their status with other students. Cohen (1994, as cited in Boaler, 2006a) states that the feedback needs to be public, intellectual, specific and relevant to the task. This helps other students recognise the value of different contributions and how it relates to their overall success as a group.

This model also suggests the assigning of student roles, such as facilitator, recorder and team captain (Cohen & Lotan, 1997) in order to ensure that all students have a clear and important part to play in the group, helping to highlight the importance of everyone's contribution. Students are also encouraged to take responsibility for each other's learning by ensuring that everyone in their group understands the discussions they have had and the solutions they have come up with, helping students to rely on each other (Boaler, 2006a). Examples of this might be getting one student to explain the solution their group had come up with or answer a follow up question to check understanding. Students are also encouraged to push the mathematical thinking of others through questioning (Boaler, 2006a).

2.2.3.1 Advantages of Complex Instruction

Complex Instruction is a more equitable model of instruction

Proponents of complex instruction argue that it provides a more equitable model for teaching as everyone is involved in the learning (Bannister, 2016; Boaler, 2006a; Cohen & Lotan, 2014). This model recognises multiple abilities of students, teaching them to value different contributions and skills (Bannister, 2016; Cohen & Lotan, 2014). The use of specific roles within groups, such as facilitator and recorder, can be used to show students that a range of skills are required to complete a task, providing purpose to all students regardless of ability (Bannister, 2016; Boaler, 2006a; Cohen & Lotan, 2014). Boaler's four year study (2006a) into mixed ability grouping and co-operation in mathematics tasks at Railside School in California led to a greater understanding between students of different ethnic, cultural and social groups, as well as showing a marked improvement in achievement outcomes across all groups. All students were engaged with high level tasks and teachers "keep the intellectual demands of the task high, by providing complex problems and by following up with high-level questions" (Boaler, 2006a, p.44). Boaler (2006b) also found that this approach reduced inequities between students of different ethnic groups. Justification and reasoning helped promote equity as students were expected to explain their thinking to others and ensure that everyone else could follow their solution (Boaler, 2006a)

Complex Instruction promotes greater relational equity

Reporting on a study of students working in mixed ability groups for mathematics at Railside, Boaler (2008) noted that students became aware that they were responsible for each other's learning, learned to take responsibility when things went wrong, developed respect for other people's ideas and developed methods of communication and support (Boaler, 2008). Although not directly related to mathematical ability, Boaler noticed that students in these mixed ability groups were expected to work and interact with others from different social backgrounds, ethnic groups and ability levels, and that this also developed good learning practices (Boaler, 2008). Complex instruction calls for the recognition and valuing of different contributions and valuing, ensuring that all students feel valued and engaged (Boaler, 2006a)

Higher levels of student engagement across ability levels
By placing greater emphasis on mathematical tasks that require reasoning and discussion for all students, teachers are able to engage a wider range of students. According to Boaler (2006b) valuing the many different aspects of mathematical work means that there are more ways for students to be successful and engage with the task, resulting in more students feeling positive about mathematics and developing higher levels of understanding. While studying students at Railside High, Boaler noted that students changed their opinions of group work over time as they discovered that all students could offer something while solving problems, and discussing problems with others helped them deepen their own understanding of a mathematical concept (Boaler, 2006b).

Encourages quality teaching practices
Complex instruction supports all students to complete the same work and participate in tasks that involve higher order thinking through valuing the conversations and discussions around mathematical tasks rather than the outcome, placing a high value on mathematical justification and reasoning (Boaler, 2006a). In this model effort is valued over ability and emphasising that high achievement in mathematics is attained through hard work rather than innate ability (Boaler, 2009). In a study on a UK school, Boaler et al. (2000) reported that teachers used a variety of effective strategies for differentiation when teaching mixed ability groups of Year 8 students, but were far more limited in the teaching styles they used when teaching students grouped by ability. In terms of assessment, complex instruction supports a move away from traditional testing towards classroom assessment based on on-going observation of student work and discussions (Cohen & Lotan, 2014).

Higher levels of academic success

Results from Boaler's 1992-5 comparative study of two secondary schools in similar areas, with similar socio-economic conditions in the UK, one using traditional, ability grouping methods and the other teaching students in mixed ability groups, showed that students in the mixed ability groups performed significantly higher in the national examinations than their counterparts in a more traditional school (Boaler, 2005). In another study, comparing academic outcomes for students at three different US schools, Boaler found that students in the school that placed students in heterogeneous mathematics class performed at significantly higher levels in mathematics tests after two years, despite starting at a lower level, than students in the two schools who organised students into ability groups (Boaler, 2008). Differences in achievement between different ethnic groups also declined significantly in the school where students were placed in mixed ability groups (Boaler, 2008). Cohen et al. (1999) also note that elementary students being taught using complex instruction methods in the San Francisco Bay Area between 1991 and 1993 showed significant gains particularly students with lower pre-test scores, bilingual students and gifted students.

2.2.3.2 Challenges of Complex Instruction

Teacher capability

Critics of mixed ability teaching models such as complex instruction, argue that it is more challenging than teaching homogenous groups as it requires excellent teaching and that this often fails to meet the needs of the most academically capable and those who are furthest behind (HMSO, 1997 as cited in Francis et al., 2017). Boaler (2005) acknowledges that mixed ability teaching is challenging, requiring more advanced curriculum knowledge and greater pedagogical skill. Management problems within the classroom can impact on the learning gains within mixed ability classes, with severe management issues needing to be addressed (Cohen et al., 1999). UK Government White Papers from 2005 (as cited in Francis et al., 2017) state that mixed ability teaching is only successful when used as a tool by the most experienced and capable teachers, and that grouping by ability should be used as the norm.

2.2.4 Culturally Responsive and Culturally Sustaining Instruction
Culturally responsive or culturally sustaining instruction shares much in common with complex instruction in that students are involved in working in mixed ability groups and there is a focus on relational equity (Anthony et al., 2016; Averill, 2018; Berryman et al., 2018). The key difference between this approach and complex instruction is a greater emphasis on cultural background and use of students' cultural tools to support their learning (Valiandes et al., 2019). Anthony et al. (2019, p.5), argue that "differentiation needs to be reframed in terms of a social justice agenda focused on embracing student differences rather than 'dealing' or 'coping' with student difference, and in many cases student limitations". Instead of viewing student differences as an issue that needs to be dealt with, this model views them as a positive that can be used to further support student learning. Averill (2018) discusses using songs, storytelling and metaphor to help students retain information about key concepts and make sense of what they are learning by connecting their lives outside school with the topic being taught in class. Teaching in this way not only has academic benefits for students, it also serves to increase engagement, motivation and connection to the learning (Averill, 2018).

2.2.4.1 Advantages of culturally responsive instruction
Supports students from different cultural backgrounds
Students are more likely to engage with a subject if they see themselves reflected in what is being taught in class (Averill, 2018). This model supports all students by requiring a focus on the cultural capital of the students and ensuring that this is brought into classroom tasks, rather than being viewed as an obstacle to deal with. Hunter (2010) reports on a study in which she worked closely with a teacher to help develop her mathematics teaching in a way that would engage all her learners, with a specific focus on Māori and Pāsifika learners. The teacher was able to provide an environment in which all students could draw on their own cultural and social norms to support their learning and help contribute to an inclusive mathematical community (Hunter, 2010).

2.2.4.2 Challenges of culturally responsive and sustaining instruction
Teacher capability and knowledge
Successful implementation of this model requires teachers to have a solid understanding of the culture of the students, and to be able to incorporate this into appropriate learning experiences for their students (Averill, 2018). According to Averill, many of the strategies

required to implement culturally responsive and sustaining instruction require teachers to have a deep cultural understanding, which takes time, opportunity and commitment to acquire. Within a multicultural context this is even more challenging. Teachers need to take care to avoid tokenistic efforts, ensuring this is done with sensitivity and respect, and in consultation with the community (Averill, 2018). Anthony et al. (2016) report on challenges discussed by teachers in relation to implementing culturally responsive and sustaining instruction, with one teacher expressing that she found it difficult to write and adapt appropriate problems into a cultural context due to her own lack of knowledge and understanding. Initiatives such as *Developing Mathematical Inquiry Communities* (DMIC) seek to support teachers in developing their knowledge and skills in this area, but this remains a challenge for many teachers.

2.3 Summary

Ability grouping remains a practice used in mathematics classes across New Zealand, despite considerable evidence in the literature about the negative impacts on student attitudes and the disadvantages specifically for students considered to be low ability or from a lower socioeconomic background. While differentiated instruction is considered by some to be an alternative to ability grouping, it shares many of the same disadvantages.

In New Zealand there is clear support for models involving mixed ability grouping, in order to provide a more equitable learning environment for all students, however, it is unclear how much influence this is having on teachers across the country. The New Zealand Curriculum and Ministry of Education guidelines state that the needs of different learners need to be catered for and highlight the importance of taking into account the variety of cultural, social and academic needs faced by students in New Zealand schools, however, there is little explicit direction about how this is done. Although there has been research into how to cater for diverse learners in mathematics there is little investigation into the current situation in New Zealand schools (Golds, 2014).

According to the National Monitoring Study of Student Achievement (University of Otago & NZCER, 2018) only 45% of students at Year 8 achieve at or above the expected curriculum level compared with 81% at Year 4. There was also a significant difference in achievement based on ethnicity, with non-Māori students scoring higher than Māori students, and non-Pāsifika students scoring higher than Pāsifika students (University of

Otago & NZCER, 2018). Intermediate schools are little investigated yet provide an important link between primary and secondary education with around 50% of all children in New Zealand attending an intermediate school providing education for students from 11 to 13 years old in Years 7 and 8 (Hornby et al., 2011).

It is important to conduct further research into the practices of intermediate schools to gain a greater understanding of how teachers are catering for diverse learners in mathematics and to develop a better picture of the rationale behind teacher decisions. Until we know what is going on in intermediate mathematics classrooms we cannot begin to address the issue of why only 45% of students at Year 8 are achieving at or above the expected level for mathematics and start making a difference for students. This research could provide a valuable insight into current practice and provide teachers and schools with a springboard from which to start examining their own approaches to mathematics teaching and assessing where further professional development is needed.

Chapter 3: Research Design

3.1 Introduction

After reviewing literature and identifying current gaps in research related to the topic of teaching mathematics in intermediate schools in New Zealand, this chapter sets out the methodology for the research. The opening sections examine the research question, approach and design, including a discussion of the paradigm adopted and the rationale for using an exploratory case study design. Then follows details about how data was collected, participant selection, data analysis methods as well as ethical considerations. The chapter concludes with explaining how the findings are presented.

3.2 Research Question

The initial research focus identified in the introductory chapter is centred around examining the ways in which teachers in intermediate schools in New Zealand are catering for the full spectrum of learning needs within their class. In the literature review four different models for delivering mathematics instruction were identified and discussed; grouping students by ability, differentiated instruction, complex instruction, and culturally responsive instruction. From a review of current literature, it was evident that further research is needed to discover how these instructional models are being implemented in intermediate schools in New Zealand to cater for diverse learning needs in mathematics, and to investigate teacher rationale for the model they use in their classroom. While there are some studies into primary and secondary schools, very little research was conducted in intermediate schools. New Zealand based research about the ways in which teachers are catering for the wide range of learning needs found in mathematics classrooms in intermediate schools, and their beliefs around what they are doing, would help identify areas of difficulty and see where further development might be required.

3.3 Research Approach

Denzin and Lincoln (2018) define a paradigm "as a basic set of beliefs that guide action" (p.97). These sets of beliefs shape the researcher's understanding of the world and shape their view of reality (Denzin & Lincoln, 2018). Inquiry paradigms shape the scope and nature of the inquiry and have implications for the methods used (Punch & Oancea, 2014). For this research I employed an interpretivist paradigm which focuses on the meaning that people bring to situations and behaviours which they then use to understand the world around them (O'Donoghue, 2007 as cited in Punch & Oancea, 2014). This research was

focused on the research question, "How are teachers in intermediate schools catering for the diverse learning needs of their students?". From this I wanted to find out from teachers what kind of instructional strategies they use to cater for diverse learners in mathematics and gain an understanding of why they chose to organise this way. Punch and Oancea (2014) state that a design centred on qualitative data is suitable for studying questions relating to interpreting participants' descriptions of practise and beliefs collecting data through semi-structured interviews and identifying themes, which made it most appropriate for studying this research question.

3.4 Research Design

Yin (2018) states that case studies are appropriate as a method of researching questions related to "how and "why". As this research is concerned with examining *how* teachers are using grouping practices to cater for diverse learners in maths, and is seeking to understand some of the reasons *why* they are adopting these approaches, the research question is suitable for case study research. The use of a case study also offers the opportunity to examine a contemporary, real life issue (Yin, 2018). In order to examine this issue more fully, a multiple case study approach was taken, to see if different school settings have a significant impact on how teachers are using instructional strategies to cater for diverse learners and enable comparison, not just between teachers in the same school but also across different school settings. Yin argues that "analytic conclusions independently arising from two cases, as with two experiments, will be more powerful than those coming from a single case (or single experiment) alone." (2012, p.64). Three schools were selected to be part of the research, each having a different school wide approach to the delivery of the mathematics curriculum.

3.4.1 Definition of the 'case'

Yin (2018) highlights the importance of defining the case to be studied. Gall et al. (2007) state that it is important to have a clear vision of the phenomenon, case, focus and unit of analysis when planning a case study. The general phenomenon being investigated in this research is catering for diverse learners in mathematics in intermediate schools. The case refers to a specific incidence of the phenomenon (Gall et al., 2007); in this instance the cases are schools that are presenting different schoolwide approaches to the instructional strategies used to cater for their learners. The unit of analysis refers to the specific aspect to be studied within the case (Gall et al., 2007). In this research the unit of analysis is the

teachers working within each school. The focus of this case study is on the instructional practices of the teachers within each school and teacher beliefs around how they are catering for diverse learners and why they believe this is the best way to cater for their learners.

Yin (2018) discusses different types of case study; descriptive, exploratory, explanatory and evaluative. Descriptive case studies are often concerned with presenting a rarely encountered example which might not be normally accessible for researchers or explaining how something occurs; exploratory case studies often involve collecting data to determine if a topic is worthy of further investigation, and if so, what questions, collection methods and data might be collected; explanatory case studies look at why things happen; and evaluative case studies look at the impact of an event, initiative or environment (Yin, 2018).This research employs both descriptive and exploratory approaches as it is focused on *how* teachers using instructional practices to cater for diverse learners in maths, *why* they have made the choices they have around instructional practices and considering what further research might be required to further investigate the situation.

3.4.2 Theoretical proposition

According to the research literature, grouping by ability is still common practice in New Zealand intermediate schools. A further premise is that teachers feel that catering for diverse learners in a mixed ability setting requires teachers to significantly develop both content and pedagogical knowledge. This research will no doubt uncover further elements that will answer the how and why question of this research.

3.5 Data Collection Methods

As noted by Punch and Oancea (2014) "we cannot study everyone everywhere doing everything" (p.210), thus sampling is a necessary part of qualitative research. Sampling was employed both in selection of schools and in selection of teachers. The sampling methods used to select the schools was what Miles and Huberman (1994) define as maximum variation. Schools were deliberately selected that had different school wide approaches to the delivery of their mathematics programme. Snowball sampling (Cohen et al., 2018) was used to select participants within each school. Using my initial contacts within the school, they then recommended others who might be interested in participating in the research. Cohen et al. (2018) argue that this kind of sampling helps use

interpersonal relationships to access participants who might otherwise be reluctant to engage with the researcher. In both cases the sampling was purposefully designed to elicit a range of experience and views.

3.5.1 Participants: Schools

As previously mentioned intermediate schools that had different approaches to their mathematics programme were contacted and invited to take part in the research. These were schools I had come into contact with through professional development and discussions with other teachers. Yin (2018) discusses replication logic for selecting cases within a multiple case study which he divides into literal replication and theoretical replication. In cases with literal replication two or more cases are selected because the researcher predicts the same results in each case, whereas in theoretical replication the researcher expects results to differ based on a theoretical difference between the cases (Yin, 2018). These schools were selected because they would provide some replication as all schools involved follow the New Zealand Curriculum, report progress made against the curriculum to the Ministry of Education and all run a similar intermediate school programme across curriculum areas. However, they also all had different school wide approaches to their maths programmes which would provide a range of different opinions and experiences. Although this sample size was small, the aim was to provide a range of views across different environments. Yin (2018) makes the case for selecting cases that offer contrasting situations, arguing that subsequent conclusions can be strengthened if replicated across different cases.

In this research, the three schools presented differing schoolwide approaches to the delivery of their mathematics programmes:

- School A had engaged with a professional development programme centred around culturally responsive teaching practices previously, although they were no longer participating in the programme.

- School B had been working with external providers to help re-examine their maths programme and had recently eliminated their accelerant and bilingual classes.

- School C had a more traditional approach to delivering their mathematics programme and gave teachers a lot of freedom to organise their programme in the way they felt appropriate.

Although the decile[1] of the school was not a factor in selecting the schools the schools were all mid to lower decile schools, ranging from decile 2 to decile 5.

3.5.2 Participants: Teachers

Initially, the plan was for 4-5 teachers including the lead teacher for maths to be involved from each school. Due to external pressures only the lead teacher and other two teachers from one of the schools were able to take part. Once permission from the school was granted for the research to take place, I contacted the lead teacher for maths before inviting interested teachers from the school to participate. The lead teacher made some suggestions regarding teachers who might be interested in participating. I then contacted those teachers directly. As previously discussed these teachers also made recommendations about colleagues who they felt would be interested in participating and these teachers were also contacted and invited to participate.

Of the participants;
- Two taught in accelerant classes, for which students had been assessed by the school as being above the academic level of the majority students attending that school
- Two teachers worked in Innovative Learning Environments (ILEs)
- One teacher taught in a specified bilingual class where 31-50% of instruction was in Te Reo Māori.
- Of the three lead teachers for mathematics two were classroom based; the other was a deputy principal with overview for mathematics (there was no specified lead teacher for mathematics in this school).

As well as interviewing the teachers, schools were also asked to share any relevant curriculum documents or supporting material that they provided to their teachers to outline expectations around the delivery of the mathematics curriculum. These were to provide

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[1]https://www.education.govt.nz/school/funding-and-financials/resourcing/operational-funding/school-decile-ratings/

background information to support the understanding of teachers' comments. Many teachers also provided access to their planning to illustrate the points they were making.

3.6 Quality criteria

In order for a piece of research to be effective it must be shown to be valid. Cohen et al. (2018) state that research is worthless if it is shown to be invalid. "Validity should be seen as a matter of degree rather than an absolute state" (Gronland, 1981, as cited in Cohen et al., 2018). Yin (2018) outlines four common tests to establish validity of research; construct validity, internal validity, external validity and reliability.

Construct validity is concerned with identifying the appropriate measures for the concepts being researched (Yin, 2018). For this research the concepts being examined are instructional models employed by intermediate school teachers for mathematics instruction. In order to ensure construct validity, multiple sources of evidence are required (Yin, 2018). In this study, interviews with teachers and lead teachers of mathematics were used, as well as observations (where possible) and relevant planning documentation from the school. A draft case study report was also made available to key informants in order to support construct validity. Participants also had the opportunity to add additional comments at the end of the interview and view the transcripts of their interview to enable them to make any clarification to the comments they had made. Research questions were shared and discussed with the participants at the start of the interview to provide them with an understanding of the purpose and direction of the research. After interviews were transcribed and approved by participants they were reviewed repeatedly to ensure the views of participants were carefully considered and that the research remained authentic and honest.

Internal validity is concerned with ensuring that inferences made from the data are correct and that alternative explanations and possibilities have been considered (Yin, 2018). In order to ensure internal validity all responses were coded within a database, with the option to code under more than one heading, if appropriate. Once coded, key themes were identified out of the transcripts. The use of the database made it possible to rearrange data based on key ideas so they could be viewed both together and separately. In order to ensure different interpretations were considered, ideas and themes were discussed with thesis supervisors to get alternative perspectives.

The possibility of researcher bias was minimised by recording and transcribing interviews meaning that comments could be revisited in full rather than relying on the interviewer's notes which might fail to capture small details and introduce bias in what was recorded (Cohen et al., 2018). This enabled me to return to the interviews to confirm my analysis and revise conclusions that had been drawn.

External validity refers to the analytic generalisation of the case study, meaning the extent to which the findings of the case study can be generalised to other cases that are similar. Conducting research in three schools that were similar in their overall structure and organisation, but which offered different approaches to delivering the mathematics curriculum, meant that common themes found were more likely to hold true across other schools if the research was expanded.

In order to ensure reliability of the study, case study protocol was followed by using a case study database to record and organise findings and maintain the chain of evidence (Yin, 2018). The use of replication logic in multiple case study research design also helps to ensure reliability of the study (Yin, 2018). This is the idea that the study could be replicated in the same school using the same methods and a similar result could be expected. This meant ensuring clear processes and procedures for conducting this study which would enable future researchers to replicate the research elsewhere. Also the use of open ended questions meant that teachers could discuss what was relevant in their opinion, and care was taken not to impose the researcher's views on the participants. In some cases, where the researcher was known to the participants, care was taken to stress that the purpose of the interview was to capture their ideas, experiences and opinions, rather than judge practice. It was also made clear to the participants that their comments would not be shared with other members of staff at their school and that all comments would remain anonymous in the final research. This facilitated participants feeling free to share honest opinions rather than say what they thought their lead teacher would want them to say.

In order to ensure the research is credible, measures were taken to ensure that the findings would be related to by those who are familiar with the setting or situation. In the case of this research, efforts were taken to conduct research in a range of different schools, with teachers with different views. Findings were also returned to the participants

to ensure they fit with their understanding and to provide a further check on validity. Interpretations of findings were also discussed with supervisors to ensure credibility.

3.7 Data collection procedures

The interviews were conducted as semi structured interviews of around 45 minutes and each participant was interviewed once. Ten interviews were conducted using the video conferencing software Zoom, and two were conducted in person during a visit to the participating school. The interviews were all recorded and transcribed. In two of the schools, interviews were followed up with classroom visits to observe the teachers and see their maths classes in action in order to give context to the comments made in the interview. Due to the restrictions in place in New Zealand at the time of the research as a result of COVID-19, this was not possible in all cases. There were two sets of questions, one for teachers and the other for lead teachers. Participants in each group were asked the same questions in the same order (see Appendices E and F), although probing and follow up questions were asked where appropriate. Interviews took place at a time that was convenient to the participants. Interviewing allows the participants to discuss interpretations and express their own point of view about the issues being examined (Cohen et al., 2018). The semi-structured nature of the interviews meant that the same basic questions were asked, enabling comparison between respondents, however, also allowed for flexibility in discussing issues of interest that arose in the course of the interview (Punch & Oancea, 2014). Interviews allow the interviewer to ask probing questions to clarify meaning and gain a more in-depth perspective, which is not captured by a written questionnaire (Mutch, 2013).

3.8 Data Analysis

All twelve interviews were audio recorded and transcribed using a computer transcription service. Transcriptions were then reviewed to make minor corrections to spelling of specific education terms. In some instances words were incorrectly transcribed due to mishearing the New Zealand accent. These were picked up and corrected during the review process.

The transcripts of the interviews were then analysed and coded according to common themes and recorded in a database. Each theme was examined to gain an understanding of participants' perceptions and motivations. The process of coding allowed for the

identification of patterns in the data. Each theme was then reviewed again, with common ideas viewed together and some of the data was reclassified. Within the database, data was able to be organised and viewed by theme, school or participant making it possible to compare ideas between schools and individual participants.

Findings were presented using a traditional multiple-case study format; by presenting the cases as three case studies, with each school discussed individually, followed by cross-case analysis of the similarities and differences between the schools (Yin, 2018).

The primary drawback of this approach for analysis is that it is the researcher's interpretation of the data and it is possible that the data could be interpreted in different ways. In order to account for this all data was coded before identifying key themes across the responses, considering multiple different interpretations of the data and, as previously discussed, alternative interpretations were discussed with thesis supervisors to gain different perspectives.

3.9 Ethical considerations

When conducting research in education, ethics is a concern as research involves the collection of data from people, about issues in which they have an interest (Punch & Oancea, 2014). In order to ensure the research was conducted ethically, ethical procedures set out by Massey University's Human Ethics Committees were followed and measures were put in place to protect the privacy and confidentiality of all participants. Each school participating received copies of the School Information Sheet (Appendix A) which explained the purpose of the research and what was involved. This was discussed and explained to the Principal of each school. The Principal of the participating schools then signed a school consent form (Appendix B) to indicate consent on behalf of the Board of Trustees that research could take place within the school. Individual participants were provided with the Participant Information sheet (Appendix C) which was discussed with the researcher prior to the interview, and all signed a consent form stating that participation was voluntary and they had the right to withdraw from the research at any time. All participants were offered the opportunity to review their comments if they desired. Where participants made comments that they indicated as "off the record" these were not used in the research but considered for background information. All participants signed an individual consent form (Appendix D).

Pseudonyms were used for both the names of the schools and the individual participants in order to protect their privacy.

3.10 Caveats about the study

With case studies it is important to note that they only provide a snapshot of what is being studied (Yin, 2018). In the case of this study, only three intermediate schools were included in the study and within those schools, only a selection of teachers were involved. It is also important to note that the three schools have very different approaches to delivering the mathematics curriculum, which could influence the views of the teachers in each school. By conducting cross-case analysis comments are to some extent taken out of context (although similar comments were repeated by a number of teachers across the three school settings, making cross-case analysis appropriate).

3.11 Conclusion

The purpose of this research was to study how teachers were catering for diverse learners in mathematics, understand why they used the approach they were using and identify some of the challenges they face. Three schools were involved in the multiple case study, with three to five teachers participating per school. The interpretivist paradigm shaped the research approach and the research design was multiple-case case study.

A total of twelve interviews were conducted using snowball sampling to select the participants within each school. These interviews were transcribed by an online transcription service and checked by the researcher. The transcriptions were analysed and coded to support identification of themes.

Reliability, validity and credibility were considered throughout the research process. There was also an acknowledgement that in any case study research there are some issues in relation to the replication of the research. Efforts were made to ensure that this research accurately and honestly reflected the views of the participants. Ethical considerations were adhered to throughout the research and Massey University Ethics Committee regulations were followed.

Chapter 4: Findings

4.1 Introduction

This chapter reports on the findings of the research data collected from interviews with teachers at three different intermediate schools in New Zealand. Interviews were conducted between November 2019 and August 2020, primarily by video call. Teachers were asked about the ways in which they cater for the diverse learning needs of their students, and their rationale for these methods.

Nine intermediate school teachers and three lead teachers for mathematics, across three different schools participated in this project. All the schools were considered to be mid to low decile schools (ranging from decile 2 to 5) and are located on the North Island. All three schools have a significant number of Māori and Pāsifika students (over 40%), with one school reporting around 75% of their students identifying as Māori. The teachers involved ranged in experience, from provisionally certified teachers to teachers with over ten years' experience.

This qualitative research follows an interpretivist paradigm and the research method is based on a multiple case study design (Yin, 2018). For each individual case the findings are reported thematically, followed by a cross case analysis, highlighting findings that are common across all three schools. The research questions were directed towards gaining an understanding of teacher perceptions of how they organised their classes to cater for the diverse learning needs they found in their mathematics classes and their rationale for what they did. School context had an impact on their practice, but there was still significant variation within each school.

In each case, the context of the school is discussed as this frames the environment in which the teachers are operating and has some bearing on the decisions they make regarding catering for their learners.

4.2 Beachside School

Beachside School is a large intermediate school in a city on the North Island. The school draws a diverse range of students from across the city, with contributing schools ranging from decile 1 to decile 9. Beachside also attracts a number of International students, primarily from Asia. Five teachers from this school were interviewed from this school, including the deputy principal with oversight for mathematics.

Classes are organised into syndicates of around five classes per syndicate. Students are divided into separate classes for Year 7 and Year 8. The school has a dedicated accelerant syndicate in which students are required to sit an entrance examination to gain entry. There is also a bilingual syndicate which caters for students wishing to be taught in Te Reo Māori. Across the rest of the school there are some syndicates where classes are single cell and some which are Innovative Learning Environments (ILEs). The school also has a multimedia syndicate, entry to which is by ballot and for which students are required to buy a specific device when they join the class.

4.2.1 Approach to mathematics instruction: Primarily ability-based grouping and across class streaming

Teachers at Beachside School are given a high degree of freedom over how to deliver their mathematics programme, and decisions about how to organise instruction for mathematics are often agreed within each individual syndicate. A recently updated school-wide rubric details what strategies and knowledge are required for each level of the curriculum in line with the New Zealand Curriculum. The rubric is organised into curriculum levels and each student has a copy of the level they are currently working within. They are expected to collect evidence for what they can do before being signed off as achieving that skill.

Teachers described the current programme for delivering the mathematics curriculum as flexible, allowing teachers to organise instruction in the way they think is most appropriate for the learners they have. Often this is decided within a syndicate. The teacher with oversight for maths describes the school approach:

> Mike: It isn't prescribed to the school per se. I like to think that teachers in teams
> devise a maths program that best suits the needs of their kids and obviously we've

a whole range needs across the school…[it's] a mixture of whole class teaching of maintenance and both whole class teaching of maths skills and knowledge and or grouping, differentiated grouping of students to their needs. And there will be some pockets of mixed ability groups as well.

Of the teachers interviewed all except one reported regularly grouping students by ability, either within their class or across classes in their syndicate. Amy, who teaches in an ILE, reported streaming students by ability across four classes. She said that the range of abilities they come across meant it was easier to stream the students in order to meet their needs. Two other teachers discussed how they primarily grouped based on ability, using testing to decide on groups and identify next steps.

One teacher explained how she used mixed ability grouping and followed what would be recognised as the model of complex instruction where rich tasks were used to promote discussion and collaboration between students, but explained that this was not common across the school and was something that she had implemented in her class due to her own experiences of learning about mathematics education through professional development she had attended.

Across the school, they were at the very early stages of looking at how mathematics should be delivered schoolwide, discussing how instruction could be organised without using ability grouping and moving away from levelled tasks. When most of the interviews took place, the lead for maths had conducted a professional development session that week on tasks around developing a positive mathematical mindset and beginning to discuss some mixed ability tasks.

4.2.2 Diversity of Learners

Teachers at Beachside School all reported having a wide range of learning needs within their classes. The lead teacher for maths explained that students were divided into tiers based on where they were in relation to the expected end of year level. If a student is one sublevel below the end of year expectation they are considered to be Tier 1, two sublevels below is Tier 2 and three or more sublevels below expectation is Tier 3.

> *Mike: So we'll have levels one to five and obviously the CWSA cohort will have level five, maybe some touching level six. [From term one data] we have around 800 students that are two or three sub levels behind where they need to be by the end of the year, so it's quite a substantial amount of the school. And probably half of them are in what we call a tier three, so three sub levels behind expectation by the end of the year.*

The classroom teachers also reported this as being their experience. Other than the teacher of the accelerant class, all teachers reported having learners from at level 2 to level 5 within their class. One teacher described her class:

> *Julie: We have quite diverse needs of year 7 and 8 learners. All my students are Maori students. I think the lowest learner my class is operating at level one...And then I have my top learners sort of like operating mid level five. Yeah. So from level one all the way to level five, however, most of them sit sort of at, I would say like late level two to early level four.*

All the teachers interviewed felt that students in the school had a wide range of learning needs which they were expected to cater for and that this diversity was greater than that found in primary school classes.

> *Amy: I guess when you're at intermediate, it's a difficult spot because you're not like at primary year one, two, where you're looking at year one, two stuff and everyone is at the same point, we span across everything.*

4.2.3 Teacher beliefs around ability grouping

Amongst the teachers, all but one discussed how having to cater for such a wide range of learners made it difficult to cater for everyone without dividing into ability groups. One teacher discussed how it was not just about the academic capability of learners, there were also other issues such as self-efficacy and engagement that often went along with lower level learners.

> *Cath: What I do struggle with is like my student who's a level one and then my next student would be probably early three.... so how do we help that student with*

the skills they need to have without making it different from other people, but it needs to be different...what's the best situation here for the student moving forward in knowing how to do this stuff? Because if I put this particular student in a mixed group, he will not talk because he's learnt to believe that he doesn't know anything.

Cath argued that though she knew there could be benefits to grouping students in mixed ability groups, her experience was that lower students like the one she described do not get involved in the group because they do not believe they have anything to offer and their knowledge and understanding in maths means that they do not feel able to contribute to a group. This view was repeated by other teachers who argued that the lower achieving students in particular did not have the basic skills to participate in tasks with other students, and that they had lower student agency.

Amy: Sometimes the students that are in [the lower ability] class, they are level one and two in maths but also their student agency isn't at the same level as students are in [the higher level] class...so it's easier to monitor those students [in the higher class]. Whereas [the teacher of the lower ability class] has a larger portion of her students that have low student agency. And so she needs to work with them more closely.

Teachers expressed that grouping by ability was an easier way of organising students, both in single cell classes and in ILEs as it meant they were able to plan for each specific group and make sure that they were checking off skills they needed to work on from the rubric. One teacher discussed how she felt that, while she understood the downsides of streaming, for her it also came down to teacher workload. She argued that she could plan more effectively and efficiently if she was grouping by ability rather than placing her students in mixed ability groups and using rich tasks.

Amy: So part of that is also about making it easier for myself. Because, yeah, I know that it definitely is kids first but also we've got to be realistic and I'm not gonna spend 24 hours a day planning.

This idea was echoed by other teachers who discussed that making changes to their programme towards rich tasks and mixed ability grouping would require a lot of additional

work and that unless it was a focus for the school it probably would not happen. Cath noted that there were a number of initiatives in the school at the time, designed to raise achievement in writing, as well as the introduction of the nationwide Digital Technologies Curriculum, meaning that any changes to the way maths was delivered was not a high priority for the school.

Teachers also commented that they felt that there would be resistance if the school did try to get rid of ability grouping, particularly from teachers who had been in the profession for a long time.

> *Amy: By some people, [ability grouping] is believed to be the best practice and an alternative cannot be seen...sometimes with all the other changes that are going on in the curriculum, we have so many other things that are brand new added in, then going through and doing a completely new math program seems a bit daunting.*

Again the argument was made that unless it was a schoolwide policy to move away from ability based grouping there would not be much change to existing practice. It was discussed that, if changes were to be made, this would need to be driven by senior management and professional development would be required.

4.2.4 Catering for lower level students

Some teachers who were interviewed from Beachside School felt that lower ability students would not be adequately catered for if they moved away from ability based grouping practices. In particular, teachers discussed how lower ability students needed remedial tasks to help them master the basic skills and start to catch up to their peers in mathematics.

Gabriella and Cath discussed how they felt that the lowest achieving students across the school needed more real world experiences than the higher students in order to ensure they had the basic skills to use maths in the world beyond school.

> *Cath: I think if a student's at a level one level, and if it's a cognitive problem or something like that, they will have different needs. So we might need to prepare*

them to just be able to interact in the world, into real life skills and things like that. I guess it depends on the child in their needs. So if they, yeah, they need to have a certain level, I guess of what they can and can't do to be able to just even go shopping at the supermarket or you know, all that stuff as well comes into it.

Gabriella: I guess you need to find the most important maths skills they need to be successful in life. Like, you know, another day when I haven't had to use algebra kind of thing or, you know, like, what's gonna what's going to help them the most in other curriculum areas and stuff and I'd say you know, getting them really solid in their number and focusing those foundation skills really.

Cath and Gabriella said that this shaped the tasks that they gave to lower level students as they wanted to make sure they were able to understand enough maths to function in the wider world, but did not necessarily feel it was appropriate for them to tackle higher order thinking tasks that other students would be tackling. Amy also discussed how, by separating the lower ability students into a different class across her ILE syndicate, they were able to target the skills that the lower students really needed and deliver it in a way that made sense to them.

Although ability grouping and streaming were predominantly the way that the most of the teachers interviewed delivered their maths programmes there was discussion about the impact on students in lower groups, and an awareness of mixed ability teaching. Lead teacher Mike discussed how his thinking was changing and that he was beginning to explore the idea of mixed ability grouping and a greater emphasis on rich, open tasks. He discussed some of his concerns with ability grouping and streaming.

Mike: Streaming for maths is probably what's happening majority of the time. I don't know if I'm such a fan of it. Kids sit there with each of like few on the bottom group and you're with a whole lot of because they're in the bottom group your self efficacy is gonna be pretty average, isn't it? You know, we're all in the dumb group, low motivation. And I'm not sure. You know, they won't get exposure to some of the higher thinking someone with a, at a higher level could come in and share their thinking, Hey, have you tried this strategy and explain it? I think the low kids would

miss out on that opportunity of the teachers there but that's my thinking, I'm a bit of a mixed bag.

Julie explained how she was committed to organising her instruction for mixed ability groups and ensuring that all students had access to the higher order thinking tasks.

Julie: I think moving away from ability based grouping [is important] because there's a stigma behind maths in terms of the dumb groups and the top groups and then the lower children they never get exposed to those high ceiling tasks. I think that's probably the main takeaway. It's a brave move, though. And it takes a lot of guts and a lot of planning as you actually have to be more structured and more planned to be able to pull that off. But it takes away all of that stigma with the low groups, high groups, and everybody's all working together.

Julie recognised that it was a big step for many teachers and would take them out of their comfort zone but felt that the benefits for everyone made the risk worthwhile. She argued that mixed ability grouping supported a Māori perspective and helped build self-esteem in students.

Julie: [Mixed ability grouping] also allows me to really make [the students] believe in themselves when it comes to a growth mindset where it's not like you're going to have this problem because that's your level. It's like I believe all of you can do this, even if we have to work together. From a Māori perspective, we have so many like whakatauki[2] to support that thinking too like mauria te pono (believe in yourself) and he waka eke noa (we are all in this together). Yeah so we are a community of learners rather than the kaiako[3] being the only person. It also makes my job easier because I have all these little experts that are helping everyone else.

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[2] *Whakatauki* means a proverb or significant saying in Te Reo Māori
https://maoridictionary.co.nz/search?idiom=&phrase=&proverb=&loan=&histLoanWords=&keywords=whakatauk%C4%AB
[3] *Kaiako* means teacher in Te Reo Māori
https://maoridictionary.co.nz/search?idiom=&phrase=&proverb=&loan=&histLoanWords=&keywords=kaiako

Cath and Julie also both identified that students being able to work together and learn from each other was a benefit of mixed ability teaching. Cath discussed how different students could get different things out of the same problem which she saw as a benefit.

> *Cath: Kids can learn from each other. And I quite like the idea that there's lots of different ways to look at a problem and to get things out of it. What one student gets out of it can be different from what another student gets out of it.*

Julie talked about the idea of students supporting each other and discussed how it gave students a chance to value different abilities.

> *Julie: I also find having mixed ability groupings allows for tuakana-teina[4] where we have got like, you know, some students that might be quite onto it with multiplication supporting the other students who may need that help. And then that role changes too like another child might be sort of at a higher level for fractions, and then they help the other children who are not, so they will switch, the roles are reciprocal.*

From her perspective this meant that students started to value different skills, rather than just focusing on achievement level according to where they were at in relation to the New Zealand curriculum.

4.2.5 Catering for higher ability students

There was a concern among some of the teachers interviewed that mixed ability teaching often means that the more capable students miss out and do not get extended. The teacher of the accelerant class expressed concern for those higher achieving students in mainstream classes saying:

> *Gabriella: I think sometimes those level five students in the mainstream don't get extended enough because maybe, you know the teachers are too busy teaching*

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[4] *Tuakana-teina* is a traditional Māori model in which an older or more expert *tuakana* helps and supports a younger or less expert *teina* https://tereomaori.tki.org.nz/Curriculum-guidelines/Teaching-and-learning-te-reo-Maori/Aspects-of-planning/The-concept-of-a-tuakana-teina-relationship

to the middle or get those lower ones coming up...I think maybe they don't get quite a push in maths.

Amy expressed concern that many teachers think that getting the higher students to teach lower students would provide them with extension but she did not believe that this was the case. She felt that streaming students across classes meant that they could be given higher level tasks that would extend them and stop them from getting held back by other students who did not understand the more challenging work. Amy used the teacher of the high level maths class in her ILE to illustrate her point, arguing that this top class was able to work through much higher level content and experience greater student agency because they were working with students of a similar ability. She said the teacher was able to provide them with higher order thinking tasks that would stretch them in a way they would not be if they were together with the lower ability students.

4.2.6 Teacher capability

Beachside School teachers all discussed that one of the biggest reasons why they felt teachers at the school were using ability grouping and streaming to cater for the needs of their students was because of teacher capability. Teachers reported that they knew about mixed ability teaching and understood that there were benefits for students, but that they did not know how to implement this in their own practice. One experienced teacher explained:

> *Cath: I don't know how to cater for all of those needs within a mixed learning group. I've never been shown.... And I would say that most staff are probably the same. You stick with what you know, really, don't you? And if you look at older staff, if no one's ever talked to you about it before or shown it you'd probably be scared to try.*

There was a feeling amongst some of the teachers that this was something they should be using but that they did not have the skills or knowledge to know what was involved and how to do it effectively. These teachers were often aware of others within the school who were teaching using rich tasks and mixed ability grouping but there did not seem to be much sharing of skills and experiences across the school. The teacher who had been

using mixed ability grouping in her class for a number of years explained that she is the only one in her syndicate teaching her students in this way.

> *Julie: I think because for others of my house I think they're still following that traditional way of teaching that they've always known and change for anybody is not easy. And I suppose in order for change to happen you need to shrink it and show people how easy it can be done.*

Julie also reported that the other teachers in her house have not shown any interest in how she runs her programme. She has shared little snippets with them but they have not asked her and she does not want to force it on them. As it's not been a schoolwide expectation to teach students in mixed ability groups, or to utilise low floor, high ceiling tasks she has not felt like it's her place to tell them what they should be doing.

> *Julie: But I do find that also being a kaiako in the Māori house, you don't want to be whakahihi like a show off, like, this is what I do, so why don't you give it a go. So you have to sort of be mindful of that thin line of being humble, as opposed to sort of sharing your successes, but finding it that thin line is not an easy thing.*

As well as saying that they were not really sure how to teach without using ability based groups, there was discussion about the content knowledge needed to be able to facilitate discussions with groups of mixed ability students. Teachers were concerned that they would not be able to quickly recognise the different strategies that students were using and be able to connect one to another. They felt that when they knew what level a child was at and had them in a specific group they could predict what strategies they would use and plan for what they wanted them to be able to do next, but in a mixed ability setting they felt this would be harder.

> *Cath: I don't think teachers know how. I think they know how to check off a rubric or know the curriculum level. They put the kids in a group with a label onto them and they're like, I'm looking at this very narrow skill within this very narrow area. If they can do this, I tick them off, I move them up. If they can't do this, I teach them x.*

Julie discussed how mixed ability teaching fitted well with the Māori perspective and argued that teachers needed to be prepared to take risks in order to improve their practice. She said that, from a Māori point of view, the best way to support teachers was to give them the freedom and support to try things out and then be ready to help them if they make mistakes.

> *Julie: It comes back to that mauria te pono, you just have to believe in yourself and find ways to learn how to do it because it's like anything else if you don't know you learn and mistakes are fine...I've also got this saying that I've been using for years and it's ma te hē ka tika and it's quite a traditional way of teaching from a Māori perspective. It means that through our mistakes, things will be right, through our mistakes we will learn... So we call it don't be a mōhio - don't be a know-it-all and tell people how things should be done. Let them learn through their mistakes*

4.2.7 Assessment, Reporting and Accountability

One of the key themes that was repeated by all the teachers interviewed was the pressure they felt from leadership to show that they were moving students up through the curriculum levels. Cath, Amy and Mike all discussed how they were expected to show movement of students, with a particular focus on accelerating student achievement. Mike explained how this meant getting students who were significantly lower than the end of year expected achievement level to make more than one year's progress in order to catch them up. As previously discussed learners at Beachside School were stratified by tiers depending on how far off the end of year expected level they were. Teachers discussed the pressure to demonstrate how they were accelerating the progress of those lower learners meant that they were reluctant to try different ways of delivering the curriculum as they were concerned that any drop in achievement would reflect badly on their own abilities. The lead teacher for mathematics explained:

> *Mike: We've got students that need accelerated learning, they need to make more than one year's progress, to start catching up with where we need them to be for curriculum expectations. That's a big part of it.*

One of the specific difficulties teachers discussed was the challenge of keeping track of individual student progress in a mixed ability environment, especially when doing rich tasks that were not specifically aimed at one level.

> *Amy: How would you know where each child was at? And what they've done in each lesson and where they are on the continuum. So if you're giving a rich learning task, how can I know that Todd over here is he's done something at advanced level three, and Jenny over here has done beginning level two...but then also extending this child and supporting this child who this child doesn't even know how to count on, while this child is working with algebraic formulas.*

Amy also explained that senior leadership had told her to organise her class by ability to make it easier to track their progress and ensure that her students were ticking off new skills and knowledge on the rubrics. This enabled her to focus on her tier 2 and tier 3 students (those who are two or more sublevels behind the expected end of year curriculum levels for mathematics).

> *Amy: in my own maths class I have, from instruction from senior management, organized my groups using the new maths tiers...before I did mixed ability but now that I've had to separate groups out to be able to work with them on top of what we already do, then I've had to go to ability groupings.*

4.2.8 Preparation for college

Another theme that emerged from the interviews was the issue of preparing students for college. Teachers felt that it was important to get students used to streaming and ability based grouping as they believed that this was what the local colleges were doing. Lead teacher Mike discussed:

> *Mike: Well, I had [a college] DP come and talk to the kids and they do a test to put them in the right class. Obviously we've got college testing coming up, presumably that's why, but I don't know for sure... [Local] colleges definitely have the top top classes but I think after that they're all mixed up. Yeah, I think they just keep the cream and then mix them up after that.*

Gabriella, who taught in the accelerant class discussed how her syndicate had a big focus on preparing their students for the top classes at college and designed their Year 8 programme to ensure their students were prepared for the testing.

Gabriella: Well, our kids are testing to get into those top classes at college and I know boys' college has got a big emphasis on problem solving and reasoning. So for them to get into those top classes, they actually need to be really good at that. So we kind of have to prepare them...We're doing maths revision as homework...so we've done measurements, statistics, algebra each week. They're actually going over maths type questions. To get them ready for college.

Cath felt that teaching in the intermediate school needed to focus on setting students up for the environment they'd be moving into at college, however she said that she was not entirely sure how the colleges delivered their mathematics programmes. When discussing some of the influences on her programme she said:

Cath: a little bit of probably heading into college, looking at what college use to stream…but I'm just looking at what the kids need before they go through to there. I guess how do we set them up for that environment?...it's kind of part of me is like, right, so, to set them up to be successful, they need to know these structures of how the stuff's going to be learnt at college like in a way...because if they get there and then the teacher's like no, this is what we're doing.

4.2.9 Conclusion

Although the school had no official policy on how the maths curriculum was delivered at Beachside School, the majority of those interviewed said that they predominantly grouped students by ability, whether within one class or across classes in their syndicate. There were some teachers who were employing mixed ability, complex instruction and culturally responsive instructional models it seemed that they were in the minority. Despite this, the teachers interviewed were aware of the issues of ability based grouping and could see some of the benefits of moving towards a mixed ability grouping model. Preparing students for college was a focus for some of the teachers at this school and shaped both what they taught and how, despite the fact that the teachers did not have a clear idea of what

mathematics instruction in the colleges their students would be moving on to would be delivered.

4.3 Riverside School

Riverside Intermediate School is a medium sized, mid decile school catering for a wide range of students from across the city, with contributing schools ranging from decile 1 to decile 9. The school reports that around 45% of their students are Māori or Pāsifika learners. Four teachers, including the lead teacher for maths were interviewed at this school.

Lead teacher Harriet explained that over the previous two years the school had undergone a dramatic change to the way they organised their classes in order to make sure they were providing students with greater equality of opportunity. This meant that the school got rid of their accelerant and bilingual classes. She said that students entering the school were now placed randomly across the different classes. The only deliberate division of students was placing children with known behavioural difficulties around the school, and with more experienced teachers. All classes were composite Year 7 and Year 8. As part of their programme of reforms Riverside school had adopted a policy of no streaming or ability grouping across all classes and in curriculum areas.

Teachers within each syndicate were divided into teaching literacy and social studies; maths and PE; and specialist subjects including technology, science and music. Students within each syndicate rotated between these teachers daily. Teachers had the option to change their specialism at the end of each year and provisionally certified teachers were required to spend one year teaching literacy and the other teaching mathematics, in order to fulfil the requirements of their teacher registration. This was done primarily to facilitate changes to the timetable that has enabled the school to reduce class sizes.

4.3.1 Approach to mathematics instruction: Complex instruction/mixed ability

Over the last three years Riverside School has been working with an external professional development provider to help them reshape and develop a mathematics programme based around mixed ability teaching to fit in with their policy on moving away from streaming and ability grouping. Lead teacher Harriet explained that they had been developing a programme of rich tasks, group work and discussion in mixed ability groups. Teachers discussed how they have been learning about low floor, high ceiling tasks and differentiated tasks, by which they mean adapting a task to make it suitable for both higher learners and lower learners.

Harriet: We've done some workshops on low floor, high ceiling tasks and got a number of PLD books for the teachers as well so even though we kind of told the teachers to start with the level 4 tasks and you differentiate from there. So for your extension kids or high ability students you would take that task and adapt it to say level 5 and then for your lower kids accessing it at a lower level say that are level 3 or level 2.

Harriet also discussed how they tried to tie what students were doing in other curriculum areas with what they were learning in mathematics, for example, they planned to do statistics in the same term they had a focus on science so they could show how the two curriculum areas linked together and could use the real world contexts from science to learn about statistical concepts.

4.3.2 Diversity of Learners

Teachers at Riverside school reported having students in their classes ranging from level two of the New Zealand curriculum up to level five, compared with the expected range for Year 7 and 8 students of mid level 3 to mid level 4 of the New Zealand Curriculum. The school no longer had accelerant or bilingual classes, so the makeup of all classes was similar. Tom and Eve explained the range of abilities they encountered in their classes.

Tom: I guess it's a big scale. I've literally got kids that will take their time or use their fingers to add six and eight together. I've then got kids who are doing advanced fractions, multiplying fractions, advanced problem solving. So I've got the very bottom end, and I've got the very high end all in my class and then everything in between.

Eve: The ranges are so wide and you've got kids that are down, you know, still using blocks to add 2 and 2. And then you've got kids at the other end that, you know, are ready to do trigonometry.

All the teachers interviewed made similar comments about the range of abilities in their classes. Each class had some students who were operating at a very basic level, requiring support and materials to solve simple number problems as well as students who were

operating at an advanced level, above that expected of their age group. Eve discussed that this made it challenging to cater for all students in the same class as the needs were so wide. She said that those students who were still needing to use materials to solve simple addition problems found it very difficult to engage with some of the tasks because they lacked the basic skills for them to access the task. While she supported the idea of mixed ability instruction and rich, open tasks, she did question whether this really worked for those who were that far behind that they did not have the basic skills needed to be involved in the discussion.

4.3.3 Catering for lower level students

The value of mixed ability teaching was discussed by all the teachers interviewed. There was a general agreement that it removed the stigma for those who would have been in the lower achieving groups and meant that students were able to work together to support each other in their learning. Teachers discussed what they saw as the advantages for students who would have been in lower ability groups if they were ability grouping. In particular they discussed how, in a mixed ability setting, all students are exposed to the same tasks and have the same opportunities to succeed.

> *Sophie: I think the kids enjoy what we are doing and there are some kids that I know would have been in the lower groups but they get to do all the work that everyone else is doing. Everyone gets to have a shot at all the tasks and then when they succeed at something they think is difficult then they feel really good about maths.*

> *Eve: Having mixed ability groupings is better for the kids. Because, you know, the lower kids are operating with the higher kids and there is just that ability to be able to, you know, stretch some when they show they are ready for it.*

The issue of students supporting each other was also raised with one teacher talking about how students could support each other better when working in mixed ability groups.

> *Sophie: Kids can work together and help each other so it isn't always on the teacher. Sometimes having another student explain it and help out with explaining an idea or strategy helps them much more and they get it easier than when they*

are just hearing it from the teacher. The kids come out with ways of explaining it that I would never think of that just seem to make more sense to them. And I think it helps them understand it better themselves as well, when they can explain it to someone else.

One teacher discussed his own experiences with being in lower groups for maths at school. He highlights how this impacted on his own attitudes towards maths. He says he can understand how being placed in a group that was considered the lower groups affects how students feel about maths learning.

Tom: I struggled with maths when I was at school, so I'm very honest with them and how I talk about my maths ability...Like, I struggled with math because I thought I was dumb in it. So I was in all the dumb classes. And it's because I didn't try. I was probably more there to muck around but I guess the kids think it's hard because they haven't got some of the things or don't really understand it very well. So they just sort of switch off and just give up and you have to get them back.

He also discussed how the perception of being the lower ability student is something that students of this age are particularly aware of.

Tom: I think it's the perception of being a lower level kid. It's like the kid wouldn't want to go out to a teacher aide, because they know that they're going to a teacher, especially at this age, a primary school, I think it's probably a bit different. At this age, when you're going to a teacher aide, you know, it's because you're dumb. And the other kids will see you as being dumb and they will get, at this age, they will tell you do you have to go to that person because you're dumb?

However, Eve did discuss how she felt that the lowest students were missing out in the mixed ability environment by not getting the chance to work in a small group with peers of a similar level.

Eve: Personally that concerns me, because I think that our low kids are missing out. Because I think it's important to have some of those small pull out groups, for kids to be able to, you know, and not all the time. But even if it was just once a

week, you know, they came in and they learned one strategy, one thing that they could do differently that they can then take and go back in, you know, go back and use it in class.

Eve felt that taking the lowest students in small groups would provide them with the chance to work on some of the strategies that the others had already mastered, enabling them to then participate more actively in group tasks.

4.3.4 Teacher beliefs

Despite his own experiences of being in lower level maths groups during his own schooling, Tom also discussed how he thought that while the theory behind the idea of mixed ability grouping was sound, he felt that it did not really work at intermediate level because the variation in ability was too great.

> *Tom: I think it would work at primary schools. But at our school, I just don't think it does. I find it too difficult. For those lowies like, they just don't get it. They are really, really bad at math, like when I'm talking like level two kids here. They're just, it's just to even just simple concepts just go straight over their head. And so having a mixed ability group with all sorts of different levels doesn't really work. Yeah, like you say the theory sounds fabulous. But I find it really hard at this age level.*

The lead teacher for maths raised the issue that when teachers were struggling to get to grips with mixed ability teaching or were having difficulties with behaviour within class their default was often to revert to ability based grouping. She said that she knew of several teachers who had reverted to ability based teaching as they found mixed ability too difficult to manage and that this was supported by senior leadership while they continued to try to upskill the teachers. Tom, an experienced teacher, reported that he would manipulate groups into pseudo ability groups in order to cater for differences between learners as he felt that this enabled him to support the development of his learners more effectively, despite the fact that he agreed that the reasons for teaching in mixed ability groups were valid.

> *Tom: I think I'm adapting to that, sort of just sneakily trying to have ability groups but it's more the really top kids are in one group and the middlies and then the lowies are in another.*

Eve discussed how she felt that not everyone is committed to the idea of mixed ability learning. In her opinion the reasons why they had moved to mixed ability grouping had not been shared well enough with the staff, meaning that most were doing it because they had been told to and because that was what their professional development was making them do, but they did not have a strong enough grasp on the why. Eve also argued that, for many teachers, this was so different to the way they had been teaching maths in the past that they found it hard to let go of old beliefs and saw mixed ability grouping as the latest fad. This meant that they were not committed to ensuring that mixed ability instruction worked in their classes.

> *Eve: I think it's the why that's missing. And so they're doing this stuff, because they have to do it not because they want to do it. We know that when we do PD that we have to do versus feeling that we want, we get something very different out of that.*

Although all teachers had expressed advantages for lower ability students when working in mixed ability groups and working on rich, collaborative tasks, it was apparent that they felt that the difference in ability between students in their class made this challenging and that not all the teachers were convinced that it was possible.

4.3.5 Teacher Capability

As with the other schools involved in the research, teachers at Riverside School felt that one of the biggest challenges of mixed ability teaching was ensuring that teachers had the capability to manage different ability levels in mixed ability grouping. There was a feeling that many teachers lacked the content knowledge and understanding of the development of mathematical ideas to be able to effectively teach in mixed ability groups. Experienced teachers discussed the content and pedagogical knowledge that they felt some teachers were lacking in terms of catering for everyone in their class.

Eve: I think it's their knowledge...especially for those top end kids, because they tend to know more than you do. And that can be quite challenging. And also how to really how to help those low kids, because in the middle, you know, they're easy, because you know, you teach them a concept once and got it, and off they go and they can do it those low kids need way more work and way more time and it's having the time to be able to focus on those low kids while still giving your high kids stuff to do and, you know, making sure that everybody is actually getting a fair bite of the pie...I'm not sure that that's really happening.

One of the teachers expressed her difficulties with managing students within a mixed ability setting, saying that she struggled to keep everyone engaged and manage behavioural problems when she was not putting students in ability groups. As a beginning teacher, Sophie said that although she agreed with the theory behind not grouping students by ability, she found behaviour management particularly difficult in this setting as some students were struggling while others were finding it easy. She also commented:

Sophie: [It's hard] especially for beginning teachers because I find that I don't have all the knowledge of all the different strategies and it's difficult when you are talking to kids and you have to be able to think what strategy they are using and how you will teach them what they need to know next. You've really got to be on your toes to understand what they are saying and describing, to help others understand and talk about it. And because all the kids are using different strategies it can be difficult to manage and make sure that everyone is understanding and making progress.

The issue of teacher capability was something the lead teacher was aware of. She discussed some of the problems teachers faced when the school started introducing the concept of mixed ability groups.

Harriet: It became very apparent that the teachers didn't know where to start with things, and their knowledge of the curriculum was not very strong, so the PLD facilitators and I stepped back and go well this is more important to try and build up because we can't actually do anything else until they have that knowledge underneath them.

The lead teacher also discussed how this was going to be an ongoing challenge as new teachers joined the school or changed from teaching literacy to teaching mathematics. She felt that few teachers were coming in with the knowledge and ability to teach in a mixed ability setting and that the school would need to support those coming in to get up to speed, as well as consolidating and continuing to develop existing teachers. Harriet explained that, as maths lead, she would be out of the classroom next year to enable her to support teachers across the school in developing their skills.

4.3.6 Advantages of specialising in one curriculum area

Although Harriet explained that the reason for dividing the teachers into literacy specialists and maths specialists was based around timetabling and to facilitate smaller class sizes, it was discussed that this had some advantages for enabling teachers to focus on one subject area and improve their own content and pedagogical knowledge in this area. Tom explained how he felt that focusing on maths for two years had helped him develop his own knowledge and his ability to teach mathematics. Discussing what had made the biggest difference for him in the last few years he said:

> *Tom: For me personally, it's my own ability in maths and improving my knowledge of mathematics, which can then filter through to the kids. I guess just concentrating on the subject itself has definitely made me I guess, look deeper into the subject and try and find new ways of being able to teach the subject...I'm always just thinking about those higher end kids and making sure that they, I'm challenging them...I do enjoy teaching it and I know the kids enjoy coming to my class.*

One teacher argued that she did not think this was true of everyone as a number of maths teachers had elected to teach maths and physical education rather than literacy because they were passionate about teaching physical education. In her opinion they were lacking in teachers who were as passionate about maths and had the drive to really improve their maths teaching abilities. Harriet said that the decision to split teachers across different curriculum areas was made by senior management to facilitate changes they were making to classes and timetables. She hoped that it would help them to develop strong maths teachers, it would require teachers to stay in one curriculum area for a few years to build up their skills.

4.3.7 Catering for higher learners

There was a general concern among a number of the teachers interviewed that mixed ability grouping did not enable them to effectively cater for higher ability learners. There was a feeling that it worked for the middle and lower level learners but that the more capable students were not getting the opportunity to be extended.

> *Tom: So I guess and at our school, they really want to move away from streaming and that sort of style of learning, and just try and stick with mixed ability which I find is really good for the middlies and okay for the low students. But the high end kids just miss out. Because I just feel that I'm sort of spending too much time with the other ones and I don't get to push those ones as far as I would like to.*

Eve discussed that there was a feeling among some parents that the mixed ability setting did not adequately cater for the higher level learners. She said that parents whose older children had been in the accelerant classes during their time at intermediate had been vocal in their opposition to mixed ability grouping. When discussing whether she felt that mixed ability worked for higher level learners she said:

> *Eve: It depends who you ask, if you ask the parents, they would say no. I know because a lot of other parents track me down in the supermarket and airport and petrol stations and talk to me about it...it is very much the idea that if they were in the extension classes, then they would be extended. And... think there's also a little bit of snobbery around it...the extension parents are very much of the opinion that their child is totally outstanding and, you know, so you've got parents that will be coming up to me going, oh, you know, my three other kids were in the extension class. And now I feel that my little Johnny is not being pushed or not being extended enough.*

Eve said she did not feel this was necessarily the case but that it was difficult to tell because there was no way to know how they would have performed in an accelerant class versus a mixed ability class.

4.3.8 Assessment and Reporting

Another theme that was discussed by the teachers interviewed was the issue of measuring the success in a mixed ability environment. The lead teacher explained that they had moved away from formal assessments and were trying to build teacher capacity to use observations in class and group discussions to measure student achievement. While some of the teachers find this a more effective and reliable way to gauge what the students are able to do, others have struggled to move away from depending on formal testing.

> *Harriet: We've done a few workshops around you don't just weigh your judgement on one particular area but you should use observations and classwork, and discussions and not just a test. We have one teacher who is very heavily reliant on testing and will make up her own and mark it for 75 kids just so she knows that's where they are, she can't make a judgement through a 10-15 minute group task.*

Tom discussed this, saying that in his class he would use some of the tests he had used before they moved to mixed ability teaching, in order to get an idea of where his students were at and what they needed to work on. While he said that he used his knowledge of the students and his observations in class, students liked doing formal testing to see how their abilities had improved.

4.3.9 Preparation for college

One teacher discussed the difficulties of intermediate as a transitional stage between primary and secondary school. She commented that, as far as she was aware, all the local colleges organised students by ability and tested the students in order to place them in streamed classes.

> *Eve: They still test the kids at the beginning...I know that they still test them and then they definitely stream them. So for all that we're saying about mixed ability groupings and we're doing at intermediate and I'm assuming that the teachers are doing at a primary school as well. When they hit high school they are streamed straight away. So yeah, because as far as I know, there is no mixed ability grouping going on at [the] high schools.*

She questioned whether the school should be working more with the local colleges to discuss what they were doing and make sure they were preparing their students effectively for their next school.

4.3.10 Nature of intermediate aged students

Two of the teachers interviewed discussed their views on the nature of students at intermediate schools, questioning whether student achievement at this level made a big difference to their academic success in the long term. Both teachers discussed the importance of teaching students at this age to be good people and develop their ability to interact with others, rather than placing such a high emphasis on academic achievement.

> *Tom: I reckon it's more about making them an all-around good person, as opposed to a brainy person.*

He went on to argue that he did not feel intermediate schools could make a big difference to the learning of students during this time and that his role was primarily to help them develop socially so they were adequately prepared for college meaning they could then go and be successful there.

Eve discussed that students of intermediate school age are developing so rapidly both physically and emotionally during this time that academic learning becomes a secondary concern. In her experience she found that many students struggled to retain information and process what they were being taught.

> *Eve: I think that the sort of middle two years of intermediate almost needs to be a holding pattern. So we just sort of hold and say, okay, we just, we're just going to go over the stuff that you already know, we're not going to teach you anything new unless you particularly want it...I would say 80% of them are just not in a position where they can actually put any more information into their brains. And the minute they get to high school, it just sort of seems to click.*

She argued that developing communication skills and learning how to present and defend a point of view was far more important than measuring progress through curriculum levels, and that far too much importance was placed on data.

4.3.11 Conclusion

On the whole, teachers were supportive of the school's stance on mixed ability teaching, using rich, collaborative tasks. However, their primary concerns were that the spread between the highest and lowest achieving students meant that not everyone was being challenged at the appropriate level. The issue of teacher capability was also raised on the grounds that teachers need a high level of content and pedagogical knowledge in order to effectively teach using this model, although the lead teacher acknowledged that they were putting more support in place and had identified this as an issue.

4.4 Lakeside School

Lakeside school is a mid-sized, lower decile intermediate school catering for students from a range of socio-economic backgrounds. The school has a high percentage of Māori students, a significant number of whom have come from Māori immersion primary schools. Lakeside school provides classes taught in Te Reo Māori and also has accelerant classes for students who have been assessed by the contributing primary schools as being of higher academic capability. Three teachers, including the lead teacher for mathematics, were interviewed.

4.4.1 Approach to mathematics instruction: culturally responsive instruction

Lakeside school had previously been involved in initiatives to develop culturally responsive instruction for mathematics, using mixed ability grouping. At the time the interviews took place, the school was no longer formally involved with these initiatives and had engaged the support of an external consultant to support further development of their programme. The school retained a policy of mixed ability grouping within classes and continued to promote culturally responsive instruction and grouping practices.

4.4.2 Diversity of Learners

Teachers at Lakeside school reported having a diverse range of learners in their classes, from low level two to high level four. Within the accelerant classes the range seemed to be from mid level three through to a few students at level five. Other than the accelerant classes, students were not divided by ability. Lead teacher Mark explained the academic diversity of the students.

> *Mark: We do have a huge range and even our accelerant kids, they are level three, all the way through pretty much there's a few level four for sure, but they're pretty much level three, and then we've got those kids who are still skip counting.*

Teachers discussed how they felt that the range of learning needs in intermediate schools was wide and that there were a number of students who, by the time they got to intermediate school, were considerably behind where they were expected to be. One teacher commented that there was something that was not working for those children who had not reached the level that was expected of them.

Caitlin: The thing is you have all of them in one class, some who can do algebra and advanced maths and a bunch who are counting on their fingers to solve simple problems. It's certainly a challenge. By the time they've got to us some kids have got it and some are so far behind. We have a battle to get them to where they need to be. Something hasn't worked for them before, like we can't assume they've just not been taught, something isn't going in for those kids. This is why we've been doing the mixed ability. To try something different and see if that works for all the students.

4.4.3 Catering for lower level students

One of the reasons why the teachers interviewed felt that employing a mixed ability, culturally responsive instructional model was beneficial for students was because they felt it had a positive impact on their mindset and attitudes towards mathematics, particularly students who would usually be in the lower ability groups. Victoria discussed her experiences with her students this year.

Victoria: When I first started with these kids a lot of them had a really poor attitude towards maths, which is kind of like, always the case. It's so much easier when you're doing [mixed ability] stuff to have the discussion, they can see that all the smart kids don't always get the right answers. I think that kind of boosts their self-confidence. And then that just, they get used to talking in front of the class.

The teachers felt that mixed ability showed students that everyone's contribution was valuable and that it took the efforts of everyone to solve complex problems, rather than just the students who were seen to be the most capable.

Caitlin: That I would say it builds up their confidence in their maths ability like teaching them that anyone can learn maths at any level and that their brain can actually learn regardless of where they're starting from.

Caitlin went on to explain that the biggest difference was for the learner who would usually be classified as lower level. By taking away those labels and not grouping them together, all students felt they had valuable contributions to make and could actively participate in the learning.

4.4.4 Assessment, reporting and accountability

One of the key issues with mixed ability learning from the point of view of the teachers interviewed was that it made it challenging to assess the level of the students, and be able to report back to parents and the school about what they are able to do.

> *Mark: What [mixed ability] maths doesn't give you the ability to do, is individually to say okay, so John's got this one and we can go on. So when I do my report, my parents I can't specifically say, here's what John's doing, here's what he needs to do next. I talk about it as a combination of like, what I've noticed in the half the time I see them because then it's like half the class with you, half without, and also for what they've got for the PAT testing.*

All three teachers discussed how they were trying to use a combination of class discussions, bookwork and formal assessments to help them assess student achievement. Victoria discussed some of her methods for doing this.

> *Victoria: Yeah, that's what I just have to use, like, I guess my own judgment. So like checking their books, seeing if they understand it. I guess you can kind of gauge when a kid gets it or not. You can see that they have no idea what they're doing. Yeah, or, I don't know. I just feel like I have the relationship now where I can ask them. Do you guys understand this?...I don't know what other things can I do?*

Lakeside school had moved away from using formal testing such as Progressive Achievement Tests (PAT) and Asttle (common standardised tests within New Zealand) and instead had moved towards the use of tasks, classwork and observations instead. Mark and Caitlin discussed how this was more effective for assessing student achievement as it meant that they got a much clearer picture of what their students could do because they were not having to consider other factors such as ability to take a test and reading skills.

> *Caitlin: If you're not a good reader, you're gonna struggle at PAT anyway aren't you, because it's all about your reading ability as well as your maths ability...If they*

can't read it, they might be quite good at maths, but they haven't had the ability to show it. PAT doesn't work that way.

For some teachers this is not what they are used to and they reported that they felt like they did not have a good handle on what the students were capable of and what they should be working on next.

Victoria: We've done one test this year for maths which was a GloSS[5], we don't do e-asttle, we don't do IKAN[6]. So I found it really difficult to ascertain where the kids are actually at because obviously you know GloSS gives you a lot of information but it's limited to number. So I haven't really been able to rely on testing information at all. So it's basically I start with whole class and then dwindle it down to workshops, basically...so pretty much just starting from scratch.

One issue that Mark raised was that moving away from formal assessment tools meant that they had to ensure all teachers were accurately assessing the ability of their students and were able to identify key descriptors for each level. He discussed how they had been working on checking that teachers were correctly able to identify what each level looked like to ensure that they were able to use evidence gathered from classwork and discussions to accurately assess where the students were at.

4.4.5 Teacher Capability

In discussion around assessment of students, the issue of teacher capability was raised. As previously discussed, the lead teacher had become aware that there were a number of teachers who were not familiar enough with the different curriculum levels to be able to correctly identify what level each student was at. This was something that Mark had started to work on in order to facilitate moving away from reliance on formal testing.

Mark: I think the biggest thing that our staff really need is understanding how to solve mathematical problems, especially more complex ones because I see they

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[5] Global Strategy Stage assessment. This is a face-to-face assessment used by teachers in New Zealand to help determine what stage a student is at on the Number Framework
https://nzmaths.co.nz/assessment-tools
[6] Individual Knowledge Assessment of Number. This is a timed number knowledge test.
https://nzmaths.co.nz/assessment-tools

have come out, maybe not even doing School C in maths, or some of them NCEA level one. And they haven't tried to upskill themselves or they haven't had the ability to upskill themselves.

Mark argued that mixed ability teaching required a higher level of skill both in terms of teaching ability and content knowledge and mooted the idea of specialist maths teachers as a way to address what he saw as a lack of skill and ability in a number of teachers.

Mark: I used to be really, really anti having maths teachers hired at intermediate... but at the moment because of the way things are I actually kind of gone towards we should have that. No, no, it sounds horrible when I say it, but if you want the best for your children, and you want the best for your different generation, we may have to look at [specialists]... because at the end of the day, it's scary that we don't have the people with the skills.

Caitlin noted that teachers were often having to teach themselves about higher level maths concepts in order to teach them in class the next day. She commented that teachers were being stretched in terms of their own mathematical knowledge at this age level and that their way of dealing with this was often to use ability based groups to narrow down what they would be expected to deal with in each teaching session. Victoria said that she felt that the fact that the school did not allow streaming meant that teachers who did not know how to effectively teach mixed ability were teaching everyone the same thing without any consideration to different needs in the class. She argued that teachers were not given enough support to understand how to teach mixed ability groups properly.

There were also tensions about the amount and nature of planning that should be required for maths lessons. Victoria felt that teachers needed to plan in greater detail to make sure they were able to cope with the higher level of maths that is required when teaching intermediate students. She commented that she felt planning should show how teachers would deal with different levels and make them think in advance about the possible solutions that students might give to a problem. Mark disagreed saying that teachers were over planning as a consequence of their lack of content knowledge, which meant their lessons tended to lack flow and did not follow what the students were saying. He argued that teachers were sticking rigidly to their plan for the lesson rather than developing from

what students were doing in the lesson which meant they were missing out on valuable clues to what the students understood and needed to develop.

> *Mark: I think schools make them use it and make us provide our planning. I think it's having a paper trail with what the ministry is expecting out of us. With our registration, etc etc. Our principals have been brought up with this vision of planning is everything. And yeah, don't get me wrong, planning is important, but it's all now pre-empting what it is that those kids might need, and you don't really know all the time positively or negatively. So that teachable moment has to also come into your everyday teaching of whatever it is you're doing.*

In his opinion, teachers needed to respond to what the students were saying and how they were solving problems in order to build on their existing strategies and keep them engaged with what they were learning.

4.4.6 Teacher beliefs

The teachers interviewed from Lakeside school all agreed that mixed ability teaching was better for students both socially and academically. There was a general feeling that teaching in mixed ability groups meant that all students had the opportunity to engage with higher level thinking and were given the same opportunities to learn. Teachers did report that this was not the case for all the teachers in the school and that other teachers preferred ability based grouping because it made it easier for them to plan what each group was going to do and progress students from one skill to the next.

> *Caitlin: I think some teachers don't like doing [mixed teaching] because it's harder to work out what the students are going to come up with, like you know they are going to have lots of different questions and solutions. So when they do ability groups they can plan just for that level and have a bit more of an idea of what the students are going to say.*

When discussing the impact of mixed ability, culturally responsive instruction on their students, lead teacher Mark explained that he saw how it benefited students' sense of self-worth and confidence.

Mark: The bits that was working for us well was it keeps your hauora going in your group because you got these kids who are quiet, afraid to speak and you found ways to value everyone's contribution...every child has a sense of ownership, of certain parts of that the math, but you also had the outside curriculum being taught as well, the sharing your learning your, your feeding back, your asking questions. And I suppose in that sense it really helped our kids a lot. Like they had a level of confidence that they probably hadn't had mathematically before.

Caitlin went into more detail about the importance of the culturally responsive aspect, explaining how this impacted her students' attitudes towards maths.

Caitlin: I try to find ways to make sure what we are doing in maths connects with the world they see outside the classroom and I think for some students this makes what they are learning make sense in a way it hasn't before. And that makes them want to work out the answers and find the solution because they can understand the context and see the point of what we are learning. That has made the biggest difference in my opinion.

Mark also discussed how they had made an effort to make sure that the questions they were selecting related more to students' lives so that they had context for what they were learning, as well as ensuring they understood how what they were learning could be useful in the future. He felt that this helped students to connect with the mathematical concepts and encouraged greater engagement. Mark also discussed how they had also focused on incorporating culturally based questions.

Mark: I suppose more of your curriculum based questions are now culture based questions. Because you know you got that Māori perspective, you dive into it, you delve into it, you put myths and legends in if you can yeah just as much as you can, where it's gonna get them interested like hands on stuff, like, how far can you can you cast a rod kind of thing, so you're doing measurement.

Despite highlighting some of the advantages of adopting a culturally responsive, mixed ability instructional method, some of the teachers interviewed also admitted that they did not always follow the programme that was being followed by the school. Lead teacher

Mark stated that he only really followed the programme when he had a facilitator in front of him or when senior management was likely to drop in. He argued that the way the school was implementing the programme did not really work for his learners.

Victoria also commented that there was little accountability or checks that teachers were teaching using culturally responsive practices and mixed ability groups. She expressed her frustration that no one was really ensuring that teachers were doing what they were supposed to be doing in mathematics and checking that they were covering the curriculum adequately.

4.4.7 Catering for higher learners

Lakeside teachers felt that a mixed ability approach works well for higher ability learners. Teachers discussed how working in mixed ability groups forced all students to be able to articulate their thinking and develop a deeper understanding of the concepts being taught.

In catering for higher achieving students in his class Mark explained that his belief was in giving them exposure to a wider range of contexts, rather than moving them up through the curriculum levels. He argued that they benefited more from consolidating their understanding and getting to use their skills on a wide range of problems and contexts, than they would from starting to teach them from the higher curriculum levels.

The teacher of one of the accelerant classes explained how some students in her class were considered to be of significantly higher ability than the rest of the class and as a consequence were enrolled in correspondence school for maths. The teacher felt this was unnecessary and was not developing their ability to reason and communicate their ideas effectively.

> *Victoria: I struggle with the correspondence aspect because I've noticed that the student knows a lot of facts. But can she articulate? she has no depth. So no one's really having any conversations with her...She sits on a laptop with the headphones and watching a tutorial and it's basically online learning in the classroom. Yeah, and no one's really helping her or giving her any ideas. I don't think that's necessarily the best way to just put them to higher levels.*

Caitlin discussed an external programme that high achieving students attended on a regular basis and how she felt that created a social divide between those who went and those who did not.

> *Caitlin: And the students on the [other accelerated] programme, they kind of have this air about them that they're superior to the other kids. And the other kids say that all they go to that programme so they must know this maths, then they automatically think they're a genius. And also, society isn't designed that way. So you're never going to be able to be in a workforce or live where it's just you and everyone else that's a genius. So that's kind of my issue.*

Both teachers expressed that having additional programmes for students considered to be high achieving was not necessary and did not fit with the schoolwide approach of teaching students in mixed ability groups. Victoria commented that she felt this was because of pressure from the parents of students who were considered to be of a higher ability to show how the school was catering for their needs.

4.4.8 Conclusion

Overall the teachers that were interviewed from this school were supportive of implementing culturally responsive instructional and grouping practices into their mathematics lessons. The primary issues from their point of view were that some teachers lacked content knowledge and skills to be able to teach effectively in this way and that this was the reason why some teachers at their school still preferred to teach in ability based groups. They felt that, in order for this model to be implemented effectively, teachers needed to have appropriate personal mathematics skills and knowledge and to be given support to ensure they knew how to manage mixed ability groups. Another key issue raised was assessment of students, raising tension over what assessments were best for showing progress, how to measure and record student progress, as well as concerns about teacher capability in accurately assessing student achievement. Although this school encouraged and expected mixed ability teaching within classes, it is worth noting that the school still had some accelerant classes for learners who were perceived as higher level learners.

4.5 Cross case analysis

The three different schools included in the research offered different school wide approaches to catering for diverse learners in mathematics. To some extent, the varying schoolwide approaches are reflected in the views and instructional strategies discussed by the teachers from each school. However, there are also a number of common themes that were raised by teachers across all the schools. Closer examination of the similarities and differences is valuable as it helps understand this issue in more detail. Yin (2018) argues that identifying trends across different cases can help determine if there is an identifiable pattern to the phenomenon and if there is a consensus about future action. However, it is important to remember that the cases in this study exist in different contexts (Yin, 2018) meaning that some differences may be a result of different contextual factors. According to Yin (2018), it is important to consider all the evidence and plausible rival explanations, rather than only select the evidence that fits the narrative. In order to address this, each of the themes that emerged during the findings will be discussed, with similarities and differences between cases discussed.

4.5.1 Teacher beliefs

In general, there was an acceptance of the idea that ability grouping or streaming was not good for lower level students. Teachers from each school discussed that students always being stuck in a low group was bad for their self-esteem and self-efficacy. However, there was also a view across all three schools that grouping by ability was considered by teachers to be easier in terms of tracking, planning and delivering the curriculum to a diverse range of students. Teachers from Lakeside and Riverside schools, where mixed ability grouping was expected, were generally supportive of the idea in theory, although several teachers expressed concerns about how it worked in practice. Teachers at Beachside School, where there was no set expectation about how teachers organise their groups for instruction, discussed the benefits of mixed ability teaching and articulated the downsides of ability grouping, however, a majority also said that they predominantly grouped by ability and that this was the norm for their school. Amy from Beachside argued that it was easier to group by ability as it narrowed the focus for planning and enabled them to keep a better track of individual student progress across the whole syndicate.

Within the two schools that had made a deliberate decision not to group students by ability (Riverside School and Lakeside School) it was reported that not all teachers in the school

fully supported mixed ability teaching in practice. Tom, Eve and Harriet discussed other teachers at their school who were not entirely convinced by the idea of mixed ability grouping, or who did not know how to implement this effectively. Tom discussed how he sometimes used pseudo ability based groups to make sure he was catering for all his learners, and Harriet and Eve also discussed that they knew a number of staff used a form of ability grouping where they could. At Lakeside School the teachers interviewed reported similar impressions of the attitudes of other staff members with Victoria and Caitlin both reporting that they knew of teachers who grouped students by ability where possible and others who did not support the use of mixed ability grouping.

The concept of differentiation was discussed with all teachers who were interviewed, and there appeared to be a wide interpretation of the term. Julie and Cath from Beachside School both raised the idea that differentiation of tasks into different levels and workshops based around student levels often results in pseudo streaming with the same children always being in the same groups. Curriculum leaders at Riverside School discussed the school's policy of organising students in mixed ability classes with no ability grouping allowed, but also then discussed differentiation of tasks to make sure they were accessible for everyone and talked about adapting tasks specifically for higher and lower levels. Lead teacher Harriet discussed the school's strategy of getting teachers to take a Level 4 task and adapt it up and down to suit different learners which Eve argued meant that they were still offering tasks based on curriculum based ability levels and thus not really providing students with the same work.

4.5.2 Teacher Capability
Teacher capability was another common theme that was discussed as being a barrier to moving away from ability-based grouping. Concerns were raised across all schools that a number of teachers lacked the content knowledge required across the curriculum levels. Teachers identified that they often had students ranging from level one or two to level five and that, in order to move away from ability grouping, they needed a high level of content knowledge to be able to manage the range of abilities within one group. Teachers discussed that ability grouping required them to be able to quickly jump from one idea to another and quickly identify strategies in a way that they felt they didn't have to when grouping students by ability. Several teachers including Mark from Lakeside, Eve from

Riverside and Julie from Beachside raised the issue of whether there were enough teachers with the skills to be able to teach mixed ability groups effectively.

Teachers from different schools discussed that they did not know how to teach effectively in a mixed ability setting, particularly in Beachside School where there was no expectation about how teachers would group students. Cath and Amy from Beachside both said that they did not feel that they fully understood what a lesson with mixed ability groups would look like and how they would work. Even within schools that were expecting teachers to use mixed ability grouping both Sophie and Eve expressed that there were teachers who were still not comfortable teaching in this way and required further development to make it work effectively.

The difficulty of finding appropriate tasks and questions to pose to mixed ability groups was also discussed by teachers across the schools. At Riverside School, they had worked with an external professional development provider to support them with this, however, teachers still raised this as a difficulty. At Beachside School, where few teachers had much experience with mixed ability teaching this was raised as a major concern for those thinking about trying it out.

In response to the perceived lack of capable teachers for intermediate mathematics programmes, teachers from both Lakeside and Riverside schools discussed the idea of specialist maths teachers. At Riverside School this was happening to some extent as teachers either specialised in mathematics or literacy for the academic year. Mark at Lakeside felt that having specialist teachers for mathematics might be a solution to the issue of teachers often not having the mathematical content and pedagogical knowledge to cater for the range of students found within each class. At Riverside School both Eve and Harriet expressed that they had hoped that this would be the case, however though some teachers had improved their skills and knowledge considerably, the turnover of staff at the school and the lack of passion for maths in some teachers meant that they had not seen the development of maths experts among their teachers. This was not an issue that was raised by any of the teachers at Beachside School.

4.5.3 Diversity of Learners

Teachers across all three schools discussed the wide range of abilities between the highest and lowest achieving students in their classes and how this created difficulties for them when trying to cater for the needs of everyone. Teachers at all schools discussed how there were students within a single class that ranged from level one or two of the curriculum, up to level five. Teachers from Riverside School reported that they felt that they were able to cater for the majority of the learners in their class but expressed reservations that they were able to address the needs of the very highest and lowest. Lakeside School had got around this issue to some extent by retaining accelerant classes for the highest ability learners and providing opportunities for higher level students to engage with correspondence courses for mathematics. Teachers at Beachside School discussed the accelerant syndicate as catering for the highest level learners, although Julie expressed how she felt able to cater for even the highest level students in her class without sending them to the accelerant house. There was a general feeling that the diversity of learners in a class at intermediate school was greater than in primary schools, making it more challenging to cater for all learning needs without using some form of ability based grouping. For many teachers, this was why they used ability based grouping to organise their students. Those working in schools which did not allow any ability grouping commented on this range of abilities as being a challenge.

4.5.4 Catering for lower level students

The teachers who were interviewed across all three schools expressed that they believed mixed ability grouping had advantages for lower level students. In general, they expressed mixed ability grouping made students feel more confident, removing the stigma associated with being in the low groups by giving all students the opportunity to work on tasks that might often be reserved for students who were considered of a higher ability. Caitlin and Mark from Lakeside both discussed how mixed ability grouping had positive benefits in terms of attitude and mindset for lower level learners. At Riverside School all four teachers interviewed expressed their concerns about the impact of ability based grouping on lower level learners, in terms of attitude towards maths, self-concept about their capability and willingness to engage with learning.

A concern among some of the teachers interviewed was whether they were properly catering for very low learners when using mixed ability grouping practices. Teachers from

all three schools expressed concern about how to include the lowest students in a mixed ability setting, arguing that some lacked the basic numeracy skills for this way of teaching to be effective. Cath from Beachside and Caitlin from Lakeside discussed students within their class who were so far below the ability of the others that they would not be able to participate and learn the skills that they needed in order to be successful. Amy from Beachside School felt that there were basic skills that the lower groups needed to cover that would be missed if they were working together with more advanced students. Tom from Riverside said that, in his experience, the lowest learners depended too much on those more capable students, allowing them to do the majority of the work and that they were not necessarily learning from those students, rather that they were sitting back and not getting involved because those more confident students were providing the solutions.

4.5.5 Catering for higher learners
The issue of catering for the higher learners also came up a number of times throughout the interviews. Teachers expressed their belief that higher learners often cannot be catered for in a mixed ability setting and that they do not get properly extended. Gabriella and Amy from Beachside, as well as Tom and Sophie from Riverside raised concerns that mixed ability teaching did not provide enough opportunity to challenge higher learners.

Teachers from Lakeside School felt that they were able to cater for higher learners through mixed ability teaching. Their experience was that they provided more opportunities to engage with different areas of the maths curriculum in different ways to support a deeper understanding of the concepts being taught, rather than pushing students up to cover aspects further on in the curriculum. Both Victoria and Mark from Lakeside School discussed how they did not think students should be rushed through the curriculum to the higher levels, rather that they should be given greater opportunity to engage with concepts in different contexts. Julie from Beachside School also felt she was able to cater for higher level learners through her programme.

At Beachside School they had some accelerant classes which catered for those who had been identified as higher level learners through testing prior to joining the school. Gabriella, who teaches in one of these classes, discussed how they focused on preparation for college as well as practicing skills they thought would support them in college testing. She also mentioned that one teacher took the highest of these students to

extend them further. At Lakeside School, despite the teachers reporting that they felt they could cater for the higher level learners within their classes, the school still had accelerant classes for higher level learners and Victoria reported additional programmes for the highest achieving students.

4.5.6 Preparation for college

Teachers interviewed also discussed the importance of preparing students for college. Gabriella and Cath from Beachside School, and Eve from Riverside discussed transition to secondary school and how their programme for mathematics was shaped by what they believed students needed to be successful when entering secondary school. All three shared their belief that their local high schools and colleges all used ability grouping and streaming to organise students for mathematics. Cath and Eve both discussed that they felt the students were likely to go into a streamed environment where they are expected to do work independently and to complete work from textbooks. They questioned how much an intermediate school programme based around discussion and collaboration would prepare them for that. The lead teachers for maths from both Beachside and Riverside also raised the issue of college preparation, saying that, to their knowledge, the high schools in their area all had some form of streaming or ability grouping and that there was currently little conversation between the intermediate schools and high schools about what the other was doing.

4.5.7 Assessment and reporting

One of the key themes that emerged from the interviews was assessment of students. Teachers from all three schools reported that there was a considerable amount of pressure to show that what they were doing in class was making a difference to student achievement results. Even in schools where ability grouping was not permitted teachers still discussed how they were measuring progress and moving students up through the curriculum levels. Cath, Amy, Eve, Mark and Victoria all discussed that they felt there was considerable pressure to move students who were considered performing below the expected curriculum level up at an accelerated rate. Mike, the lead teacher for mathematics at Beachside School discussed the number of students they had who required accelerated progress, stating that teachers were expected to progress these students by more than one academic year to try and catch them up to the expected level.

Teachers across the schools said that this pressure made them reluctant to try new things and experiment with different ways of organising instruction. Amy from Beachside explained how she had implemented ability grouping within her already streamed class as a way of helping her to manage the acceleration of students she knew needed to make additional progress. Both Tom from Riverside School and Cath from Beachside School made the point that many of the students who were not reaching the expected level in maths had often been struggling in previous years and that it seemed unreasonable to expect that they could move these students up to the expected level within one year. For those teachers working in a mixed ability setting such as Riverside School and Lakeside School, they expressed concerns with how they accurately measured progress within a mixed ability environment. Mark at Lakeside School discussed how he struggled with being able to accurately identify what each child could achieve when they had been working on a task in a mixed ability setting. This was echoed by Harriet at Riverside School who talked about difficulties faced by teachers across her school. Although teachers at Beachside School were often using ability based grouping they also questioned how they would assess students if they were to use more mixed ability grouping.

4.5.8 Nature of learners in intermediate schools

As previously discussed Eve and Tom at Riverside school argued that intermediate age students are going through huge change so why focus so much on academic achievement and instead focus on social skills?

> *Eve: That's, that's what the ministry understands. And I mean, as a school we are required to present to the board and the assessment data. And I mean, and how do you assess that they have learned how to actually solve conflict without punching somebody in the face?*

Cath from Beachside School discussed what teachers might do differently if they did not have to report on student achievement and assess students all the time. She argued that many would probably run a completely different programme which focused more on developing number sense, problem solving and application of skills in a real world context. When asked why she was not doing this at the moment Cath replied that pressure to be able to show how her teaching fitted in with the school's interpretation of the curriculum, along with having to report the progress of her students against curriculum levels every

term. This was partially echoed by Victoria at Lakeside School who discussed how she had started to implement "problem solving Fridays" when she would give students a range of rich problems to solve. When asked why she did not do this more often she replied that she felt she wouldn't be able to show how she was meeting the needs of all the students and progressing them through the curriculum levels, even though she knew that students were developing a greater level of understanding and knowledge through problem solving.

4.5.9 Conclusion

Despite the fact that the three schools had different school wide approaches to maths curriculum delivery, there were many similarities in the perceptions of the teachers. Teachers were concerned about ensuring that all students were being catered for, with particular concerns raised about the higher level students and lack of conviction that mixed ability teaching could suit their lowest ability students. Teachers across all schools discussed the pressures of ensuring students were making appropriate progress and demonstrating that their practice was making a difference to those in their class. Pressures felt from school management and the Ministry of Education seemed to be a factor in determining how confident teachers were with trying new strategies. The issue of teacher capability was also a big factor for teachers, with many reporting that this was a significant barrier to changing their teaching practice.

Chapter 5: Discussion

5.1 Introduction

This chapter considers the key themes that arose from the interviews in response to my research question, "How are teachers in intermediate schools catering for diverse learners in mathematics", and draws upon relevant literature to explore specific findings in more detail. This chapter is structured into six sections examining the key thematic findings outlined in the cross case analysis. These sections are; grouping practices, teacher beliefs (including catering for higher and lower level learners), catering for Māori and Pāsifika learners, transition to college, assessment and reporting, and teacher capability. Links are made to relevant literature where the findings of this study reflect findings of previous studies, and areas of new understanding that come out of this research which may add to the current body of literature have also been highlighted.

The interpretivist paradigm is used to uncover peoples' experiences and understanding of the issue of catering for diverse learners (O'Donoghue, 2007 as cited in Punch & Oancea, 2014). This research is a New Zealand based piece of research that will inform key stakeholders in the New Zealand education system about how teachers are currently dealing with the issue of catering for diverse learners in intermediate schools and some of the challenges they face in doing this. It may also provide a starting point for teachers and schools to further examine and address some of these issues.

5.2 Grouping practices

Four different instructional approaches were identified for making sense of this study; ability grouping or streaming, differentiated instruction, complex instruction and culturally responsive or sustaining instruction. Two of these models of instruction involve mixed ability grouping (complex instruction and culturally responsive instruction), while the other two involve either direct ability grouping or indirect (through differentiation of tasks) grouping. While part of these models of instructional practices centres around grouping, complex, culturally responsive and differentiated instruction models all make mention of what tasks are given to students and how those tasks are presented. However, in the interviews with teachers, their primary focus was on how they grouped students and the reasons for this, rather than discussing what tasks they were using, how they were using them and why. Few teachers discussed aspects other than grouping and only one teacher involved in the study discussed in any detail the tasks that they used for students and how

this helped them cater for diverse learning needs. It is possible that the questions led teachers to talk about grouping practices rather than other ways they were catering for diverse learners, but it does suggest that, for the majority of teachers, grouping is the primary way that they manage the variety of learning needs in their class. This supports the views of Higgins and Eden (2015) who discuss the prevalence of grouping in New Zealand education, particularly in mathematics and reading instruction, arguing that the notion of grouping is often synonymous with good teaching in current New Zealand practice. They argue that the idea of small group instruction is often unchallenged in New Zealand education yet it often involves the traditional idea of the teacher as instructor and does not necessarily promote students' active participation in discussion (Higgins & Eden, 2015). Higgins and Eden posit that small group instruction can divide students into smaller learning environments and remove some of the opportunities for them to learn from each other, support each other and develop collective responsibility for learning, which they argue would benefit Māori learners in particular (Higgins & Eden, 2015). None of the teachers involved in the research questioned the notion of grouping and their primary consideration when discussing how they catered for diverse learners in mathematics was how they grouped students rather than discussing other elements of their pedagogy.

5.3 Teacher beliefs

5.3.1 Teacher beliefs relating to ability grouping

The teachers involved in the study generally recognised the issues associated with ability grouping, in particular discussing the negative impact that ability grouping can have on students who are considered to be of a lower ability. All expressed some concerns that grouping by ability resulted in low self-esteem and self-efficacy in students who were in the lower ability groups. There was little reference among the teachers to research or literature relating to ability grouping, rather a general sense that, from their experience, those in the lower groups stayed there and did not progress with the other students. Golds' (2014) findings suggest that few schools engage in critical analysis of practices around mathematics. Although there was discussion with the lead teachers of Riverside and Lakeside schools who had engaged with the literature and research, this was not reflected in the comments by the teachers except for Julie at Beachside School. Hornby et al. (2011) found in their study of mathematics in intermediate schools in Christchurch, that there was little evidence that decisions made about mathematics delivery were based on research evidence. Findings from this research suggest that though some of the schools have

engaged with research evidence at the leadership level, the same does not seem to be true of the majority of teachers, which could explain why not all teachers were fully supportive of the initiative implemented at their school.

Despite the acknowledgement of issues with ability grouping, it was a recurring theme among the teachers that the diversity of students within their classes made this challenging to address in practice. Even in schools in which ability grouping was not allowed, teachers expressed concerns that they did not feel mixed ability grouping could cater for the needs of everyone. Teachers also discussed that it was easier for them to manage and plan for groups who had similar ability levels and needs, as they could narrow the focus of what they needed to prepare and could better predict the outcomes of group work. This supports the findings of Spina (2018), Gamoran (2002), Golds (2014) and Boaler (2006a) who all discuss that there is a perception that ability grouping is easier and more manageable for teachers. When discussing the issue of tracking and assessing students, teachers also indicate that they found it easier when students were grouped by ability as they could easily identify the skills that each child had mastered and plan for their next steps.

5.3.2 Teacher attitudes towards mixed ability
Across all the schools there was discussion about how mixed ability grouping could be beneficial for lower learners but a lack of conviction that it worked in practice. A number of teachers across all schools discussed some of the advantages of mixed ability grouping and expressed that they felt it could be beneficial for their students, however, they also said that they had not seen it modelled effectively in the classroom and were not confident implementing this in their classes. Teachers reported how they still used ability grouping, regardless of the schoolwide practices that were in place. A number of teachers at Riverside School and Lakeside School, where the school wide policy did not allow for grouping by ability, still admitted that they used some form of ability grouping when they could to facilitate their teaching. Lakeside School had accelerant classes which took the highest ability students. This demonstrates that not all teachers were aware of or convinced by the reasons for implementing a mixed ability grouping model

5.3.3 Catering for lower ability students

Some teachers interviewed reported feeling that their lowest ability students would not be able to participate in mixed ability group settings as they were too low to access the work. This concern primarily came from teachers who were not involved in mixed ability grouping, however, it was mentioned by some who worked in schools that expected teachers to implement mixed ability grouping practices. The implication was that lower level students needed to be given more remedial tasks that focused on learning basic strategies and knowledge. Teachers from Beachside School and Riverside School mentioned working with lower level learners in a small group in order to work on these more basic skills which supports claims by Spina (2018) and Macqueen (2013) who argue that lower level learners are often exposed to a limited view of the curriculum as teachers focus on developing what they consider to be foundation skills. This also suggests a belief that learning in mathematics is linear and follows a set pattern of skill acquisition as the teachers are assuming that students cannot access tasks if they have not yet acquired the foundation skills which Anthony et al. (2016) attribute in part to the implementation of the Numeracy Development Project (NDP) throughout New Zealand schools. Although the NDP was not directly discussed by teachers there was much discussion regarding what stages and curriculum levels students were at and about filling in gaps in their learning to ensure they could progress to the next level. When discussing lower level learners there was a heavy emphasis on what they could not do and how they would struggle to participate in mixed ability groups, rather than discussing the ways in which they could benefit and add to the collective learning.

A number of teachers expressed a concern that the lower students would get the higher students to do all the work and would not learn anything themselves. They expressed that this meant those students would not be developing the required skills as they would become too dependent on the more capable students. Higgins and Eden (2015) discuss hitchhiking and mirroring as a valuable way to develop skills and confidence in lower level learners as they can use what other students that they are working with are doing, in order to support their own learning. Julie from Beachside School argued that, particularly for the Māori students she taught, students working collaboratively across ability levels and focusing on collective responsibility for learning helped all her students to progress but this view was in the minority across schools. Other teachers expressed concern that

tuakana-teina[7] models, in which more capable students supported less capable students, meant those more capable students were being held back from extending their skills and knowledge, while the less capable students might become too reliant on help from others.

5.3.4 Catering for higher ability students

A recurring theme across the interviews was a belief that ability grouping was the best way to cater for higher ability learners. Teachers reported that they felt that the highest learners in their classes could not be adequately extended in a mixed ability setting. Within the schools that had a policy of teaching in mixed ability groups, teachers still felt that more needed to be done to cater for higher ability learners. None of the teachers interviewed presented evidence that proved this was the case, but many discussed the challenges of extending higher level students, suggesting that the issue is more that teachers struggle to keep up with the academic demands of the higher level students rather than there is evidence that higher level students are not extended.

Of the three schools involved in the research, two schools offered accelerant classes to cater for students who were considered to be of a higher ability. One of these schools, Lakeside School, expected teachers to teach students in mixed ability groups and had previously been involved in a programme which promoted culturally responsive instructional practices. In the case of Beachside School, the general feeling was that the accelerant classes were necessary to cater for the higher level learners as they would not get adequate extension in a mainstream class, and to enable teachers to better prepare these students for the higher ability classes at college. In the case of Lakeside School, the accelerant teacher who was involved in the study felt that the needs of the students could just as easily be catered for in a mainstream classroom. The existence of accelerant classes suggests that there is still a perception that students considered to be of higher ability require different teaching to the rest of the students.

5.3.5 Developing teacher buy in

In discussing different approaches to catering for diverse learners in mathematics across the three different schools it was apparent that there was a disconnect between teachers,

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[7] *Tuakana-teina* is a traditional Māori model in which an older or more expert *tuakana* helps and supports a younger or less expert *teina* https://tereomaori.tki.org.nz/Curriculum-guidelines/Teaching-and-learning-te-reo-Maori/Aspects-of-planning/The-concept-of-a-tuakana-teina-relationship

lead teachers for mathematics, and school leadership. Among the lead teachers there was a common drive to develop mathematics teaching that was socially equitable, moved away from ability based grouping and was based, to varying degrees, on current research around maths education, but this did not appear to be shared by senior leadership further up the school or entirely embraced by all teachers.

As one teacher from Riverside School said, if schools want to move teachers away from ability grouping and encourage the use of mixed ability teaching then they need to develop the understanding of 'why' among their teachers. This would mean modelling how it works as well as discussing the reasons for making the change, in order to develop teacher buy in. Where the notion of 'why' mixed ability could be used effectively to support diverse learning needs was strong, teachers were more likely to find ways to make it work.

5.3.6 What does it mean to be lower or higher ability?
There was a strong sense that teachers' views on ability were centred around the expectations for each curriculum level as set out in the New Zealand Curriculum, which are focused around number knowledge and strategies. When discussing students, all teachers discussed them in terms of curriculum levels and where they sat in relation to these. The notion of ability was presented as a student's ability to solve problems at a given level. Lead teachers across all schools discussed tasks in terms of what level of the curriculum they targeted and many of the discussions revolved around the knowledge and strategies students were expected to have mastered at each level, rather than identifying other mathematical skills such as ability to communicate an idea, work flexibly with numbers or solve real world problems. Cohen and Lotan (2014) and Boaler (2006a) discuss the importance of recognising multiple abilities. These are described as different skills that students bring to the task, such as the ability to communicate an idea, work as a team, link ideas together and so on. If the focus is purely on ability in terms of knowledge and strategies that students can or cannot use, then it does become challenging to work out how to get them working together in one group without the "higher" ability students carrying the others. There was little evidence across the schools that skills aside from the knowledge and strategies required at each level were being valued.

The implication of this is that the majority of teachers interviewed were giving their students problems which were centred around the knowledge and strategies that students were

expected to be able to use at each level, rather than open problems allowing for multiple solutions and representations. Students were assessed on their ability to solve problems at a given curriculum level, including in schools which supported mixed ability grouping.

The fact that most teachers appeared to view ability in terms of curriculum levels ties in with the fact that teachers were very much focused on grouping practices rather than the tasks or skills that they wanted to develop. The discussion kept coming back to how they grouped students and how this helped them progress students through curriculum levels, rather than discussing the types of tasks or the skills they were trying to develop in the students.

5.4 Focus on Māori and Pāsifika Learners

While one teacher discussed tasks that were designed to engage Māori and Pāsifika learners, the majority of teachers focused on how they catered for higher and lower ability students. This supports research that claims that not enough is being done to ensure that all students are being catered for in a way that is culturally responsive and sustaining (Higgins & Eden, 2015; Anthony et al., 2016).

The notable exception to this was Julie from Beachside School. She was the only teacher who explicitly discussed how the instructional model she utilised in her classroom fitted with Māori views about learning. She acknowledged the multiple abilities (Cohen & Lotan, 2014) of her students and discussed the importance of a culturally responsive approach to her mathematics programme. Julie was working in a school that did not have a school wide policy on how mathematics lessons should be delivered. However, she also noted that others working with her in a Māori focused syndicate were not delivering their programmes in the same way, attributing this to lack of knowledge and experience of how to do this.

5.5 Transition to college

Transition to college was discussed by teachers across different schools. The perception was that the colleges and high schools that students moved on to after intermediate school all grouped students by ability and valued traditional knowledge and strategies as measures of ability in mathematics. A number of teachers discussed how this shaped their mathematics teaching as they were aware that they needed to prepare their students for

the transition to their next school. Some questioned how some of the strategies that were being taught in intermediate schools would transfer over to high school. Interestingly teachers' ideas around how college taught maths were largely based on their beliefs rather than explicit knowledge of the high school programmes. Of particular concern was the high school testing which intermediate school teachers believed was used to stream the students for the following year. Some teachers questioned whether it was worth teaching in mixed ability groups and using rich learning tasks when they would be streamed when they got to secondary school and would be working from a textbook.

5.6 Assessment and Reporting

Assessment of student ability and reporting on achievement to the school, Board of Trustees and the Ministry of Education was a recurring theme across the findings. Teachers reported that they felt under pressure to show that they were progressing their students through the curriculum levels, and provide evidence that they were accelerating the progress of learners who were not on track to be meeting end of year level expectations. The issue of accelerating the progress of students who were not on track to be meeting end of year expectations was a big focus in interviews with the lead teachers of each school. This supports the arguments of Francis et al. (2017), who reported similar findings regarding the pressure to move students "up".

In all the schools involved, most teachers discussed how to get students who are below the expected end of year curriculum to meet the expected standard, despite the abolition of National Standards from the start of 2018. Although schools no longer need to report on the number of students who are below, at and above the expected level, this language was still used by teachers at all schools and was at the forefront of any discussions around catering for diverse learners. The curriculum level appeared to shape their expectations for different students and students were viewed in terms of where they were in relation to the expected end of year level. Teachers talked in terms of what they were doing to move students "up" through curriculum levels with a specific focus on the students who are just below expectations, as these are the ones they are likely to be able to move, which is in line with the findings of Spina's (2018) study in Australia.

Teachers discussed the pressure they felt from senior leadership, and indirectly from the Board of Trustees and Ministry of Education, to prove they are moving students up to

where they are "supposed" to be, rather than developing mathematical mindset. As a consequence, teachers appeared reluctant to try anything different because they are unsure they can prove that it makes a difference to those middle students. In some cases, teachers discussed how they had implemented a greater degree of ability grouping within their streamed class to facilitate programmes to accelerate the learning of those who are not expected to meet the required end of year standard.

It could be argued that the nature of the New Zealand curriculum means that the focus becomes concrete, measurable skills that can be measured against a rubric towards curriculum levels. These curriculum levels are focused on number knowledge and arithmetic skills, rather than mindset, communication, or problem solving skills. Even in schools where students are not grouped by ability, assessing them against these achievement levels reinforces the idea of lower achieving and higher achieving according to those parameters. Rubrics created and used by Beachside School to unpack these curriculum levels also reinforced this. Students at Beachside were expected to know where they were in relation to the curriculum levels and identify what they needed to do in order to reach the next curriculum level, which reinforced the idea of ability levels. In terms of assessing students, teachers reported that they found it hard to measure exactly what each child could do when working with mixed ability. They discussed the difficulty of being able to identify which skills they could tick off to prove they are moving students up.

Park and Datnow (2017) argue that the increase in accountability plays a large role in the increase in ability grouping as it makes it easier for teachers to identify the areas they need to teach in order to demonstrate progress. They argue that teachers perceive this as more manageable and more effective. Spina (2018) also supports the idea that accountability for showing the progress of students through the curriculum often results in ability based grouping as a way of showing how teachers are catering for diverse learning needs. Lead teachers for maths at each of the schools discussed the difficulty for their staff of assessing student progress when using a mixed ability model and identified that this was an area in which teachers needed additional support.

One teacher directly raised the issue of assessment, questioning what teachers would do differently if they stopped being so concerned with curriculum levels and assessing students by these parameters. She suggested that teachers might be more confident

changing the way they taught if the emphasis was on developing skills such as communication of ideas, problem solving, collaboration and linking ideas between areas of maths. Lockhart (2009) argues that maths in schools is focused on rote memorisation and accurate application of procedures rather than an art form which provides students with a way to wonder and question the world around them. Teachers seem to have an idea that problem solving is discrete from number and algebra, measurement and statistics rather than the point of it all. Do we need to move away from a short term tracking which requires a set amount of progress per year? Do assessment systems need to value more than just content knowledge and following taught strategies? Schools and the Ministry of Education measure hard data related to progress against the curriculum levels rather than soft data relating to skills and dispositions such as communication and collaboration skills, and as a consequence progress through these levels becomes what is considered success. While a student may have developed in their ability to communicate and participate in mathematical thinking, this is not measured by the curriculum levels and therefore not valued in the same way.

5.7 Teacher capability

Teacher capability was also a key theme that came out of the findings. Teachers from every school discussed how they felt teaching at intermediate level required a high level of content and pedagogical knowledge from them due to the diversity of learning needs found in their classes. Teachers discussed their perception of the wide range of mathematical abilities that they found within their classes, as measured against the New Zealand Curriculum levels, stating that their classes often had students from level one or two, up to level five of the curriculum. There was a belief that this diversity of learning needs within their classes was greater than the range found within primary classes and teachers felt that this made it challenging to cater for with mixed ability grouping practices.

Teachers raised the issue of teacher capability as a barrier to implementing instructional strategies that involved mixed ability teaching. Lead teachers for maths in particular expressed concern that many teachers lacked the pedagogical and content knowledge to be able to manage groups spanning multiple abilities. Teachers felt that the level of pedagogical and content knowledge required for mixed ability teaching was higher than when grouping by ability as it required teachers to be able to identify numerous ideas and strategies and support students who had differing levels of understanding.

In response to concerns about lack of capability in teaching mathematics to intermediate school students, the idea of mathematics specialists was suggested by some teachers. At Riverside School they hoped that getting teachers to specialise would build expertise (although it must be noted that this was not the explicit intention). This idea was also put forward by Mark, the lead teacher for maths at Lakeside School, who argued that the higher level of mathematical knowledge required to effectively teach intermediate aged students might make it worth considering having specialist teachers, although he did mention that this might reduce curriculum integration of maths with other curriculum areas. Mark also raised questions about how best to upskill teachers who might not have a high level of personal maths, especially when there are other areas of the curriculum that might need development.

However, it could be argued that, by moving away from traditional measures of ability, changing the tasks and the skills that are valued in the classroom, this might not be such an issue. Boaler (2006a) argues that teachers need to develop the mathematical mindset of their students to value more than just speed of recall and ability to follow procedures. This suggests that the answer lies in developing these skills rather than purely focusing on upskilling the content knowledge of teachers, changing the nature of what they teach and how they deliver it might be more effective in catering for diverse learners. Many of the teachers in the study were more than capable of delivering the mathematics curriculum at all levels found in intermediate schools yet a number of them expressed that they did not know how mixed ability teaching could work as they understood it was not just a case of removing ability groups, but also in changing other aspects of their curriculum delivery.

Lockhart (2009) claims that, as a culture, we do not really know what mathematics is. He argues that we think of it only as the basis for science and technology rather than the art of explanation, and that we have lost sight of the creative process of discovery and reasoning. While we can all access great examples of literature, art, science and sport few can point to similar examples of mathematical excellence (Lockhart, 2009). The implication for teachers is that it becomes difficult to inspire and engage students in maths when teachers themselves do not have a clear vision of what it means to be a great mathematician in the world beyond education.

5.8 Conclusion

The initial research question was "how are teachers in intermediate schools catering for diverse learning in maths" and from this research it is apparent that teachers primarily use some form of grouping. Throughout the interviews teachers talked about the different ways they group their students and their reasons for doing this. In the school where there were no guidelines about how instruction should be delivered, the majority of teachers grouped by ability, either within their own class or across classes in their syndicate. Two schools had adopted a mixed ability grouping approach which was largely adhered to by the teachers but it was evident that a number of teachers found ways to differentiate the learning along ability lines as they believed this made it easier for them and ensured they were able to cater for the higher and lower ability students.

In terms of rationale for their choice of grouping strategies, teachers discussed teacher capability, catering for the higher and lower students and assessment of student progress as key factors in determining how they taught. They discussed the pressures of assessment and showing they were making a difference to the achievement levels of their students as a primary concern. For many, this made moving away from ability based grouping a difficult prospect as they were concerned about how they would measure and track individual progress through curriculum levels. The way that mathematical skill is measured and assessed in New Zealand schools makes it challenging for teachers to move away from ability grouping as there is a heavy emphasis on curriculum levels, progression through the levels and accelerating progress for those students who are not on track to meet the expected level by the end of the year. Teaching students across the wide range of ability levels, as measured against the curriculum, presents a very real challenge for teachers but if the notion of ability were to be reframed this might give teachers the freedom to develop a wider range of skills than just rote memorisation of number knowledge and procedures.

Chapter 6: Conclusion

6.1 Introduction

In this research I investigated teachers' use of grouping practices to cater for diverse learners in maths in three New Zealand intermediate schools. From this I developed a picture of teacher and school rationale for how they used grouping within and across classes to support the needs of students. Teachers discussed the perceived advantages and disadvantages of different grouping models. They also discussed barriers to adopting different grouping models. The intention of the research was to explore teacher perception of different grouping practices and provide them with an opportunity to voice some of their concerns and challenges in catering for the wide range of student learning needs in mathematics at intermediate school level. Literature from around the world indicates that mixed ability teaching has wide ranging benefits for all students. For New Zealand, most of this research comes from overseas and does not focus on intermediate schools.

6.2 Grouping strategies to cater for diverse learners

The findings of this research showed that teachers largely focused on grouping practices as a method for catering for diverse learners, with only a few teachers commenting on the nature of the tasks and content they were teaching. In general teachers supported the theory behind mixed ability teaching, recognising some of the issues with ability grouping, particularly for lower ability students.

Assessment and student progression based on the measures of the New Zealand curriculum were also a key area of focus for teachers. They felt considerable pressure to demonstrate that their students were making appropriate progress and that students who were deemed to be not tracking to meet the expected end of year standard were being accelerated. For some, this meant that they felt grouping by ability was easier as they could identify and target the needs of smaller groups and could demonstrate how they were meeting the academic needs of all of their students. Teachers were not confident that they could still assess and track student progress if they were to adopt a mixed ability instructional method.

Teacher capability also played a big role in determining how teachers catered for the learning needs of their students. There was a general feeling that teachers often didn't have the content of pedagogical capability to teach in mixed ability groups.

6.3 Recommendations

From the findings of the research it is evident that there is a real need to develop capability, both in terms of content and pedagogical knowledge. Teachers were largely supportive of the theory behind mixed ability teaching but felt they lacked the skills and knowledge of how to implement this effectively while still catering for the full spectrum of learning needs in their classrooms. It was also apparent that part of the issue for teachers was that they were focused on grouping practices more than considering the nature of what they were teaching. Both complex and culturally responsive instruction are centred around more than just mixed ability grouping practices; they also call for rich learning tasks with multiple solutions or representations which develop communication, collaboration and problem solving skills. Focusing on recognising multiple abilities and ensuring that students value skills besides being able to get an answer quickly are important elements of these instructional models, which was something that was discussed by few teachers, even those working in schools where mixed ability grouping was the expectation. Schools could benefit from using research evidence to support the development of the 'why' and the 'how' needed to change practice in order to better cater for diverse learners in mathematics. Teachers, as well as curriculum leaders need to engage in critically analysing the ways they are catering for diverse learners and considering research evidence to support their understanding.

In the wider New Zealand context, it would be beneficial to explore a wider interpretation of "ability" in relation to maths in our schools, moving away from focusing on strategy and knowledge based curriculum levels to incorporate a wider range of skills. Throughout the interviews teachers talked about the pressures of moving students up through the curriculum levels as set out in the New Zealand Curriculum and often ability grouping was seen as a way to ensure they were addressing each skill to move students up. What we measure we end up valuing. If student progress is being measured in terms of knowledge and procedures, rather than problem solving, communication, collaboration and other skills then that is what teachers will focus on improving in their students.

Teachers need to develop their understanding of what "good" mathematics is and how it is practiced beyond school. We know what good literature looks like but for many, examples of good mathematics are inaccessible, meaning that our view of maths is

shaped by what we learned at school rather than how maths is used beyond school. Lockhart (2009) discusses the beauty of mathematics and describes it as 'the art of explanation' yet school maths is largely concerned with procedures and knowledge.

6.4 Limitations of the research

Only three schools (and a limited number of teachers within those schools) participated in the research meaning it is difficult to generalise findings from such a small sample. Research findings would not necessarily be the same across other schools. Many of the teachers commented on their perception of the practice of others within their school but this was not investigated further by the researcher.

No data was collected from observations in the classrooms about how grouping worked in practice, nor was student or parent voice collected. Research from overseas has focused on student perceptions or reported on student results which were not examined here.

Although data was collected from a range of different types of classes within schools (bilingual, ILE, accelerant, traditional classroom) this was not a focus of the research. Not enough data was collected to draw any conclusions about how different classroom environments impact on grouping practices.

6.5 Suggestions for further investigation

Investigating in a wider range of types of classes (bilingual, ILE, accelerant) as well as different schools would enable researchers to gauge if these differences have an impact on how diverse learners are catered for. In this study all the schools involved in the study were low to mid decile and in reasonably similar areas of the country. It would be interesting to see if the views were different in low or high decile schools, or in different parts of New Zealand.

Looking deeper into assessments could provide a valuable avenue for further investigation. Comparing what schools are using to assess student progress and how this impacts on the way they cater for diverse learners in mathematics could help build a better picture.

Research looking into student achievement at intermediate school, comparing students taught using complex or culturally responsive instructional methods to those in ability grouped classes could also be valuable. Teachers had a perception that mixed ability teaching does not work for the higher and lower learners and this would be an interesting area for further investigation.

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Appendix A: School Information Sheet

Catering for the diverse learning needs of mathematics students

PRINCIPAL and BOT INFORMATION SHEET

My name is Jenna Hatch and I am a teacher and syndicate leader in Tauranga. I am currently completing a thesis as part of a Master of Education (Mathematics Education) through Massey University. My research is looking at how intermediate schools are catering for the diverse learning needs of their students in mathematics. Intermediate schools often find that they need to cater for students with wide ranging needs, often within the same class. The purpose of this research is to explore current practice within intermediate schools to identify what works for schools, teachers and students, what difficulties are faced, and potential further research/supports. The findings will provide an overview of current practices and could also provide the Ministry of Education with an insight into the needs of intermediate schools in relation to catering for diverse learners in mathematics.

I am inviting your school to take part in this research which involves teachers and mathematics curriculum leaders across three New Zealand intermediate schools. Participants will be interviewed about their experiences, successes, challenges and ideas around catering for diverse learners in mathematics. This will be a chance for your teachers to engage with research, share the experiences of your school and reflect on their own practice.

If your school participates, what will be involved?
I am looking to interview 3-4 teachers per school, including a senior leader with curriculum oversight for mathematics. Each teacher will be involved in an interview of around 30 minutes, conducted either in person or by video call. I would also like to spend one day in your school observing the teachers involved (which would not be recorded) in order to get a clearer picture of what their practice looks like in action; however, given the current climate, this is not an essential part of the research.

If appropriate, access to planning and school curriculum documents related to mathematics such as mathematics planning guidelines, matrices or rubrics, or specific mathematics programmes you are using would also be requested.

Information gathered will be used to identify themes across the three schools. In providing a snapshot of how intermediate schools are catering for students with diverse learning needs, the research will also include participants' views of successes and challenges going forward. The names of schools and participants will be kept confidential to the research team. The use of pseudonyms and non-identifying descriptors will be used in

any written material to preserve anonymity or individual teachers within participating schools.

Recordings of interviews will be kept confidential and only viewed by the researcher and supporting staff at Massey University. Individual participants will have the right to review and edit their comments until the findings are written up.

Raw data will be stored securely in password protected electronic files or locked filing cabinets for five years after completion of the project, when it will be destroyed. Data collected will only be used for the purpose of this study.

Participant's Rights
Participants are under no obligation to accept the invitation to be part of the study. If they decide to participate, they have the right to; decline to answer any particular question; withdraw from the study at any time until interview recordings have been reviewed and approved; ask any questions about the study at any time during participation; provide information on the understanding that their name will not be used unless they give permission to the researcher. The school will be given access to a summary of the project report when it is concluded.

If you would like to participate, how do you volunteer?
If you are happy to participate in this study please let me know by emailing me: ▮▮▮▮▮▮▮▮▮▮▮▮▮ and returning the attached consent form.

If you have any questions regarding this research study you are welcome to contact me email: ▮▮▮▮▮▮▮▮▮▮▮▮ or phone: ▮▮▮▮▮▮▮

Alternatively you can contact my supervisors at Massey University (Palmerston North):
Professor Glenda Anthony
email: gjanthony@massey.ac.nz phone: 06 356 9909 extension 84406

Dr Pania Te Maro
email: p.temaro@massey.ac.nz phone: 06 356 9909 extension 84459

Thank you for considering taking part in this research.

Jenna Hatch

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher, please contact Professor Craig Johnson, Director Ethics, telephone 06 3569099 ext 85271, email humanethics@massey.ac.nz.

Appendix B: School Consent Form

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Institute of Education

Massey University, Te Kunenga ki Purehuroa, New Zealand

Catering for the diverse learning needs of mathematics students
PARTICIPANT CONSENT FORM - SCHOOL

I have read, or have had read to me in my first language, and I understand the Information Sheet attached as Appendix I. I have had the details of the study explained to me, any questions I had have been answered to my satisfaction, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to allow the school to participate in this study and I understand participation is voluntary and that teachers involved may withdraw from the study at any time.

 On behalf of the Board of Trustees:

1. I agree/do not agree to allow teachers from the school to participate in the study.
2. I agree/do not agree to allow for observations of classes at the school.
3. I agree/do not agree to allow access to documents relating to mathematics curriculum delivery.
4. I wish/do not wish to have data placed in an official archive.
5. I agree to the school participating in this study under the conditions set out in the Information Sheet.

Declaration by Principal or Board of Trustees Representative:

I _____ in my capacity as _____

hereby consent to _____School taking part in this study.

Signature: _____   Date: _____

Appendix C: Teacher Information Sheet

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Institute of Education
Massey University, Te Kunenga ki Purehuroa, New Zealand

Catering for the diverse learning needs of mathematics students

TEACHERS' INFORMATION SHEET

My name is Jenna Hatch and I am a teacher and syndicate leader in Tauranga. I am currently completing a thesis as part of a Master of Education (Mathematics Education) through Massey University. My research is looking at the ways in which intermediate schools cater for the diverse learning needs of their students in mathematics. Intermediate schools often find that they need to cater for students with wide ranging needs, often within the same class. The purpose of this research is to explore current practice within intermediate schools to identify what works for schools, teachers and students, what difficulties are faced, and what needs further research. The findings will provide an overview of current practices and could also provide the Ministry of Education with an insight into the needs of intermediate schools in relation to catering for diverse learners in mathematics.

I am inviting you to take part in this research which involves teachers and mathematics curriculum leaders. Participants will be interviewed about their experiences, successes, challenges, and ideas around catering for diverse learners in mathematics. This will be a chance for you to engage with research, share your experiences, and reflect on your own practice.

Following confirmation from your principal and Board of Trustees for your school to participate in this project, the principal/senior leadership has provided names of teachers who may be interested in taking part. In each school I am looking for 3-4 participants, including a senior leader with oversight for mathematics.

If you participate, what will you need to do?
Participation involves a 30 minute interview (in person or video call) at a time which is convenient for both participant and researcher, which will be recorded. Recordings will be available for the participant to review and edit if required. Where practical I would like to complete a follow up observation of a mathematics class (which will not be recorded) in order to see the class in action. It would be beneficial if you are willing to share your mathematics planning with the researcher, however this is not a requirement of participation in the project. Following the observation the researcher may have some follow-up questions which can either be provided by email or by video call.

Information gathered will provide a snapshot of how intermediate schools are catering for students with diverse learning needs. During the research, the names of schools and participants will be kept confidential, although other staff members may be aware that you are participating. The use of pseudonyms and non-identifying descriptors will be used in

any written material to preserve anonymity or individual teachers within participating schools.

Recordings of interviews will be kept confidential and only viewed by the researcher and supporting staff at Massey University. You will have the right to review and edit your comments until the findings are written up.

Raw data will be stored securely in password protected electronic files or locked filing cabinets for five years after completion of the project, when it will be destroyed. Data collected will only be used for the purpose of this study.

Participant's Rights
You are under no obligation to accept this invitation. If you decide to participate, you have the right to: decline to answer any particular question; withdraw from the study at any time until interview recordings have been reviewed and approved; ask any questions about the study at any time during participation; provide information on the understanding that your name will not be used unless you give permission to the researcher. You will be given access to a summary of the project report when it is concluded.

If you would like to participate, how do you volunteer?
If you are happy to participate in this study please let me know by emailing me: ▮▮▮▮▮▮▮▮▮▮▮▮ and returning the attached consent form.

If you have any questions regarding this research study you are welcome to contact me email: ▮▮▮▮▮▮▮▮▮ or phone: ▮▮▮▮▮▮

Alternatively you can contact my supervisors at Massey University (Palmerston North):
Professor Glenda Anthony
email: gjanthony@massey.ac.nz phone: 06 356 9909 extension 84406

Dr Pania Te Maro
email: p.temaro@massey.ac.nz phone: 06 356 9909 extension 84459

Thank you for considering taking part in this research.
Jenna Hatch

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher, please contact Professor Craig Johnson, Director Ethics, telephone 06 3569099 ext 85271, email humanethics@massey.ac.nz.

Appendix D: Individual Consent Form

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MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

UNIVERSITY OF NEW ZEALAND

Institute of Education

Massey University, Te Kunenga ki Purehuroa, New Zealand

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Catering for the diverse learning needs of mathematics students

PARTICIPANT CONSENT FORM - INDIVIDUAL

I have read, or have had read to me in my first language, and I understand the Information Sheet attached as Appendix I. I have had the details of the study explained to me, any questions I had have been answered to my satisfaction, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to participate in this study and I understand participation is voluntary and that I may withdraw from the study at any time.

1. I agree/do not agree to the interview being sound recorded.
2. I agree/do not agree to the interview being image recorded.
3. I wish/do not wish to have data placed in an official archive.
4. I agree to participate in this study under the conditions set out in the Information Sheet.

Declaration by Participant:

I _____ hereby consent to take part in this study.

Signature: _____   Date: _____

Appendix E: Interview Questions – Teachers

Domain & Lead Question	Probe questions	Expected Data/Notes
Tell me about the diversity of learning needs in your classroom?	- Ability levels - Special needs students - Socio-economic background - Cultural diversity - School experience Is this typical of the school?	General description of the make up of their class and the diversity
Tell me about the ways you cater for your students during mathematics learning time	- By ability (curriculum levels or stage) - By needs identified from a formative assessment - Using a diagnostic activity - Task design - Why have you chosen to organise like that? (potential follow up: what would you do if you weren't constrained by the school?) - How successful has this been in your classroom? How do you know? - Are there any groups/students who have not made the progress you have expected? Why do you think this has been?	
There are multiple suggestions and description of practices used by ERO and the MoE for catering for diverse	- (prompts: getting students with the same level ability together, encouraging participation, identifying	

learners. Differentiation is a frequently used term – tell me about your understanding of this term and what it would look like in a mathematics lesson. What do you think is important when grouping students?	needs and targeting teaching to those, mixed ability) - Prompt: is differentiation a practice that you use, how etc.
- In all schools we have students who struggle with maths, why do you think this is so? - What do you do think is the best way to support struggling students?	- Differentiation? Mixed ability grouping? Withdraw programmes? Targeted teaching? Through particular tasks?
- At the ends of the spectrum of learning needs we have students with special/high needs and gifted students - How are the learning needs for these students supported in your class?	- [prompt, explore if this works, if the teacher feels she has the skills, if there is a school wide support/policy, what is needed to better support these students etc, once she has talked through her personal situation] - What interventions/ programmes have you been involved in/ have been run in your school? Do you think these have been successful? Why/why not? - What do you think is the best way to cater for gifted learners in mathematics? Why?

- What have been your biggest successes this year in your mathematics programme? Why is this? - What has been the biggest challenge? Why is this?	
School Wide (Assessment and Policy): - How do you assess the learning needs and progress of your students? - How do you measure the progress of your students? - How does the school track and report on students progress? -	- Why have you chosen to do it this way? - Are practices standardised across the school?

Appendix F: Interview Questions - Lead Teacher

Domain & Lead Question		Probe questions	Expected Data/Notes	
Tell me about the diversity of learning needs in your school?		- Ability levels - Special needs students - Socio-economic background - Cultural diversity - School experience	General description of the make up of their school and the diversity	
Tell me about the ways students are organised for mathematics across the school?		- By ability (curriculum levels or stage) - By needs identified from a formative assessment - Using a diagnostic activity - Why has the school chosen to organise like that? - How successful has this been? - How do you know? - Are there any groups/students who have not made the progress you have expected? - Why do you think this has been?	Description of how classes are organised - Year level? - Ability? - Cultural (bilingual classes?) Rationale	

There are multiple suggestions and description of practices used by ERO and the MoE for catering for diverse learners. Differentiation is a frequently used term – tell me about your understanding of this term and what it would look like in a mathematics lesson. What do you think is important when grouping students?	- (prompts: getting students with the same level ability together, encouraging participation, identifying needs and targeting teaching to those, mixed ability) - Prompt: is differentiation a practice that you use, how etc.
- In all classes we have students who struggle with maths, why do you think this is so? - What do you do think is the best way to support struggling students? - Tell me about the biggest successes you've had across the school in supporting struggling learners	- Differentiation? Mixed ability grouping? Withdraw programmes? Targeted teaching?
- At the ends of the spectrum of learning needs we have students with special/high needs and gifted students	- Is there a schoolwide policy/programme? - What interventions/ programmes is the school

- Do you have these learners in your class, and if so how are their learning needs supported?	involved in/ have been run in your school? Do you think these have been successful? Why/why not? - What do you think is the best way to cater for gifted learners in mathematics? Why?
School Wide (Assessment and Policy): - How do you assess the learning needs of students across the school? - How do you measure the progress of students across the school? - How does the school track and report on students progress?	Prompt: are there school wide practices? - Why have you chosen to do it this way? - Are practices standardised across the school?

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