# THE MĀTAURANGA MĀORI IN MATHEMATICS DIRECTIVE

## Exploring the place of mātauranga Māori in Mathematics teaching and learning

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# IHO|ABSTRACT

This thesis explores issues concerning mātauranga Māori in mathematics teaching and learning here in Aotearoa. The Ministry of Education has directed that mana ōrite mō te mātauranga Māori be embedded in teaching, learning, and assessment. Thus, this research primarily aims to understand the development leading to the directive of including mātauranga Māori in education policies. For the English-medium secondary education settings, the second and third aims of this research are to explore what mātauranga Māori means to teachers of mathematics and to consider the connections between mātauranga Māori and mathematics teaching and learning. To investigate these aims, a semi-structured group discussion with four secondary mathematics teachers from an English-medium setting was conducted. The results of this thesis highlight the confusion and challenges secondary mathematics educators have toward defining, and subsequently, implementing mātauranga Māori in their classrooms. This thesis also found that there is enthusiasm and interest around learning how to ensure indigenous and marginalised learners reach their mathematics potential. Believing that indigenous worldviews have the potential to shift education outcomes for minority learners, this thesis adds to literature related to indigenous education, secondary mathematics education, and English-medium education of Māori learners.

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To my dad, this mihi is for you, for being my shoulder to cry on.

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Title definition: *Te Take Rangahau* translates to "the purpose of this research". *Te Take* translates to "the purpose", and *rangahau* is a metaphor for research. An interpretation of *ranga* is weave, and *hau* has rich meaning in te ao Māori (the Māori worldview) linked to spirituality (Mead, 2003). Put together, the literal translation of rangahau is a weaving together of the unseen. To make sense of what is sensed.

## 1.1 Setting the scene

> *Mathematics is scary, yet even more, it is fascinating. Some may not like it, but would like to like it, or at least to be able to peep at will into its murky mysteries. Many think it is inaccessible. But this is not true. It is perfectly possible to love music without being a musician...*
>
> *—Launay, It All Adds Up, 2018*

Te Tāhuhu o Te Mātauranga–The Ministry of Education has directed mātauranga Māori be integrated into its resources such as the National Certificate of Educational Achievement (NCEA) standards and the New Zealand Curriculum (Ministry of Education, 2020). Despite appearing to be a recent directive, the shift in New Zealand education to be inclusive of Māori culture has been a long journey. Since the 1960s, there has been a deliberate education focus on increasing educational outcomes of Māori learners. The education focus has transitioned from enhancing biculturalism (Codd, Harker, & Nash, 1985; Walker, 2016) to working toward tino rangatiratanga (self-determination) (Gerrard, 2018; Durie, 1998; Smith, 1992). Some sixty years post educational policies seeking shifts, Māori still experience poorer educational outcomes when compared to their non-Māori peers (Bishop, Berryman, & Wearmouth, 2014; Durie, 2003; Riwai-Couch, 2021).

In Aotearoa, English-medium schools conduct much of their instruction in English. Māori-medium schools conduct much of their instruction in te reo Māori. For mathematics teaching and learning in English-medium secondary schools, the Ministry of Education (MOE) directive offers an opportunity to enhance achievement in mathematics classrooms for underachieving Māori learners. Aotearoa is not alone when reflecting on the achievement of indigenous mathematics learners. Indigenous learners are more likely to leave the mathematics classroom without any qualifications and of those who remain in mathematics learning to the end of

secondary education, are less likely to participate in courses which include more complex mathematics learning (Gutiérrez, 2017; Tate, 1995). Excellent achievement outcomes must remain a focus for education, but for Māori learners' success in education is more than academic achievement alone. It is crucial for overall health and wellbeing to be considered (Riwai-Couch, 2021). As such, equity is the test of how wholesome our education is. The pool of literature discussing mathematics teaching and learning for Māori in English-medium settings is less than what exists for Māori-medium settings (although, still a small pool of literature). If content can be shared, findings for a study into achieving equity in a Kaupapa Māori kura (Māori-medium school) highlighted that "equity in a kura kaupapa Māori is more than gaining high achievement results in traditional Western school subjects…the relationship between student achievement and Māori identity are complementary" (Meaney, Trinick, & Fairhall, 2013, p. 259).

Mana ōrite mō te mātauranga Māori (equal status for Māori knowledge) is a response to inequity. Mana ōrite mō te mātauranga Māori took its directive form by MOE as one of seven changes when work began on the NCEA update in 2019. At the early stages of implementation, lead advisors from MOE were tasked with ensuring te ao Māori (the Māori worldview) was being considered in the creation of new education assessment resources. Mana ōrite (equal status) has a history stemming from the Treaty of Waitangi and the issues surrounding New Zealand's struggles to equally value the founding cultures – Māori and Pākehā (a local term used to describe a New Zealander who is generally New Zealand European) (Durie, 1998, Riwai-Couch, 2021). Mana ōrite will not be explored in its entirety in this thesis. Mātauranga Māori forms the focus for this exploration, and put simply, is a term used to describe Māori knowledge (although it must be warned that this translation is inadequate).

Researchers from MOE shared findings from a survey they conducted in 2021 asking for feedback on the NCEA changes. They shared that "these respondents believe that Mathematics is universal, and it is contexts, and not concepts, which change" (Ministry of Education, 2021b, p. 4). At the time, the mathematics teaching sector suggested that "mātauranga Māori in the subject (Mathematics) content is too vague to provide meaningful comment on" (Ministry of Education, 2021b, p. 4). MOE responded to this feedback with two interpretations, that is, "some see the possibility for cultural innovation and that this allows a

move towards better and more authentic interaction with te ao Māori, others worry that the approach will be limiting and superficial" (Ministry of Education, 2021b, p. 4).

The concern around the appropriateness for mathematics to be culturally inclusive is a core idea in this thesis. The stance of this exploration is that the concept of universality has been misunderstood as accultural, that cultural innovation allows more authentic interactions with mathematics, and that we do not yet know enough about the relationship between mathematics and te ao Māori for us to know whether we are superficial or limiting in either mathematics or te ao Māori.

## 1.2 Research aims

This study explores the understandings of mātauranga Māori in mathematics teaching and learning for current mathematics kaiako (learning facilitators). The intention of this research is to examine the interpretation of the MOE directive *mana ōrite mō te mātauranga Māori* in the English-medium secondary setting, an exploration that goes beyond previous examinations of mathematics teaching and learning (see Anthony, Walshaw, 2007; Hāwera, Taylor, 2008; Meaney et al., 2013) and mātauranga Māori (see Simon, 1993, Riwai-Couch, 2021). As such, there are three key aims in this study:

1. To understand the policy development leading to the directive of including mātauranga Māori
2. To explore what mātauranga Māori means to kaiako
3. To consider the connections between mātauranga Māori and mathematics teaching and learning.

To meet these aims, this thesis reviews literature which seeks to define mātauranga Māori and its inclusion as a directive in current education policies. It will also link the reviewed literature to how mātauranga Māori is interpreted by mathematics kaiako in English-medium secondary settings. This research provides a perspective of how the directive of including mātauranga Māori in mathematics teaching and learning is viewed within the education system here in Aotearoa. It is hoped that this thesis will add to the current literature that links the indigenised education policies with practice in the mathematics classroom. The goal of this research is to open discussions relating to the immersion of indigenous epistemologies within education practices. This exploration is not focused on the measure of effectiveness or achievement rates

from using mātauranga Māori in English-medium secondary settings, although this would be an interesting topic to investigate further.

## 1.3 Justification for research

There has been an iterative shift towards indigenising education policies here in Aotearoa over the last sixty years (Walker, 2016). The move towards indigenising education policies, and therefore, education practice is both exciting and unknown. It is a quest for the unknown which justifies this research and there are many reasons for exploring indigenising directives in education. Furthermore, researching this shift in terms of mathematics teaching and learning helps fill the void in research that currently exists which is predominantly focused on Māori-medium or primary mathematics learning (Years 1-8).

While there exists a numerous supply of literature related to why it is necessary to indigenise our systems and structures (see Chapter Two), little is known about teachers' experiences while implementing (or attempting to implement) indigenous ideologies in teaching and learning. Furthermore, enhancing educational outcomes for Māori has been an ongoing focus for educators since Māori first realised they were getting a raw deal in education during the early 1900s (Walker, 2016). Linking this aspiration to increasing our nation's mathematics capabilities leaves scope for investigation. This has left unanswered questions about how we equitably enhance mathematics outcomes for secondary school students, in particular, our underachieving Māori learners in English-medium settings.

Turning to indigenous people to create opportunities for shifting focus in education has accelerated changes and the increased integration of te ao Māori content and contexts in education resources has been deliberate (see Berryman & Macfarlane, 2017; Durie, 1998; Penetito, 2010; Smith, 1992). Lawrence (1992) asserts that "…our scholarship must strive to be both pragmatic and utopian. Our work must respond to the immediate needs of the oppressed and subordinated. Education must involve both action and reflection. Theory must be informed by active struggle, and in turn it must inform that struggle" (p.2239). Māori (and indeed, many indigenous or minority peoples) struggle and have struggled to reach a level of educational outcomes that match those of the dominant group. As Lawrence (1992) summarised, this research is based on the utopian belief that all learners can achieve at their potential, yet it understands that there are barriers to overcome.

To justify further, research linked to education has the potential to significantly impact learner outcomes by improving practice and informing policy (Creswell, 2014). As a mathematics teacher who is Māori, who teaches Māori, it is a selfish assertion that the purpose of this research is to assist my own practice in the classroom. Yet, other teachers may benefit from this addition to the literature associated with linking what we know about mātauranga Māori to what we know about teaching mathematics in a secondary English-medium school setting. Similarly, informing policy is a koha (gift) this thesis may offer through documenting lived experiences of practitioners and activators of the government's education direction toward equitable and excellent outcomes (Ministry of Education, 2021a).

## 1.4 Epistemological stance and theoretical framework

The epistemological positioning of the researcher must be stated, as well as the theoretical frameworks guiding this research. Epistemology can be best described by its etymological definition which comes from the Greek *episteme* meaning "knowledge", and *logos* meaning "to reason". A simpler definition is given by Crotty (1998, p. 8) who says epistemology is "how we know what we know". As this research is concerned with mātauranga Māori, the epistemological position of the researcher is founded on critical theory. Critical theory generally seeks emancipation and liberation, especially concerning marginalised peoples (Berryman, Soohoo, & Nevin, 2013; Creswell, 2014; Stewart, 2007). This positioning leads to a more localised Kaupapa Māori theory. Kaupapa Māori research is about being Māori. It values and legitimises Māori knowledge (Smith, 1992).

There are two textual stances this thesis sustains. One textual stance in this thesis is that Aotearoa is used as the name of the country more commonly known as New Zealand. There is a preference of some to list this country by both its English and Māori names to respect biculturalism. This will not be done in this thesis. If biculturalism is to be honoured in its entirety, then all words would be translated. This serves no reasonable purpose. If using New Zealand is relevant in discussion then this will be used but as critical discourse theory explains, the use of te reo Māori will be treated as normal. May (2001) gives an adequate description for the approach to te reo Māori for this thesis stating that "the normalisation of minority languages… is a legitimate and defensible sociological, political activity" (p. xiii). This said, for the purpose of following academic writing conventions and to assist the reader, non-English words will be translated upon first appearance and a glossary of terms can be found on page

86. The second textual stance is that clarity of meanings for terms can be found in their literal translations. Dictionary definitions will be relied upon to give clarity of meaning for words and phrases where social interpretations cloud our understanding. This stance is well placed in a study exploring what mātauranga Māori means for mathematics teaching and learning.

It is important to state here that this research makes three assumptions. Firstly, this thesis exploration assumes mātauranga Māori can be incorporated into mathematics teaching and learning. This position validates indigenous knowledge, beliefs, and systems as a norm to how human interactions take place, in this case in education, but could be applied to all scenarios. There is a myriad of literature which works hard to diminish the validity of indigenous ways of thinking and some of that literature will be critically explored. Secondly, it assumes mātauranga Māori is not being widely implemented in Aotearoa education. There is much anecdotal evidence to suggest that this is the case in secondary English-medium schools (see Ministry of Education, 2021b) but this is from the perspective of teachers being able to associate pedagogy with mātauranga Māori. While examining the findings in Chapter Five and Six it may be found that there are already examples of practice which could be considered as implementing mātauranga Māori. The final assumption is that the discipline of mathematics can be a conduit for implementing mātauranga Māori and vice versa. That is, implementing mātauranga Māori in the mathematics classroom is positive, both for the educational experience of teacher and learner and in academic outcomes for all learners. This research is not interested in proving or disproving these assumptions.

## 1.5 Methodology

The methodology used to approach the research aims, as discussed in Chapter Four, is qualitative. The plan for collecting data in this thesis initially involved two focus groups, semi-structured discussions with a total of seven participants, including the researcher who would participate as a member of both the kaiako and lead advisor groups. One focus group would be three kaiako who were currently teaching mathematics in an English-medium secondary setting, and the second focus group would be three lead advisors working at MOE in either mathematics, statistics, mana ōrite, or Māori advisory roles. Unfortunately, the lead advisors working at MOE were not able to participate in this study for legal reasons. This was due to the redesigning of New Zealand's qualification system for senior secondary students and the New Zealand Curriculum at the time of this research. Although the absence of their voice leaves

scope for further investigation, the voice of the four kaiako offers useful findings. Their voice was collected using a semi-structured group discussion and was conducted face-to-face. Smith's (2000) seven code-of-conduct features –which exemplify using mātauranga Māori to set the procedures for conducting this enquiry –ensured that the data was sourced ethically and with respect. To analyse their narratives, thematic analysis was used initially, and this was largely based and adapted by the nodes outlined by Peel (2020, p. 8). To share their narratives, Bishop's (1997) collaborative storying was utilised. Chapter Four provides a more in-depth discussion and rationale for the methodology and methods used within this exploration.

## 1.6 Guide to thesis structure

This thesis is structured into five significant chapters and bound together by the Introduction titled *Te Take Rangahau* and the conclusion titled *Whakaaro Whakatau*. This thesis can be considered to consist of two parts. Part One provides a theoretical backbone for this exploration and is expressed in Chapter Two, Chapter Three, and Chapter Four. Part Two addresses the findings of this research and is expressed in Chapter Five and Chapter Six. Each chapter is given a title that uses mātauranga Māori through names expressed in te reo Māori. In te ao Māori, te reo Māori is considered a taonga (treasure). I utilise this treasure intentionally to maintain a connection to my mātauranga Māoritanga and position my research within a Kaupapa Māori framework. A personal description of their intended meanings is conveyed immediately following the title to allow the reader to immerse themselves in my thinking.

The current chapter, Chapter One, is called *Te Take Rangahau*. It outlines the aims and the justification for this thesis, as well as a brief explanation of the methodology used to conduct this research. *Ngā Herenga Mātauranga* form Chapter Two and Chapter Three. Collectively, they provide the contextual backdrop as they introduce relevant local (Aotearoa) and international literature on mātauranga Māori and mathematics teaching and learning. Chapter Two is primarily concerned with defining mātauranga Māori as well as examining the historical shifts in education policy. The purpose of this chapter is to explore definitions, policy evolution, and studies positioned in an Aotearoa context meeting the first aim of this thesis of understanding the policy development leading to the directive of including mātauranga Māori. Chapter Three aims to define mathematics as a learning discipline as well as examining effective pedagogy, specifically for mathematics. The purpose of this chapter is to meet the

third aim of this research of considering the connections between mātauranga Māori and mathematics teaching and learning.

Chapter Four, *Ngā Tikanga Rangahau,* will outline the methodology and methods used to respond to the research aims for this thesis. This chapter will demonstrate the researcher's positionality, the research methodologies and approaches undertaken, introduce the participants of this study, justify the data collection and analysis methods used, and discuss ethical considerations and limitations of this research.

The key findings from the data analysis of the focus group discussion are split into two separate chapters. Throughout the data analysis stage of the project, it became evident that it would be beneficial to combine the findings and discussion. Chapter Five and Six address the second aim of this thesis which is to explore what mātauranga Māori means for kaiako. Chapter Five is titled *Te Huarahi Ki Konei|The Pathway Leading Here*. It introduces the learning journeys of the kaiako by sharing the interactions they had in the classroom as learners. It then leads to their initiation into teaching in Aotearoa and how shifts in education have shaped them into kaiako. Common themes discussed here are whanaungatanga, "traditional" teaching, power, and manaakitanga.

Chapter Six will discuss the findings that arose which connect mātauranga Māori and mathematics teaching and learning from the perspective of the participants and is called *Te Huarahi ki Mua*. It will share the meanings of mātauranga Māori and how they see it in the classroom, as well as expressing how they manage expectations in a seemingly rapidly changing education context. Common themes such as culturally relational pedagogy and ako (teach or learn) are notably discussed. Concluding this chapter are the findings of fear and hope as key themes noticed throughout the discussion.

Finally, Chapter Seven will tie the preceding chapters together by summarising the major findings of this exploration and is titled *Whakaaro Whakatau*. The relevance of these findings in relation to the literature examined will be highlighted to show how this thesis has added to literature on mātauranga Māori in mathematics teaching and learning. This chapter will reflect on the three research aims once more and suggest possible areas for further research.

# CHAPTER 2 NGĀ HERENGA MĀTAURANGA | LITERATURE REVIEW 1

Title definition: *Ngā Herenga Mātauranga* translates to "the interconnected literatures". Ngā is plural signifying the multiple pieces of relevant literatures which have been examined. *Herenga*'s closest English equivalents are "link, tie, or bond" (Williams, 1957) representing the connections between the literature and my exploration. *Mātauranga* translates to "knowledge" (Williams, 1957) and is used here to represent literature as diverse knowledges I have used to explore my research questions.

The intention of this thesis is to explore the understandings of mātauranga Māori in mathematics teaching and learning. The research aims that this two-part literature review hope to address are the first and third. The first research aim is to understand the policy development leading to the directive of including mātauranga Māori in education here in Aotearoa. The third research aim is to consider the connections between mātauranga Māori and mathematics teaching and learning. The following two chapters will provide a contextual foundation for this research by reviewing relevant literature. The first of these chapters, *Mātauranga Māori and its inclusion in New Zealand education,* begins a literary exploration centered around the core topic of education in a predominantly Aotearoa context. The second of these chapters, *Mathematics, teaching and learning, and mātauranga Māori,* will explore literature related to concepts of mathematics teaching and learning in a broader context, linking studies from an international context with localised research.

# MĀTAURANGA MĀORI AND ITS INCLUSION IN NEW ZEALAND EDUCATION

## 2.1 Introduction

This chapter forms the first half of the literature review within this thesis. This section specifically relates to the first research aim which is to understand the policy development leading to the directive of including mātauranga Māori. As this initial section is dedicated to Aotearoa contexts, this chapter begins with an exploration into mātauranga Māori. That is, literature associated with defining and explaining mātauranga Māori will be collected and reviewed in answer to the question, what is mātauranga Māori? This chapter will then explore the socio-historical movements in Aotearoa leading to education policies which direct the inclusion of mātauranga Māori in teaching and learning. Finally, this chapter will explore studies which give examples of teaching and learning in Aotearoa while managing the implementation of the Ministry's directive.

## 2.2 What is Mātauranga Māori?

Mana ōrite mō te mātauranga Māori is one of seven changes that form a change package being used to develop new assessment and learning resources relevant to Aotearoa secondary education, but there is uncertainty about what this looks like in the mathematics classroom. To assist in this exploration, an understanding of what mātauranga Māori means is necessary. This section is guided by a definition-focused analysis using te reo Māori and will be followed by a collation of interpretations shared by the literature. Finally, the common translation of mātauranga Māori will be reviewed in two sections: knowledge as taonga, and knowledge as a group possession.

### 2.2.1 Mātauranga Māori

*Mātauranga Māori* is commonly translated as "Māori knowledge". This simple translation causes confusion and locates mātauranga Māori in the past. This thesis is based on the understanding that Māori knowledge is an insufficient answer to the question "What is mātauranga Māori?" It is hoped that investigating what mātauranga Māori means, and avoiding simple translations, will allow a better connection to the meaning of mātauranga

Māori. This method to define mātauranga Māori avoids ambiguity and focuses on what is, rather than what is implied.

*Mātauranga* translates to "knowledge" and *Māori* is a collective noun used to define the indigenous peoples of New Zealand which I refer to mostly as Aotearoa in this thesis (Williams, 1957). Māori also means ordinary or normal. Te reo Māori (Māori language) is known to be metaphoric. That is, as a language, te reo Māori is less concerned with definitions and unitary meanings and is more concerned with symbolic and multifaceted meanings.

> *Metaphors allow people to communicate complex configurations of information that better capture the rich, continuous nature of experience than does literal discourse alone…speakers can convey richer, more detailed, more vivid images of our subjective experience …images seem to embellish what is communicated.*
>
> *—Gibbs, The Poetics of the Mind, 1994, p. 125*

The issue with multifaceted, metaphoric meanings is that they are only understood by those who have knowledge of the language used. To attempt to describe its meaning for those who are not literate in te reo Māori, a literal method will be used.

The term *mātauranga* has the root word mātau, as a verb it means "to know, understand, or to study" (Williams, 1957) and as an adjective it means "knowledgeable" (Ngata, 1993, p.248). A translation for *(ra)ranga* is "weave" (p. 528). Therefore, the literal translation of mātauranga is the weaving together of diverse knowledge and ways of knowing. This process of knowledge creation is eloquently defined by Durie (2012) where he states that, "mātauranga Māori is an always evolving …body of knowledge" (p.23). This literal investigation overcomes the confusing issue of positioning mātauranga Māori in the past. Te Aka Māori Dictionary (n.d.) describes mātauranga Māori as "Māori knowledge — the body of knowledge originating from Māori ancestors, including the Māori world view and perspectives, Māori creativity and cultural practices". There are three notable discussion points to explore: originating from ancestors, Māori world view and perspectives, and creative and cultural practices. This definition ties together the metaphorical meaning with the literal. Exploring the three discussion points will assist in understanding why mātauranga Māori is included in educational policies.

Using Māori knowledge as an answer to the question "What is mātauranga Māori?" is insufficient if it lacks an understanding of it originating from ancestors, that it's founded on Māori world views and perspectives, and is made up of creative and cultural practices. Without

these considerations, the translation of Māori knowledge positions mātauranga Māori in the past, a pre-colonial concept and has the trouble of being interpreted as such. There are two issues with this position. Firstly, for people who have a connection to their pre-colonial history it can be easy to say that mātauranga Māori can only be accessed by Māori like themselves, as a kind of gatekeeping and purism which excludes others. Secondly, for those who are unfamiliar with Māori ways of being before colonisation, it can be a default of comfort to accept their inability to participate in indigenous worldviews and practices and disengage from any attempts to normalise and implement a concept such as mātauranga Māori. When discussing historical education for Māori, Metge (2015) states that "[t]he preservation, protection, and presentation of knowledge that tuku iho nō ngā tūpuna (passed down by past generations), did not preclude adaptation and chance. On the contrary, knowledge must be kept relevant and useful in the present" (Metge, 2015, p.264). Indeed, mātauranga Māori represents more than a single tradition, worldview, or knowledge. It represents how Māori interact with the world around them now, how they interacted in the past, and how they may interact in the future (Hoskins & Jones, 2023; Mead 2003).

### 2.2.2 Knowledge as a taonga

In the definition of mātauranga Māori used by Te Aka Māori Dictionary there were three notable points. The first was about knowledge originating from ancestors and the theme of acknowledging learnings from the past to better inform the future is supported by other ao Māori writers (see Best, 1923; Durie, 2012; Mead, 2003; Metge, 2015; Ruru & Nikora, 2021). In te ao Māori, knowledge originated in the heavens, and is a gift from the gods (Best, 1923). Tānemāhuta, a progeny deity of Ranginui (sky parent) and Papatuanuku (earth parent), ascended to the highest heaven and brought back the three baskets of knowledge – te kete aronui, te kete tuauri, and te kete tuatea. Te kete aronui held knowledge that helps and assists humankind and te kete tuatea contains knowledge of what is harmful and dangerous. Finally, te kete tuauri contained knowledge relating to ritual and memory. Wehi, Beggs, and McAllister (2019) share that "[m]ātauranga has been described as an indigenous knowledge system that spans the physical and spiritual worlds" (p. 2). This definition begins to evolve into the second notable point from the Te Aka definition of mātauranga Māori including Māori worldviews and perspectives.

The intimate connection between the physical and spiritual effects on knowledge is acknowledged by Māori, as is the iterative and ever compounding nature of learning. In te ao Māori it is seen as something that is ever changing and growing as new evidence presents itself (Mead, 2003; Metge, 2015). Mead (2003) clarifies that "mātauranga Māori is not like an archive of information but rather is like a tool for thinking, organising information, considering the ethics of knowledge, …and informing us about our world and our place in it" (p. 306). The focus on knowledge as being ever evolving from an ao Māori perspective introduces the third notable point in Te Aka Māori Dictionary's definition for mātauranga Māori of creativity and cultural practices. Thus, knowledge to Māori is valued and protected. It is also not an individual enterprise.

### 2.2.3 Knowledge as a group possession

An ever-increasing understanding of the benefits of collective knowledge creation is shifting the way educators educate, moving away from individual merit and toward collaboration. The collective creation of new knowledge is explored by Metge (2015). The attainment of knowledge for Māori was a group possession, and that learning was for the benefit of the collective iwi, hapū, whānau, rather than for the ambitious needs of the individual such that "[e]ducation strategies stressed learning in the context of relations with people" (Metge, 2015, p. 263). That said, Hokowhitu (2011) points out that to consider Māori as a unitary entity minimises the potential for mātauranga Māori to be applied diversely. Certainly, there are common lived experiences and cultural practices that Māori can share with each other, but it remains unreasonable to assume all Māori are the same (Black, 2014; Doherty, 2014; Hokowhitu, 2011; Poata-Smith, 2004). The implications of assuming what is good for one Māori is good for another, especially in education, is that Metge's (2015) message of collective learning is misinterpreted as a universal group rather than its intended meaning, which is a diverse and dynamic set of parts making up the collective. The most important concept is the interrelationship between the members of the collective, and how their interactions grow and evolve prior knowledge into new knowledge (mātauranga). Hirini Moko Mead (2012, as cited in Ruru & Nikora, 2021) considers mātauranga Māori as "constituting the knowledge base which Māori people must have if they are to be comfortable with their Māoritanga and competent in their dealings with other Māori people" (p. 42). In discussing the aims of education pre-colonisation, Moana Jackson (2016) said that Māori could not fail in education

because the aim was perpetual learning. Learning based on enhancing and growing an understanding of the world, transmitting learnings in an ever-evolving manner supported a purposeful, relevant, and learning focused education.

In the English-medium secondary context here in Aotearoa, mātauranga Māori has the potential to enrich education. This potential is affected by how mātauranga Māori is interpreted. The definition of mātauranga Māori includes a fundamental acknowledgement that "not all people 'know' in the same way" (Stanfield, 1985, p. 396) and that innovation, including ever-evolving intellectual understanding of the world around us, is a social enterprise, not an individual one. Through an exploration into what mātauranga Māori means from the literature, this section defined knowledge from a te ao Māori perspective. The section to follow discusses the evolution of education policies in Aotearoa.

## 2.3 Education Policies

To understand the reasons behind the MOE directive of including mātauranga Māori in teaching and learning, a look through the history of Aotearoa's educational policies will be discussed here. In this section, a historical overview of education in Aotearoa will be followed by the policies which have shaped education foci post-colonisation. This discussion will highlight the evolution of education policies leading to the directive of *mana ōrite mō te mātauranga Māori*. As such, this section seeks to explore literature associated with answering the first aim of this thesis - to understand the policy development leading to the directive of including mātauranga Māori. Although this section begins with the mission schools in the early 1800s, this starting point does not deny the existence of formal learning systems prior to European contact. As discussed in the previous section regarding mātauranga Māori, there existed institutions and common strategies for effective teaching and learning for Māori. Here, we begin with the first mission school in Rangihoua, a small settlement in the Bay of Islands in the Far North.

### 2.3.1 The first mission schools

Thomas Kendall, an Anglican missionary, opened the first mission school in Rangihoua during the spring of 1816 (Jones & Jenkins, 2011; Simon, 1998; Sorrenson, 1979). The educational focus during this time was to teach Māori to read and write, so that they may benefit from civility (Simon, 1998; Walker, 2016). Such was the dedication of the first missionaries that the Bible was translated into te reo Māori, and the predominant language of school instruction

was done in te reo Māori (Lee-Morgan & Hutchings, 2016). Ranginui Walker (2016) highlights that the missionaries' work was "predominated on the notions of racial and cultural superiority" (p. 20) referencing the early reverend's beliefs that Māori were "filthy and debasing" (p. 20).

The missionaries' notions of racial superiority can be linked to the Doctrine of Discovery. Originating as a papal bull (catholic law) during the 15th and 16th century, the Doctrine of Discovery gave explorers a legal right to claim found land and exert sovereignty over it so long as no Christians resided there (Ngata, 2019). Non-Christians were viewed as less than human and therefore colonisers were able to declare land as terra nullius (vacant land). Ngata (2019) explains that the Doctrine of Discovery verified the idea that groups of humans could be hierarchically structured, in this case, based on religion. This kind of legal discrimination is interrogated by Moana Jackson (Jackson, 2012) who shared an address to the United Nations at the Permanent Forum on Indigenous Issues:

> "The Doctrine of Discovery suggested a right to take control of another nation's land, it necessarily also implied a right to take over the lives and authority of the people to whom the land belonged. It was in that sense, and remains to this day, a piece of genocidal legal magic that could, with the waving of a flag or the reciting of a proclamation, assert that the land allegedly being discovered henceforth belonged to someone else" (Jackson, 2012, para 3).

Here, Moana Jackson speaks to the notion of unspoken consequences. While the Doctrine of Discovery gave legal sovereignty over physical land, the detrimental effect suffered by those who already lived and used that land was and is pervasive. Ranginui Walker (2016) discusses the education focus of mission schools as following a restricted curriculum suited to domination and control. He shares that instruction was narrowed to only religious studies and in te reo Māori only. This was thought to eliminate the possibility of Māori learning non-Christian English concepts (Walker, 2016). For Māori though, they believed that the entirety of European knowledge lay in the writings of the Bible and keen to share this learning with all other Māori, Māori learners became teachers who travelled and taught Bible studies to other Māori (Elsmore, 1985). Equipped with the teachings of a religiously curated curriculum, the assimilatory goal of colonisation had begun.

### 2.3.2 A quest for assimilation

> *…in order to dispossess us of our lands, lives, and power, the colonisers had to educate us to think that what we already knew, or might know from our own traditions, our own education and our own cultural understanding of the world was not worthy.*
>
> *—Jackson, Decolonising Education, 2016, p. 39*

A shift in education focus came in with the Education Ordinance of 1847. In this ordinance, Governor Grey began a quest to assimilate Māori through government subsidies for church boarding schools who accepted Māori learners. The idea was to separate Māori children from their Māori whānau (family), and therefore assimilate Māori into European ways (Barrington, 1970). Reinforced by the Native Schools Act in 1858, a subsidy was created to award schools whose language of instruction was solely in English (Barrington, 1970; Durie, 1998; Walker, 2016). The purpose of offering extra financial support encouraged schools to forego any Māori cultural connection in the hopes of "civilis[ing] the natives" (Walker, 2016, p.23). Thus, any learning associated with Māori knowledge or worldviews was actively and deliberately excluded. Māori knowledge was believed to be inadequate, without qualification, and contradictory to Māori advancement in the 'new world'. Believing this, Māori leaders and parents supported the assimilatory Native Schools Act 1867 (Foucault, 1980; Walker, 2016) in the hopes that their children would be better off.

Ten years later, a national education system was established with The Education Act 1877. The Department of Education was created and assumed the responsibilities of the Native Schools from the Department of Native Affairs (Walker, 2016). At their peak, there were 166 Native Schools across the country (Simon, 1998). Māori, who maintained a desire to learn and advance within the society being formed at the time, sustained an interest in Native Schools. Yet, the intention of the government was to "phase out the Native Schools in communities which had been 'Europeanised'" (Walker, 2016, p. 24). Over the following 30 years, urbanisation of Māori whānau from rural areas to more fruitful employment opportunities in the cities meant that more and more Māori ākonga (learners) were being sent to boarding schools (Walker, 2016). For these ākonga, school became a funneling system for the development of manual workers, a place of isolation and "cultural surrender" (Walker, 2016, p. 25). Cultural surrender included the exclusion of te reo Māori. This was a common practice of colonising cultures which sought to assimilate the indigenous population (McIlwraith, 2011;

Milloy, 1999). Despite these education priorities of the time, Te Aute College matriculated three of its Māori graduates in the late 1800s who went on to further academic achievement in university. The first was Apirana Ngata. He was followed by Māui Pōmare and Te Rangihīroa Buck.

Te Aute College is a boarding school located in Hawkes Bay for Māori boys. Established in 1854 for the Anglican Mission, John Thorton prepared Te Aute ākonga for university by offering a curriculum which included Euclid geometry, Latin, Chemistry, and New Zealand Law, among other topics of learning. Although this contradicted the goal of power and subjugation of Māori in education, the Director of Education worked to refocus Native School curriculum to instead offer learnings suited to manual labour. For Hukarere, the native girls boarding school, their academic subjects were replaced by sewing, housekeeping, and cooking. Walker (2016) asserts that the purpose of education during this time for Māori "should train boys to be good farmers and girls to be farmers' wives" (p. 26). Subsequently, there would not be any more Māori graduates of higher education for some 50 years following Ngata, Pōmare, and Buck.

In 1935, the first Labour Government set out to provide publicly funded education for all secondary aged students. Although this policy gave the impression of fair education for all, the Department of Education at the time maintained the cultural adaptation mentality and set up Native District High Schools which had a limited curriculum catering to an education of Māori who will be labourers (Walker, 2016). It would be another ten years before Māori whānau would demand School Certificate be offered to their children at secondary school (Walker, 2016). At the same time, schools struggled to staff their rural Māori schools and the existing policy designed to lock Māori out of the teaching profession was reversed (Walker, 2016). This meant that Māori could participate in higher education again and a quota of 60 Māori teacher trainees would graduate from Teaching College in the early 1940s. They each contributed to an indigenisation of New Zealand classrooms through the careful incorporation of Māori songs and art in their teaching (Walker, 2016).

### 2.3.3 Toward biculturalism

Despite the New Zealand education system now having publicly funded secondary schools and Māori teachers in the classrooms, Māori still experienced poorer academic and social outcomes when compared with tangata Tiriti (Treaty partners) (Riwai-Couch, 2021). The Hunn Report in 1960 would prove to be a pivotal reflection of the status of Māori claiming that Māori

tended to have a lower life expectancy than other ethnicities, were significantly absent from higher education, and were three times more likely to be unemployed compared to Pākehā (Hunn, 1960; Walker, 2016). Hunn's report would usher in a shift toward bilingual education and education policies which recommended a focus on the inclusion of Māori culture in education activities (Durie, 1998; Walker, 2016). MOE established committees and foundations with the intention of making education better for Māori. However, the limitations of these policies were inevitable due to the predominantly Pākehā teachers being responsible for implementing bilingual and Māori-centric education in English-medium school settings.

The late 1960s saw several hundred Māori teachers practicing and were growing an educational experience which included marae visits and other cultural activities. It was during this time that a move toward constructing marae on school campuses became an accepted means of increasing education's connection to Māori culture in schools. In 1971, Tūroa Royal, an MOE advisor recommended that "cultural differences be understood, accepted, and respected by children and teachers, the school curriculum must find a place for the understanding of Māoritanga, and special measures must be taken to achieve the goal of equal opportunity" (Codd, Harker, & Nash, 1985, p. 75).

Education's aspiration of equal opportunities introduces the concept of biculturalism. In an Aotearoa context, biculturalism is a reference to Te Tiriti o Waitangi and the Treaty of Waitangi. Signed in 1840 by some Māori rangatira (leaders) and delegates of the Crown of England, the Treaty is known to have been created as a mechanism for partnership between Māori and Pākehā, two distinct groups working together for mutual benefits. Partnership, participation, and protection form the principles of the Treaty. These three principles ensure a focus on positive relations is maintained. This is necessary because Te Tiriti o Waitangi – the te reo Māori version of The Treaty of Waitangi – does not say what its English version does. A focus on the bicultural nature of New Zealand allows a place for tangata Tiriti alongside tangata whenua (people of the land, the indigenous Māori). The next section discusses a Tiriti concept called tino rangatiratanga. Tino rangatiratanga (total autonomy) was written into Te Tiriti o Waitangi, guaranteeing that Māori would retain total autonomy over their own aspirations, treasures, and lives. The principle of tino rangatiratanga goes beyond simply adding more Māori to being by Māori, for Māori.

### 2.3.4 Tino rangatiratanga

*…ka wakarite, ka wakaae …ki nga tangata katoa o Nu Tirani te tino rangatiratanga o o ratou wenua o ratou kainga me o ratou taonga katoa.*

*—Te Tiriti o Waitangi, 1940, Article 2*

Tino rangatiratanga was a notable term used in the Māori language constitution document of New Zealand, Te Tiriti o Waitangi. The same section of the English language version, The Treaty of Waitangi, said "full exclusive…undisturbed possession". Despite relating most specifically to ownership of lands and physical resources, academic correspondents argue that the Māori language document specifies that taonga are included in the caveat, and in te ao Māori, treasures relate to all items of worth, both physical, intellectual, and spiritual. One of the most valued taonga for Māori is their language. As discussed in the previous section, the education policies of the 20th century almost extinguished te reo Māori and an entire generation of Māori would grow up in Aotearoa without the opportunity to learn te reo Māori within the public education system. In a sociolinguistics study in the 1970s of the distribution of te reo Māori speakers, Richard Benton, a linguistics scholar, found that only 5% of Māori in New Zealand spoke te reo Māori fluently and thus, forecast the death of the Māori language if nothing was done to save it (Benton, 1979).

From here, a rapid occurrence of pro-te reo actions took place during the 1970s and the 1980s. Of great significance was the Māori Language Petition led by Waikerepuru and Ngā Tamatoa who in protest presented 30,000 signatures to Parliament, insisting on the recognition and revitalisation of te reo Māori. An outcome of this was the Waitangi Tribunal claim WAI11 which recognises Government's breach of the Treaty of Waitangi, alienating Māori from their taonga, te reo Māori. The first was the Kōhanga Reo movement. Based on kaupapa Māori theory, Kōhanga reo were pre-school education facilities where instruction was in te reo Māori exclusively and learning revolved around Māori knowledge and beliefs. The literal meaning of *kōhanga reo* is "language nests". They were established and run by Māori kuia (grandmothers), koroua (grandfathers), aunties, uncles, mothers, and fathers who were also the teachers. The consequences of assimilatory education policies meant that many Māori born and educated during this time grew into adults who did not know how to speak or understand te reo Māori. Indeed, the Kōhanga Reo movement was a response by this generation who acted and took control over the education of their own children (Durie, 1998). As pre-school Māori children

grew into primary aged children, it became apparent that they would need to remain in an education system that continued to support their Māoritanga. Thus, Kura Kaupapa Māori were created to cater for Māori children and the first of its kind, Te Kura Kaupapa Māori o Hoani Waititi opened in West Auckland in 1985.

Kaupapa Māori theory is "the philosophy and practice of 'being Māori'" (Smith, 1992, p. 11). While Kōhanga Reo were based on the Māori concept of whānau, Kura Kaupapa took learning in a Māori-medium setting to another level. Acting on their own behalf and dedicated to being distinct from the colonial education system by operationalising tino rangatiratanga, most Kura Kaupapa Māori were based on a philosophy called Te Aho Matua. There are six principles underlying the Te Aho Matua philosophy of learning:

- Te ira tangata – the essence of a child with physical, spiritual, and emotional needs
- Te reo – a dedication to promoting the advancement of te reo Māori
- Ngā iwi – the community which nourish and foster children
- Te ao – the world of light, the understanding of reality
- Āhuatanga ako – learning related to the aspirations of the whānau and the national curriculum
- Ngā tino uaratanga - the values and special character of the kura
  (Te Rūnanganui o Ngā Kura Kaupapa Māori o Aotearoa, 1998).

It would be another four years before the status of Kura Kaupapa Māori as official learning institutions would be recognised in the Education Act and as Māori learners graduated from their primary learning, the secondary school equivalent, wharekura, would open in 1993 (Calman, 2012). Reportedly a success for Māori academic achievement (see Calman, 2012; Durie, 1998; Smith, 1992), the Kura Kaupapa philosophy would be utilised for English-medium settings in the first Maori education strategy in 1999.

The Māori education strategy had three main goals: to raise the quality of English-medium education for Māori, to support the growth of high-quality kaupapa Māori education, and to support greater Māori involvement and authority in education (Berryman, 2017). Tino rangatiratanga was beginning to take shape. Penetito (2010) warns that "Māori education continues to be appropriated and misrepresented by the advocates of mainstream education" (p. 52). That said, the momentum of the strategy of 1999 would grow in 2005 to a reformed

education strategy titled *Ka Hikitia - Managing for success: The Māori education strategy 2008-2012*.

Ka Hikitia (Ministry of Education, 2008) represented a dedicated focus to Māori achieving as Māori. Certainly, researchers of Māori education have long fought to better affect systems and structures to facilitate a shift toward indigenising them (see Berryman, 2017; Durie, 1998). A review following the implementation of Ka Hikitia reported that "[t]here were hopes that Ka Hikitia would lead to the sort of transformational change that education experts, and particularly Māori education experts, have been waiting for decades. Although there has been progress, this transformation has not yet happened" (Office of the Auditor-General, 2013, p.7). It seems that addressing the long-standing issues in education will require a considerable amount of time (Wolfe & Haveman 2001, Ladson-Billings, 2006). Acting on recommendations from the Auditor-General's review, the 2008-2012 Ka Hikitia was built on in the next iteration titled *Ka Hikitia – Ka Hāpaitia: The Māori education strategy 2012-2020*. Juliet Gerrard, the Prime Minister's Chief Science Advisor, asserted that mātauranga Māori can add value to education but "must be integrated from the beginning" (Gerrard, 2018, as cited in Ruru & Nikora, 2021, p.17). As such, Ka Hikitia – Ka Hāpaitia (Ministry of Education, 2020) explicitly challenges English-medium settings to do more for their Māori learners. Utilising the developments made in Māori-medium education, the education strategy encourages the sustainable integration of systems that are inclusive of Māori identity, culture, and language.

This section discussed the evolution of education foci and the policies which legislated action in schools which directly impacted Māori learners. It was a deliberate decision to discuss education post-European contact and to reiterate, there existed systems of teaching and learning which Māori used to educate themselves and others (see Best, 1923; Jackson, 2016; Metge, 2015; Ruru & Nikora, 2021; Penetito,2010). To summarise, education in Aotearoa post-European contact was initially used as a tool for assimilation. Experiencing the detrimental impact of an assimilatory education, shifts towards equalising outcomes (biculturalism) by adding Māori into education became the focus. Following this, education became "a site for decolonisation" (Lee-Morgan & Hutchings, 2016, p. 7). Hokowhitu (2004) warns though, focusing on decolonisation places Māori knowledge as being impacted by colonisation. This way of thinking perpetuates a power struggle where Māori are chasing rangatiratanga as the oppressed culture rather than viewing their existence as autonomous and sustaining. It is

important then to consider tino rangatiratanga as indigenising rather than decolonising, thus moving to empower Māori education by accepting, integrating, and legitimising Māori worldviews and ways of being.

## 2.4 Equity and Excellence

*We shape an education system that delivers equitable and excellent outcomes.*

*—Ministry of Education, 2021a*

Equity and excellence are common educational aspirations across the globe (Howell, 2020; Gutiérrez, 2002; Van Avermaet, Van Houtte, & Van den Branden, 2010). Equity seeks that all learners have access to opportunities irrespective of their background and excellence seeks to "stimulate outstanding performance and development of specialist skills" (Van Avermaet et al., 2010, p. 1). In a review of our current status in mathematics and statistics, a panel of experts from the Royal Society Te Apārangi (2021) shared that the current mathematics learning here in Aotearoa is inequitable, and that academic excellence was not being experienced by all learners. They suggested that shifting this reality would require "substantial, considered investment in mathematics and statistics education, and change at virtually all levels of the education system" (Royal Society Te Apārangi, 2021, p. 4).

Equity, as an educational aspiration, sets a low standard. All learners should have equal opportunities to participate in quality education and expect their education to support their academic potential. It seems that this is a difficult educational aspiration to achieve. This could be because our definition of equity is unclear. Specific to mathematics, Gutiérrez (2002) proposes a working definition of equity labelled as coordinating three efforts:

1. Get marginalised students to master dominant mathematics
2. Develop a critical perspective among all students about knowledge and society
3. Ultimately address a positive relationship with mathematics, people, and equity throughout areas of the globe.

She argues that once these three efforts are coordinating with each other, the research agenda will support teacher practice that draws on action research, "redefining what the practice of mathematics means along the way" (p. 148).

Placing equity and excellence as mutually independent outcomes can also cause issues. An example of this is a study of how the United States mathematics education sector was unable to raise the achievement of marginalised learners while also excelling students who are academically capable. Rather, equity and excellence are seen as opposing aspirations (Noguera, 2001). That is, if we give energy into enhancing excellence, then there will exist a group of students who will not achieve equitable outcomes. Similarly, if we work toward equity then there will exist a group of excellent students who will fail to meet their potential academically. It is no surprise that this thinking forms the core reason why many New Zealand English-medium schools retain their streaming status and continue to group learners by (often perceived) academic ability. The three coordinating efforts integrate excellence within their tenants and illustrate equity and excellence as co-dependent entities (Gutiérrez, 2002). This co-dependence is known in Māori-medium settings where equity is achieved through excellence as an education aspiration by individuals, and supported by their school community (Meaney et al., 2013).

## 2.5 Summary

Linked to the first research aim, this chapter provided an insight to the policy development leading to the directive of including mātauranga Māori. It collated literatures that define and explain mātauranga Māori. This chapter then explored the socio-history of education policies here in Aotearoa which led to the MOE directive of including mātauranga Māori. The final section of this chapter discussed the education outcome of equity and excellence and offered a working definition for mathematics education.

The following chapter discusses mathematics as a core discipline and explores the reasons why it is perceived to be of such importance to our society, and many others around the world. This discussion will link to effective pedagogy literature and will end with a review of research which illustrate the use of mātauranga Māori in teaching and learning.

# CHAPTER 3 NGĀ HERENGA MĀTAURANGA|LITERATURE REVIEW 2

This chapter forms the second half of the literature review. The first part of the literature review explored what mātauranga Māori is, as well as analysing the changes to education foci here in Aotearoa. To follow, the second of the two-part literature review will focus on mathematics and pedagogy.

# MATHEMATICS, TEACHING AND LEARNING, AND MĀTAURANGA MĀORI

## 3.1 Introduction

The research aim this section addresses is the third, that is, to consider the connections between mātauranga Māori and mathematics teaching and learning. To do this, the following chapter explores mathematics and its te reo Māori translation, pāngarau. It will briefly explore the current state of mathematics education. Following this, literature relating to effective pedagogy will be examined, namely, works by local and international academics such as Berryman, Bishop, Niss, Gutiérrez, Anthony, Walshaw, Golding, and Webber. Finally, literature associated with implementing mātauranga Māori will be summarised.

## 3.2 Mathematics

It is commonly accepted in most countries around the world that mathematics holds the key to participating fully in the world around us (Golding, 2018; Niss, 1994). So much so that the academic wealth of a country is often measured by its citizens' competency in mathematics. Certainly, in the opening statement of their book titled *Where does mathematics come from?* cognitive scientists George Lukoff and Rafael Núñez (2000) share that "[m]athematics is deep, fundamental, and essential to the human experience" (p. xi). The start of my exploration in this chapter will use their literature along with others to explore mathematics, where it came from, and perhaps find an answer to why we perceive it as being essential for our existence. This will be followed by a more located discussion about mathematics education in an Aotearoa context.

### 3.2.1 Te ao pāngarau

> *Mathematics has been described as an art, a language, and a science. For some, it is a means of unlocking nature's secrets. As Galileo testified so eloquently: "[The universe] cannot be read until we have learnt the language and become familiar with the characters in which it is written. It is written in mathematical language".*
>
> *—Mubeen, Mathematical Intelligence, 2022, p. 3*

Pāngarau is the reo Māori word used for the discipline of mathematics. The title of this section, te ao pāngarau, represents the socio-cultural constructed world of mathematics. As will be discussed in the paragraphs to follow, this mathematics world lies in neither the physical nor mental space, but in the socio-culturally constructed human experience. Interested in the relationship between language and mathematics, Barton, Fairhall, and Trinick (1998) discuss the origin story of the word pāngarau. They define pāngarau as the made-up word constructed following a discussion about the meaning of mathematics. The discussion led to the use of *pā* meaning "concerning", "having to do with", or "connected to". *Nga* was added as a gerund turning "pā" into a noun, *pānga* was used to mean "relationship" (of the mathematical kind). *Rau* translates to "hundred" and is used in the (now fully formed) term *pāngarau* to mean "many". Therefore, Barton et al. (1995) define *pāngarau* as meaning "many relationships" and go on to translate mathematics as *tikanga pāngarau* which means "conventions of many relationships" (p. 5).

For comparison, a dictionary definition of mathematics is "the abstract science of space and number (pure mathematics); or as applied to branches of physical research, for example astronomy (applied mathematics)" (McIntosh, 1950, p. 736). As such, it is common to view mathematics as existing without humans. Galileo's quote implies that mathematics is the language of the universe, a surety of nature. It is true that we can count our toes, we can measure our wealth, and model the rate of growth of an algae bloom, make forecasts about weather, but Hersh (1998) as well as Lukoff and Núñez (2000) argue that the existence of relationships that can utilise mathematics is not proof of mathematics itself. Rather, mathematics is the metaphorical representation of these concepts. A human creation that is neither physical nor mental but a socio-culturally constructed mechanism for rationalising the physical world around us. In agreeance, Kindersley (2019) discusses Einstein's thinking around mathematics as being an independent human creation which often can be related to the

natural world. Mathematics can be considered a metaphorical system representing reality, "the interface between intellect and imagination" (Kindersley, 2019, p. 6).

The writers of the history of mathematics highlight the culturally diverse and iterative evolution of mathematics as a learning subject (see Jackson, 2012; Kindersley, 2019; Launay, 2018) (although, acknowledgement must be made regarding the lack of representation of women mathematicians, the scope of which will not be discussed here). They share that mathematics has been refined to suit the needs of the time. The symbols we would use for numbers has evolved from tally marks on bone and stone and is a melting pot of symbols from first century India, Muslim Spain, and Arabic numerals from the eleventh century to the European numerals of the sixteenth century that we still use today[1]. The number line, a metaphorical representation of the order of numbers would come shortly after that in the seventeenth century by John Wallis visually displaying zero, negative values, and later, decimals, fractions, percentages, roots, and irrational numbers. The development of numbers saw the growth of algebra. Algebraic representations opened mathematics to being able to find all possible solutions, not just one for a single situation. This would lead to the creation (rather than discovery) of the number set known as imaginary numbers (or values representing the square root of negative 1). The imaginary number set then allowed problems previously unsolvable to be solved.

It is interesting to note that while the evolution of our numbers would reach a peak relatively recently (including, much to the surprise of many, the only recent acceptance of zero as a number, and the existence of negative numbers), humans of the past would be creating mathematical discoveries in geometry. From measuring a rectangle of land and the space it occupies to exploring the mathematics of music, Pythagoras would eloquently share that "there is geometry in the humming of the strings, there is music in the spacing of the spheres" (Kindersley, 2019, p. 43). Around the ninth century Islamic trigonometry was taking off. Sine tables had been created with the intention of practical application in astronomy and more interestingly, so that their Muslim community would be able to locate their holy city, Mecca, from anywhere in the world. Consistent with the theme of a socio-culturally created subject

[1] As a side note, the Roman numerals sit aside as a number system and has its origin story in the systems used by Ancient Egypt and China (Kindersley, 2019).

Boyer (2011, as cited in Kindersley, 2019) would say that "Trigonometry, like other branches of mathematics, was not the work of any one man, or nation" (p. 74).

Mathematics as a system designed to define and replicate phenomenon imagined and experienced by humans is worth consideration. The implication of this knowledge on secondary education is that we begin to design a more inclusive learning subject. Mathematics in education is considered a core subject which means there is a common understanding that learning mathematics is of value. Many societies across the globe make the learning of this subject compulsory up until a certain age, here in Aotearoa, this tends to be around 16, but each school has the autonomy to make this decision. Contentiously, in the United Kingdom, Prime Minister Rishni Sunak has begun pushing for maintaining mathematics learning up until learners are 18, arguing that "in a world where data is everywhere and statistics underpin every job, our children's jobs will require more analytical skills than ever before" (Sunak, 2023, para 7). Although subject specific, the Prime Minister's statement is echoed by Francis Su in a more general sense. In The Chair's 2017 farewell address to the Mathematics Association of America, Su declared that the reason why we do mathematics is to help people flourish (Su, 2017).

The commonly held belief is that the aptitude a society has in mathematics directly determines the success of that society. This is a global phenomenon where mathematics is viewed as being fundamental to the progress of a society, their economic and social wellbeing is thought to correlate to mathematics education (Golding, 2018). To give reasons why mathematics is important, Niss (1994) defines the correlation between the health of a nation and its mathematics education:

> *Mathematics as a science serves to generate knowledge and insight; mathematics provides tools for the exercise of a very wide range of social practices and techniques; (and) mathematics resembles an art form such as sculpture, painting, architecture, and music…giving experiences of beauty, joy and excitement […] [Learning mathematics] does not take place spontaneously and automatically, mathematics needs to be taught. So, mathematics is also a teaching subject in the educational systems of our societies. (Niss, 1994, pp. 367-368)*

In relation to our societal needs of mathematics, Niss (1994) collates early writings from a range of scholars (Booss & Krickeberg, 1976; Friedman 1989; Khoury & Parsons, 1981) and shares four examples of how mathematics assists a functioning society:

1. The most widely accepted is that mathematics assists indirectly (albeit, at varying degrees) to many of the science disciplines, including information sciences. Examples are the physical and biological sciences, digital technology, the engineering sciences, and economic and sociology sciences.
2. In a more direct manner, mathematics is utilised for its capacity to make decisions based on mathematical modelling. This use of mathematics to inform society tends to be used to better understand natural phenomena allowing us to make more accurate decisions based on empirical evidence from past observations.
3. Being numerate, just as being literate, is also offered as a fundamental requirement in today's society. The ability to use mathematics better informs general matters in every-day life such as money transactions, calendars and coordinates for location, codes and measurement.
4. Finally, the continual transmission of mathematics learning grows a competent and successful population, so much so that countries invest heavily in mathematics education to foster mathematics competence with the understanding that it will enhance social and cultural outcomes.

Echoing this theory, an Expert Advisory Panel set up to provide advice to MOE on refreshing the English-medium mathematics and statistics learning area of the New Zealand Curriculum, suggested that the wellbeing of Aotearoa New Zealand is dependent on our mathematics capabilities (Royal Society Te Apārangi, 2021). They went on to recommend continual and ongoing investment in improving mathematics and statistics education.

### 3.2.2 Māori and mathematics

As discussed in the previous section, mathematics is generally viewed as a high-value, needed-for-life subject of learning. But who values mathematics and for whose life will it be needed? Bishop (1988) discusses the discipline of mathematics as being inclined to privilege the dominant culture. In a case study into the perception of Māori students of mathematics, Hāwera and Taylor (2007) found that when asked the question "Ki ōu whakaaro, he mea nui te pāngarau? He aha ai? (Do you think mathematics is important? Why?)", one Māori learner replied "Nā te mea he pai mō tō rōrō (Because it is good for your brain)" (p. 41). Webber (1996) discusses the mathematics capabilities of early Māori, in particular Māori wāhine, and their findings indicate Māori are "authoritative knowers and doers of mathematics" (p.20). Metge

(1996) also shares evidence of Māori being competent knowers and doers of mathematics, yet it is widely known that Māori are underachieving in mathematics and are underrepresented in higher mathematics learning.

### 3.2.3 Mathematics is "universal"

The Aotearoa mathematics teaching sector feedback of the Level 1 NCEA standards indicated that many view mathematics as universal (Ministry of Education, 2021b). Universal, used in any context, represents truth, fact, and existence, devoid of cultural nuances and interpretations. Universality is unaffected by geographical location and hints at notions of objectivity. Concerningly, the idea that one size fits all advantages those whom Ranginui Walker (1990) describes as the people who are seen to matter most. It is becoming increasingly accepted that all things exist in relation to who is perceiving them and for a dominant culture, claims of universality hold true because their perception and experience of the world almost always suits them. This thinking can be attributed to a reductionist tendency which can be traced to the philosopher Descartes which implies mathematics is culture free (D'Ambrosio, 1992; Launay, 2018; Webber, 1996). Certainly, this thinking dominates current mathematics education in Aotearoa.

To shift society away from this frame of thinking, Pāngarau as representing the exploration of many relationships allows the discipline of mathematics to move away from fact driven certainty alone, and toward growing an imaginative and responsive subject. Cautiously, any attempt to try to retrieve and relive pedagogies of the past without understanding the cultural and social contexts which existed then will inevitably be ineffective (Barton et al., 1998). The potential for Māori success in mathematics education lies, perhaps, in the ability of education to allow Māori learners to push the boundaries of what is commonly accepted in a mathematics classroom.

### 3.2.4 Mathematics education

> *The current state of mathematics and statistics education in English-medium schools is the product of a deeply complex system working at multiple levels. Teachers are at the heart of our education system, they have met all the requirements placed on them to be fully qualified and cannot be blamed for how the system works.*
>
> *—Associate Professor Ell, Royal Society Te Āpārangi, 2021, p. 4.*

In his retiring address to the Mathematics Association of America in 2017, Francis Su discussed an example of what kind of person we imagine learns, or indeed, is good at mathematics. He posed the question, "when you think of someone who is good at mathematics, or likes mathematics, what do they look like?" Individuals' answer to this question may look similar and Su is illuminating our socially constructed biases regarding who is more likely to be a good at mathematics. Although a tired bias (see Friedman, 1989), the idea that males are more likely to be good at mathematics than females is still in existence. Holding biases perpetuates the marginalisation of learners who do not fit the mold, so to speak. Particularly, ākonga Māori have continued to represent a significant proportion of learners who underachieve in mathematics giving evidence to the suggestion that Aotearoa society may not believe they are as capable at mathematics as others (Meaney at al., 2013).

A mathematician's perspective may provide a solution. Paul Lockhart (2009) suggests that instead of teaching mathematics as a mechanical set of techniques, teaching it as a living art is preferable. He argues that "math is really about raw creativity and aesthetic sensitivity" (p. 6). This understanding of mathematics is not new to a mathematician, but there is a disconnect between mathematics education and what mathematicians understand. Shifting education toward viewing mathematics as a living art may also shift societies' view of mathematics.

Societal perceptions of mathematics education in Aotearoa can be described as objective relevance, and subjective invisibility. Called the *relevance paradox* (Niss, 1994), it describes mathematics as a discipline to be an invisible subject and can be exemplified by the quote "[m]athematics is useless to me, but at the same time I know that I am useless without mathematics" (Niss, 1994, p.378). Objective relevance describes one's theoretical understanding that mathematics is useful. Subject invisibility describes one's inability to identify mathematics when it exists, or to deny its existence entirely. Furthermore, mathematics can be difficult to learn, creating another obstacle. These obstacles must be overcome as learning mathematics is an entitlement here in Aotearoa.

Mathematics is considered entitlement learning (Howell, 2020; Hudson, 2018; Young & Muller, 2013). Entitlement learning describes topics or subjects that are too important to leave to chance. Golding (2018) argues that the purpose of public education is to nurture the potential of its citizens so that they may become contributing adults in society. The central idea being that a flourishing society is created by flourishing individuals, education is seen as being a core

conduit to achieving this. Mathematics as an entitlement subject necessary for a flourishing society may have contributed to a hierarchy of academic subjects at the secondary school level in English-medium settings.

Mathematics, English, Classical Studies, Science, and particular languages such as French firmly hold tight to the perception of importance in Aotearoa education. Wally Penetito (2010) explored this concept in relation to first year te reo and tikanga Māori teachers stating the need to "appreciate the pervasiveness of ideologies and hierarchies in the everyday world of teaching and learning. Philosophical reality versus idealism seemed to be a mirror of the dichotomy between theory and practice" (p. 32). Walker (2016) shared an investigation into exam grading and found inequities in pass rates for subjects such as mathematics and subjects such as te reo Māori and art. He found that a scaling system was being used to inflate the pass rates of what he terms "academic" subjects and deflate "non-academic" subjects. Walker (1990) confirmed that in one particular year, only 39.1% of Māori language learners passed the exam where a lower scale was employed to balance a higher scaling range in dominant subjects. This finding gave evidence "of education maintaining Pākehā domination and Māori subordination" (Walker, 2016, p. 33). Despite the previous exploration into reasons why mathematics is considered a core discipline, consideration must be given to Penetito, Hughes, and Walker's findings and a reminder of mana ōrite is appropriate.

This section discussed pāngarau, including a literary exploration into mathematics as a discipline and why it is deemed as being fundamental to gaining a good education. Niss (1994) offers an answer to this question, saying that its value "is related to the way in which mathematics is activated to deal with matters and issues beyond mathematics itself" (p. 367). The perception that mathematics can solve problems related to all other academic disciplines is where it gains its notoriety (Boose & Krickeberg, 1976; Niss, 1994). It is also widely stipulated that a more mathematically competent population will experience positive social benefits in general (Golding, 2018; Niss, 1994; Royal Society Te Āpārangi, 2021). Bridging the gap between the societal understanding of mathematics as an individual endeavor (Resnick, 1987; McMurchy-Pilkington, 1996) and the imaginative and social mathematics used to solve unknown problems requires effective pedagogy (Lockhart, 2008).

## 3.3 Effective Pedagogy

Effective pedagogy theory provides examples of practice for effective teaching, including the teaching of mathematics suited to Lockhart's (2009) concept of mathematics as a living art. Glenda Anthony and Margaret Walshaw's (2009) *Effective pedagogy in mathematics*, and Mere Berryman's (2013) *Editorial: Culturally responsive pedagogies as transformative praxis* are two literary examples reviewed in this thesis. Both readings discuss a learner's identity as being impacted by education, and education being impacted by the identity of the learner (see also Berryman, 2013; Durie, 1998; Wenger, 1998,). This idea acknowledges that all ākonga are entitled to mathematics education that is beneficial and helps them become "powerful mathematical learners" (Anthony & Walshaw, 2009, p. 6). This section will explore literature relating to culturally responsive and sustaining pedagogy, critical theory, and its relationship to teaching, and discursive and interactive classrooms. Finally, an introduction to the Common Practice model will collate the literature before it.

### 3.3.1 Culturally sustaining

Connecting learning to students' worlds and worldviews is an integral part to effective pedagogy (Gutiérrez, 2017; Resnick, 1987; Webber, 1996). Culturally sustaining pedagogy allows learners to be and bring themselves to their learning environment. Relating learning in a responsive way ensures that learners can utilise their own sense making ideas to construct solutions to given problems supported by dialogic discourse (Anthony & Walshaw, 2009; Berryman, 2013; Gutiérrez, 2017; Molinary & Mameli, 2010; Penetito, 2010; Wenger, 1998). Metge (2015) describes examples of this partnership from a Māori perspective and states that "learning and teaching involved recognition of the importance of emotions as well as the intellect. Te reo Māori included both thinking and feeling in the word *hinengaro*" (p. 264). This pedagogical consideration represents a shift away from a Western model of educating which values suppression of emotion.

English-medium secondary schools here in Aotearoa have been described as spaces which privilege the interests of the dominant culture (Brayboy & Deyhle, 2000; Hynds, Averill, Penetito, Meyer, Hindle, & Faircloth, 2016; Penetito, 2010; Shields, Bishop, & Mazawi, 2005). This can be evidenced through inequitable academic achievement, inequitable resource allocation, disproportionately high early school leavers who are Māori, and a lack of diversity in educational leadership roles (Hirsch, 1990; Hynds et al., 2016). In all examples of disparity,

Māori are disadvantaged. In a cycle of general failure and inequitable representation, a perpetual state of mind in education is formed. Deficit thinking becomes the status quo of educational perception where it is accepted and expected that Māori learners will tend to underperform when compared to Pākehā. Working toward celebrating and sustaining Māori culture requires a cultural shift in education. Bishop (2012) describes two concepts that can shift the culture of education here in Aotearoa: effective partnerships and increasing dialogue between school leaders and indigenous communities.

Effective partnerships in relation to Aotearoa education require English-medium schools consider Te Tiriti o Waitangi. Using Te Tiriti realigns power to sit with indigenous communities and works to ensure they are impactful contributors, facilitators, and leaders of decisions made in education. Interactions between tangata Tiriti and Māori use tino rangatiratanga to operationalise educational aspirations. Increasing dialogue between school leaders and indigenous communities must include the understanding that school leaders can be indigenous community members and indigenous community members can be school leaders. There is an overrepresentation of non-indigenous English-medium secondary school leaders. Because of this there is a perception that school leaders tend to be disconnected from their Māori communities. Ensuring education leaders are diverse teams will actualise Bishop's (2012) aspiration of shifting the culture of Aotearoa education.

MOE expects teachers to teach in ways that engage and encourage Māori learners to reach their potential whilst acknowledging their unique "cultural distinctiveness" (2008, p. 18). Cultural relationships for relational pedagogy are developed when power is shared, culture counts, learning is interactive and dialogic, connectedness is fundamental to relations, and there is a common vision of excellence for Māori in education (Bishop & Berryman, 2006; Bishop & Glynn, 1999). This requires educators to be critical of their practice and ensure that they are aspiring to disrupt disparities for Māori learners.

### 3.3.2 Critical theory and its relationship to teaching and learning

Disrupting disparities introduces another pedagogical concept being focused on for effective teaching and learning. It has been argued that critical theory has been influential in questioning the fairness of structures and systems which impact society. Subsequently, this has opened dialogue relating explicitly to marginalised groups, dialogue that has previously been too uncomfortable to discuss (such as race-based, sexuality, and gender equity). This new dialogue

has challenged oppressive and marginalising societal norms. The development of race-based epistemologies has impacted the research agenda and is being applied to education, but Ellsworth (1989) warned that "it is not necessarily the appropriate epistemological frame for all race-oriented emancipatory work" (p. 10, quoted and cited in Scheurich & Young, 1997). That said, critical theory gives permission to marginalised learners to voice their concerns.

### 3.3.3 Discursive and interactive classrooms

Discussed in Berryman et al. (2003) as part of developing cultural relationships for responsive pedagogy, discursive and interactive learning in the classroom enhance opportunities for excellence through sense making. Dialogic discourse promotes authentic communication and collaboration between learners and teachers. This leads to sense-making in a co-operative and interactive way (Anthony & Walshaw, 2009; Berryman, SooHoo, & Nevin, 2013; Gutiérrez, 2017; Molinari & Mameli, 2010; Penetito, 2010). Freire (2001) shared how teachers can do this and suggests that realising the academic potential of learners involves recognising and utilising the diverse knowledge that both the teacher and learners possess.

Sustaining an interactive classroom where interdependence supports dialogic discourse is the goal of this pedagogical focus. Helpfully, Timperley (2013) lists two key skills a teacher needs to have. Firstly, a teacher must have professional skills. Professional skills in teaching are described as curriculum content knowledge and knowledge of a full range of teaching activities, for example rote learning, lecturing, group or paired work, and independent work. Alongside professional skills, a teacher must have adaptive expertise. This skill allows the responsive application of professional skills to maximise learning. This flexibility in teaching means that challenges, diversity, and unique or new situations result in positive learning outcomes in the classroom. The Common Practice model offers further support to teachers.

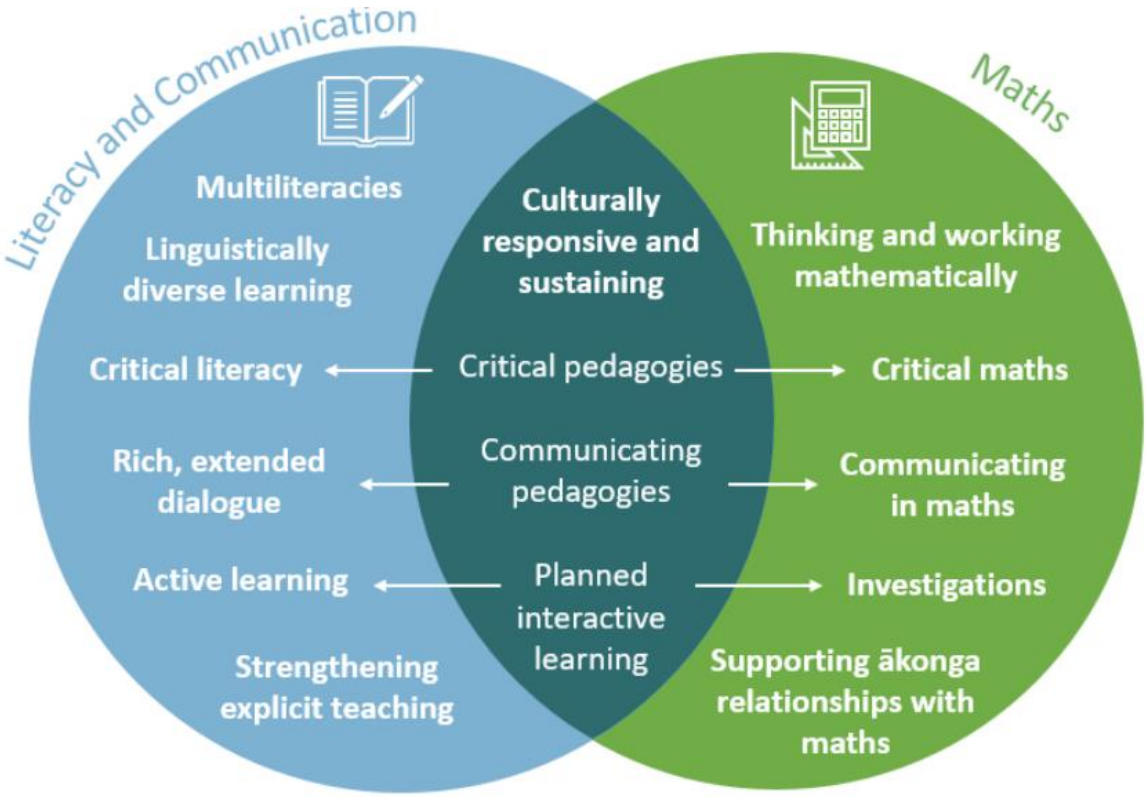
### 3.3.4 Common Practice Model

The Common Practice Model is a collaboratively designed framework for teaching of Literacy and Communication, and Mathematics from primary school to the end of secondary schooling. It is designed by sector experts and MOE as one part of a wider strategy aiming to "address inequity by lifting educational achievement for all" (Ministry of Education, 2023, p. 1). Currently in its Phase One form (Ministry of Education, 2023), the model hopes to standardise the teaching in Literacy and Mathematics. For the Literacy and Communications, and Mathematics Strategy, alongside the Common Practice model sits the work being done on the

refreshed New Zealand Curriculum and the early childhood curriculum, Te Whāriki. Put simply, if the curriculum documents discuss what learning should be taught in Aotearoa New Zealand, the Common Practice model guides teachers on how to teach it.

Figure 1

*Overview of the pedagogical approaches in the Common Practice Model*




*Note:* From "The Common Practice Model: The Literacy & Communication and Maths Strategy" by Te Poutāhū Curriculum Centre, 2023 (https://www.education.govt.nz/our-work/changes-in-education/curriculum-and-assessment-changes/literacy-and-communication-and-maths-strategy). CC BY 3.0 NZ. Shared with permission.

The four shared pedagogical theories founding the Common Practice model are culturally responsive and sustaining, critical, communicative, and planned learning opportunities (Ministry of Education, 2023). The two mathematics-specific pedagogical approaches added to these four bases are thinking and working mathematically and developing learners' relationship with mathematics. Intertwined, they form the 'how-to' guide on teaching in Aotearoa New Zealand.

## 3.4 Implementing mātauranga Māori

> *Celebrating and sustaining indigenous languages and cultures is a universal concern, and there are calls across communities to incorporate indigenous knowledge bases into the school curriculum.*
>
> *—Hynds et al., Examining the impediments to Indigenous strategy and approaches in mainstream secondary schools, 2016, p. 536*

The evolution of education and education policies here in Aotearoa lead to operationalising the current directive of including mātauranga Māori, but Jackson (2016) warns that often, attempts to decolonise systems can lead to further manipulation to suit the needs of the coloniser. He gives an example of prisons where inmates are overrepresented by Māori. He suggests reframing the management of prisons to include and use Māori to manage prisons as Māori would be best at managing Māori. This concept may look appealing but all it does is reframe Māori thinking to suit a Pākehā, and a neo-liberal agenda. Similarities can be made with the MOE directive of including mātauranga Māori. Could this just be a reframing to placate Māori under the guise of enhancing tino rangatiratanga whilst changing little in the system to have any meaningful effect on Māori student outcomes? This remains to be seen but is worth considerate observation.

In a mixed methods research project investigating culturally responsive leadership in 84 English-medium secondary schools Hynds and colleagues (2016) found that a lack of authentic partnerships between school leaders and learners and their school communities impeded the school's ability to cater to their Māori learners. Voice from whānau indicated a lack of adequate partnership between the two groups saying "I don't think it's up to the school to decide what achieving as Māori means. It is for us, the whānau to decide" (p. 543). Where the predominantly Pākehā school leadership remain confused about what Māori success as Māori is, Māori whānau are clear in that it is for them to decide.

Thinking of their similarities, both mātauranga Māori (Royal, 2012) and mathematics (Gutiérrez, 2017) are human endeavors and, as such, are susceptible to diverse application, definition, and use. Gutiérrez (2017, p. 6) argues "that different ways of knowing, different knowers, and different forms of knowledge are all legitimate, partial, and interdependent". Similarly, both are about epistemological plurality, about connections and relationships built on dialogic discourse (Anthony & Walshaw, 2009; Gutiérrez, 2017; Metge, 2015). Despite the

similarities, national achievement data in mathematics paints a grim picture of inequity for Māori learners (Meaney et al., 2013). These results contradict education's aspiration in Aotearoa of "shap[ing] an education system that delivers equitable and excellent outcomes" (Ministry of Education, 2021a).

## 3.5 Summary

> *Scientists search for truth, and sometimes find beauty there by chance. Artists search for beauty, and sometimes find truth there by chance. Mathematicians, for their part, have moments when they seem to forget that there is a difference between the two…They mix the true and the beautiful, the useful and the superfluous, the ordinary and the unlikely.*
>
> *—Launay, It All Adds Up, 2018, p 236*

This chapter considered the connections between mātauranga Māori and mathematics teaching and learning, the third research aim. To do this, it explored mathematics teaching and learning, linking discussions by influential academics such as Berryman, Bishop, Niss, Gutiérrez, Anthony, Walshaw, and Webber in both overarching concepts of mathematics and pedagogy. Finally, a review of research illustrated the use of mātauranga Māori in teaching and learning, offering these as examples of indigenising education systems and practices.

Through examining the literature on mātauranga Māori and mathematics teaching and learning it becomes apparent that there are gaps that this thesis attempts to address. Although there are strong shifts toward indigenising policies and educational structures globally, there is limited literature that explores the repercussions of shifting policy for the frontline staff such as kaiako. Furthermore, while there has been a general acceptance of the literature seeking to enhance indigenous student outcomes, there is a limited understanding of how this is done in praxis. In an Aotearoa context, this has left mathematics teachers with unanswered questions around how to authentically include mātauranga Māori in their practice, thus, influencing the research aims for this thesis.

The chapter to follow outlines the methodological framework used for this thesis. Within this chapter, the research paradigm will be acknowledged, along with a justification of the theories, methods, and processes this research will follow. The sampling method used will be identified, followed by a justification for the data collection and analysis methods used. Finally, the

following chapter will explore ethical and cultural considerations that were undertaken to carry out this research including any limitations that may affect the research.

# CHAPTER 4 NGĀ TIKANGA RANGAHAU|METHODOLOGY

Title definition: *Ngā Tikanga Rangahau* translates to "the rules of conducting research". *Ngā* is plural signifying the multiple forms of tikanga considered in this section. *Tikanga* contains the root word "tika" which translates as correct or the right way which "involves moral judgement about appropriate ways of behaving" (Mead, 2003, p. 6). A literal translation of *rangahau* is "to make sense of what is sensed" and is a metaphor for the act of researching. Therefore, this title guides research methodologies, methods, and procedures through the concept of tikanga.

The intention of this thesis is to explore the understandings of mātauranga Māori in mathematics teaching and learning. There are three key aims associated with this exploration. The first is to understand the policy development leading to the directive of including mātauranga Māori. The second aim of this research is to explore what mātauranga Māori means for kaiako. The third aim is to consider the connections between mātauranga Māori and mathematics teaching and learning. Using qualitative methods will be appropriate for exploring these three key aims. The previous literary review chapters identified current and historical research, both in a local, Aotearoa context and an international context, which discuss mātauranga Māori and mathematics teaching and learning separately. The gap in the research discussing both mātauranga Māori in mathematics teaching and learning gave rise to this thesis. Exploring the understandings of mātauranga Māori in mathematics teaching and learning through quantitative methods would not meet the needs of the key aims in this study. Collecting evidence through narratives is the most appropriate data collecting method for this exploration.

## 4.1 Introduction

This chapter, Chapter Four, consists of six sections. The initial section will explain the research paradigm used to ground the research suited to the three key aims being explored. The four sections which follow outline the core research theories, research methods, and processes forming the philosophies and therefore, research actions underpinning this investigation. Included are the research questions which will guide discourse in the focus group discussions. Finally, ethics and limitations will be identified.

## 4.2 Research Paradigm

### 4.2.1 Philosophical Worldview

The philosophical worldview of research influences the approach to research and should be discussed explicitly. In this section, the philosophical worldview will be outlined and defined, and how this worldview has shaped this research. It is important to define the term *worldview* to mean "a basic set of beliefs which guide action" (Guba, 1990, p. 17). As Guba's definition states, the role of the researcher plays a central part in how research is conducted so this section discussing the research paradigm will also discuss the researcher's positioning. In this thesis, the philosophical worldview will be called the research paradigm.

A constructivist paradigm is a model for guiding research based on explorations into human understandings of "the world in which they live and work" (Creswell, 2014, p. 8). It allows the researcher to seek the complexity of diverse views and recognises how the researcher's background shapes the interpretation of participants' views (Cohen, Manion, & Morrison, 2007; Creswell, 2014). Creswell (2014) outlines four major elements which Constructivism consists of:

- Understanding
- Multiple participant meanings
- Social and historical construction
- Theory generation

Summaries of this paradigm are associated with the writings of Bishop (2005), Creswell, (2014), Crotty (1998), Lincoln, Lynham, and Guba (2011), and Mertens (2010). They discuss the four major elements and say that social constructivists believe that individuals develop subjective understandings of their lived experiences. These understandings are diverse, and their meanings are varied. In a constructivist paradigm, meanings are constructed socially. That is, through interactions with others within their social, cultural, and historical settings. From the researcher's perspective, open and broad questions facilitate the collection of understandings in an effort "to look for the complexity of views" (Creswell, 2014, p. 8). Looking for the complexity of views assists the second aim of this research which is to explore what mātauranga Māori means for kaiako. Consistent with a Constructivist paradigm, it is important

to acknowledge the researcher as an active participant, collaboratively creating discourse alongside other participants through broad, open-ended questions.

### 4.2.2 Researcher positioning

> *Researchers recognize that their own backgrounds shape their interpretation, and they position themselves in the research to acknowledge how their interpretation flows from their personal, cultural, and historical experiences.*
>
> *—Creswell, Research Design, 2014, p. 8*

In a constructivist paradigm researchers recognise that undergoing truly objective research is futile. This research embraces and uses for its benefit the effects of subjectivity. As defined by Oxford English Dictionary (n.d.), to be objective is to be "uninfluenced by personal feelings or opinions when considering and representing facts". Bishop (2005) synthesises this concept more simply and says that "objectivity…is a denial of identity" (p. 129). The myth of objectivity in research practice is discussed further by Scheurich and Young (1997, p. 7) where they suggest that "ways become so deeply embedded that they typically are seen as 'natural' or appropriate norms rather than as historically evolved social constructs". Freire (1972) describes an introspective process, which challenges researchers to humanise and liberate their understanding of the participant – researcher relationship from being one of authority and perceived objectivity to one of subjectivity which considers the importance of identity (see also Collins, 1991; Bishop, 2005; Williams, 2011). Identity of the researcher becomes a pivotal part of the research process, as does their place within the experiences of the participants they wish to represent (Smith, 1992; Scheurich & Young, 1997; Bishop, 2005; Berryman, et. al., 2013). With this in mind, I seek to be a "research storyteller" (Bishop, 1997a, p. 29), moving beyond data gathering and "toward mutual construction of meaning making within culturally appropriate contexts" (Bishop, 1996, p. 153).

Mutually constructing meaning suits my positioning as an insider. An insider in research is described as a member of the group(s) the research is investigating (Bishop, 1996; Williams, 2011). As a secondary mathematics teacher at an English-medium school in Te Tairāwhiti (East Coast region of the North Island of New Zealand), and as a Māori researcher, positioning myself as an insider allows me to assume a participatory role, a role interested in unpacking my own understandings alongside potential participants with whom I have pre-existing collegial relationships (Heshusius, 1994). The concept of this research began during my work in the

review of achievement standards in 2019. It was here where I was first asked what mātauranga Māori was in mathematics teaching and learning. Answering this question became the inspiration of this exploration.

## 4.3 Research Theory

There are four key research theories supporting this exploration. Firstly, this research is critical in that it believes that social systems have been constructed by an overpowering dominance and seeks retribution by considering the marginalised. Following this, kaupapa Māori and culturally responsive methodologies will be defined in relation to this research. Finally, the research theory known as Critical Discourse Analysis will also be defined. This section has two goals: to define the founding theories of research guiding this exploration, and to state how these theories impact research practice.

### 4.3.1 Critical Theory

Critical theory is defined as a method of research enquiry which challenges structures which are often oppressive and seeks to transform them (Eketone, 2008; Smith, 1992; Stewart, 2007). As an inquiry method, it supports research as a social and political mission (Saldaña, 2011). To be specific, critical theory seeks emancipation and liberation, especially concerning marginalised peoples (Berryman et al., 2013; Creswell, 2014; Stewart, 2007). As this research is concerned with advancing the education of Māori, critical theory supports the ongoing dedication to transforming outcomes, as does Kaupapa Māori theory.

### 4.3.2 Kaupapa Māori

> *…one of the greatest strengths of the concept of kaupapa Māori research is that it is based not just in a rigorous intellectual framework, but in a critique that might lead people to think through change.*
>
> *—Jackson, Decolonising education, 2016, p. 47*

From localising critical theory, Graham Smith (1992) states Kaupapa Māori research is about being Māori. It is connected to Māori philosophy and principles, validates, and legitimises Māori knowledge, and understands the importance of Māori language and culture. When discussing indigenising research methods Berryman et al. (2013) reflect on what exists, saying "[t]raditional Western research frameworks have given little regard to participants' rights to initiate, contribute, critique, or evaluate research" (p. 1). Similarly, Bishop (1997) said research “denied the authenticity of Māori experiences and voices and replaced them with an

'authoritative' voice of the 'expert'" (p. 7). In all cases, the subjects are treated as outsiders by the researcher and remain unaffected positively by the findings of such projects (Banks, 1993; Bishop, 2005; Scheurich & Young, 1997). Following that whakaaro (thought), Kaupapa Māori methodologies offer "an indigenous approach to research… challenging the dominance of the Pākehā worldview" (Bishop, 2005, p. 114).

For this research, Kaupapa Māori theory holds a tenet that mātauranga Māori is valid (Smith, 1992). As a Māori researcher, in a discipline that is predominantly viewed as a Western subject (Gutiérrez, 2017), Kaupapa Māori methodology allows the assumption that mātauranga Māori can exist within te ao pāngarau (the mathematics world). This research intends to "address the prevailing ideologies of cultural superiority" (Bishop, 1994, p. 175) and as such, Kaupapa Māori prioritises being Māori, legitimising Māori cultural beliefs and practices (Smith, 1992). That said, it was not necessary for participants to be Māori which means Culturally Responsive theory is suitable for this study.

### 4.3.3 Culturally Responsive

Kaupapa Māori methodology implies that all participants in research are Māori. This research required participants who were kaiako of Māori learners but did not require participants to be Māori. Therefore, a culturally responsive methodology is fitting to describe the expectations of the participant in this exploration. Berryman et al. (2013) describe reciprocity, dialogic and relationship-building as important aspects in research where researchers and participants "interact in dynamic collaboration" (p. 42). Creating a dialogic space has the potential to create new understandings by including, building upon, and utilising diverse worldviews through discourse (Bishop, 1997a; 1997b; 2005; Harrison, MacGibbon, & Morton, 2001; Locke, 2004; Mahuika, 2008; Webber, 2009). Legitimising the worldviews of mathematics teachers helps ensure the wairua (spirit) of their whakaaro (thinking) is adequately collected and their mana (prestige) remains protected (Smith, 1999). The final research theory used is Critical Discourse Analysis which allows the deliberate use of te reo Māori and stresses the importance of meaning.

### 4.3.4 Critical Discourse Analysis

Weiss and Wodak (2004) describe the nature of Critical Discourse Analysis (CDA) in research as understanding the impact power, discourse, hierarchy, gender, ideology, culture, and society have on the interpretation and explanation of research. For this thesis, CDA is

interested in the relationship between language and power" (Weiss & Wodak, 2004, p. 12). As English is considered "the basic unit of communication" (p. 12) it is placed in a position of power. CDA allows this research to be anchored in linking the mātauranga Māori within te reo Māori to better share its findings. Thus, te reo Māori is treated as normal. This said, writing conventions will be adhered to and te reo Māori words and phrases will be translated or described and added to the glossary on page 86 for the reader.

## 4.4 Research Methods

### 4.4.1 Participants

As one of the aims of this thesis is to explore what mātauranga Māori means for kaiako it is appropriate at this point to introduce a valuable part of this exploration, the participants. It is necessary to note that from a statistical perspective, sampling methods for collecting reliable data seek to ensure a representative sample is used for population inferences (Sarantakos, 1993). This thesis did not seek a representative sample of mathematics teachers. Rather, it prioritises the experience of the individual and does not attempt to generalise the mathematics teaching sector here in Aotearoa. Thus, the participants were invited members of what Bishop (1996) calls a whānau of interest. Metaphorically speaking, he suggests that this whānau contains members who are known to the researcher. Inviting known potential participants supports an identity sustaining research environment based on relationships where safety and comfort with each other already exists.

Three lead advisors at MOE who were members of the researchers metaphoric whānau were invited to participate in this project. It was hoped that their voice would represent the perspective of the expert in the areas of mathematics, or te ao Māori. Although interested, the current work with the Curriculum Refresh, the development of Numeracy and Literacy corequisite, as well as the review of Achievement Standards meant that the invited participants were unable to contribute for legal reasons. Their perspective is still important to my research aspirations, and their voice represents a gap in the current literature.

Three kaiako of mathematics at a secondary English-medium school in Te Tairāwhiti who were members of the researcher's metaphoric whānau were invited to participate in this project. It was hoped that their voice would share the perspective of a mathematics teacher who works in a school with a high Māori population. These participants accepted the invitation and were

interviewed together in a focus group. To maintain their anonymity, they were given the option to select a pseudonym collated from the digitally mis-transcribed reo Māori collected during the transcription process. Each participant provided a distinct quality. Scott had the longest tenure in the mathematics classroom. Neil was a tauiwi of English descent but had been teaching in Aotearoa for much of their professional career. O'Malley had the least amount of teaching years' experience and was the only kaiako to have studied through our current (but, soon to be evolved) NCEA system. The researcher, as the fourth participant, has ten years of tenure and is represented by the data named Gitana. Three of the four kaiako are Māori.

### 4.4.2 Initial research process considerations

Research involving a researcher's own immediate work setting as well as involving participants who are colleagues can be convenient (Glesne & Peshkin, 1992). This type of research is also reliant on the presumption of established relationships that support the research goals, yet this process can lead to compromised data which can be difficult to validate. It is the researcher's responsibility to minimise risk to participants and demonstrate a dedication to collecting accurate and authentic narratives (Creswell, 2014; Glesne & Peshkin, 1992). As such, an invitation, and clear explanations about where the study would take place, who was invited to participate, and how the results would be reported was explicitly shared with participants as part of the approval process (see Appendix I, III, IV, VI). In response to the validation concerns outlined by Glesne and Peshkin (1992), the participants had the opportunity to review the transcript and offer corrections and alterations so long as it did not interact with other participant contributions. Alterations were made based on feedback and no alterations interacted with other participants' data (see Appendix IV).

Social interactions are an important aspect of Māori culture (Bishop, 1996; Cram, 1993; Smith, 1992). Where Western research methods value the individual and act to separate the researcher from the researched, Kaupapa Māori and Culturally Responsive research theory both value connectedness (Cohen et al., 2007; Cram, 1993). Therefore, I conducted a semi-structured discussion with a focus group of mathematics teachers of Māori students in an English-medium school. They responded to the overarching research question: What do teachers of mathematics understand about mātauranga Māori?

### 4.4.3 Semi-structured group discussions

The chosen method of collecting data was a semi-structured group discussion and was held in May 2022 for the kaiako focus group. Group discussions as a data collection method is said to have been introduced by Kurt Lewin in 1939 (Sarantakos, 1993). Initially used to investigate processes that occurred in the group, this method evolved into unpacking the content of the discussion which is consistent with its use in this exploration. The philosophy of this method is that the group will stimulate discussion through varied opinions (Sarantakos, 1993). Although the advantage of group discussions for data collection is that it encourages participants to "express views and evaluate situations" (Sarantakos, 1993, p. 253) there are some issues that arise from this method.

An issue of particular concern for exploring thinking is that the group conditions may increase non-sampling errors such as participants not sharing their thoughts through fear of being different from the group. As a new researcher, I also may be unprepared to manage engagement in a way that supports full and truthful participation. Another concern is that some participants may dominate the discussion, and some may choose to not participate at all. These issues, if unmanaged, mislead the researcher and disable the researcher's ability to gather quality data (Berger, Wolf, & Ulmann, 1989; Dreher & Dreher, 1991; as cited in Sarantakos, 1993). Sarantakos (1993) offers guidance to minimise the effect of the listed errors as ensuring the research leader controls the discussion by encouraging participation, managing dominating participants, and keeping the discussion on topic. They also describe the need for the research leader to maintain a safe and "warm atmosphere among the members of the group" (p. 252). To maximise authentic participation this discussion was held in the school where the kaiako worked and a comfortable sharing environment was maintained. The duration of the discussion was 75 minutes and was recorded audio-visually.

### 4.4.4 Recording the discussion

Recording the discussion for considerate analysis was done on an audio-visual recorder on my laptop. A participant offered to run a secondary audio recorder from their phone in case the initial method failed. All participants gave permission for the methods of recording (see Appendix III). The method of collecting data in a group discussion setting using an audio-visual recording assisted in ensuring the contents of the discussion represent the intentions in which they were shared. This meant that the transcription process was long given that the written

transcription, the visual recording, and the audio data required analysis. This proved to be invaluable because there were actions and nuances of body language which helped me gain a better understanding of the intentions of what participants shared as well as seeing how the other participants reacted and responded.

### 4.4.5 Analysis and interpretation of data

The analysis and interpretation of data from this exploration is key to investigating the second and third research aims of exploring what mātauranga Māori means to kaiako, and to consider the connections between mātauranga Māori and mathematics teaching and learning, respectively. In qualitative research, the researcher makes sense of the data by organising and grouping common and repeated terms to make meaning from the collected narratives (Creswell, 2014). Consistent with Critical Discourse Analysis where priority is given to the essence of words in the language they originate, the term *data* has whakapapa (geneology). In Latin, the root term *datum* (which refers to a single piece of data) means "something given". Considering the essence of the word data shifted focus away from viewing the participants' research contributions as something collected and analysed into a taonga (treasure) given by the participants. To consider data as taonga means to treat data as a treasure, as well as something to be treasured.

In recognising the precious nature of the data, it is the researcher's role to identify patterns (Peel, 2020; Creswell, 2014; Saldaña, 2011). For example, "[i]t is the researcher's responsibility to make known the processes for identifying patterns, constructing descriptions and developing interpretations to trace the logic of the analysis." (Peel, 2020, p 3). Thematic analysis was used as an initial process for planning the interpretation of the narratives. Peel (2020, p. 8) synthesises the work of Braun and Clarke (2006), Creswell (2013), Miles, Huberman, and Saldaña, (2014) and others in a six-stage data collection and analysis process. The six-stage data collection and analysis process are

(1) collect the data
(2) engage with the data
(3) code the extracts from the data
(4) generate code categories
(5) conceptualise the themes from the categories generated
(6) contextualise and represent the findings.

This analysis method worked well as a system for engaging with the narrative of the kaiako. The common themes that presented themselves were power sharing, identity, mātauranga Māori, pedagogy, and relationships. The themes identified initially suited the partitions used in the literature reviews where Chapter Two discussed mātauranga Māori and its inclusion here in Aotearoa, and education's quest for equity and excellence, and Chapter Three which discussed mathematics, teaching and learning. When piecing together the findings it became difficult to maintain an intimate connection to what the participants were sharing. The analytical system for organising their voice was disrupting and suppressing what the participants were intending to share.

To overcome this issue, collaborative storying was used to better share the narratives of the kaiako. Collaborative storying is a research process which seeks to share the lived experiences of participants in a collaborative and constructive way (Bishop, 1997a). The dialogic, conversative, and reflexive style of collecting data in this research meant that collaborative storying was better suited to take an in-depth and meaning-focused style of analysing the narrative from the kaiako. The initial themes were let go, and the voice was reorganised into a structure that seemed to better share their intent. This structure shared the journey from when the participants were learners themselves, to what their experiences are as kaiako now. This section was named *Te Huarahi ki Konei|The Pathway Leading Here*. Following this, the Findings and Discussion chapter called *Te Huarahi ki Mua|What Lies Ahead* shares the concerns and aspirations of the kaiako as they navigate the directive of including mātauranga Māori in mathematics teaching and learning. This restructuring of data better suited the exploration into how mātauranga Māori is experienced by the kaiako who participated in this study.

## 4.5 Ngā Pātai Rangahau|Research Questions

Creswell (2014) guides the creation of research questions in this study and states that the researcher should use exploratory verbs such as 'report' or 'reflect' to adequately collect the views of participants through open language. He also warns that research questions in qualitative methods may evolve as the study progresses. Initially designed with the potential to evolve in mind, the three key research aims investigated in this study were:

1. To understand the policy development leading to the directive of including mātauranga Māori.

2. To explore what mātauranga Māori means to kaiako.
3. To consider the connections between mātauranga Māori and mathematics teaching and learning.

The questions used to guide the focus group discussion between the kaiako were

1. What do you understand mātauranga Māori to be?
2. What similarities can you draw between mātauranga Māori and mathematics?
3. What differences can you draw between mātauranga Māori and mathematics?
4. What connections can you make between teaching and learning in mathematics and mātauranga Māori?
5. What support do you need to enable you to meet the Ministry of Education directive?

The final question (5) was added during the focus discussion. As the kaiako expressed their concern about understanding mātauranga Māori in their classrooms, an opportunity to share what they might need to assist their understanding was offered. Creswell (2014) describes questions of this nature as identifying further networks of expertise which could lead to new understandings related to the study. It is hoped that this will lead to further exploration and open new investigations related to the MOE directive and the teaching and learning in the mathematics classroom.

## 4.6 Ethics and Limitations

As the title of this chapter indicates, ethical considerations are of high value in this research. Kaupapa Māori research methods were foundational in ensuring I was conducting mana enhancing research from the beginning. Enhancing mana requires conducting ethically considerate research and Linda Tuhiwai Smith (2000, p. 242) outlines seven guidelines which form the code-of-conduct I followed:

1. aroha ki te tangata (a respect for people)
2. kanohi kitea (the seen face – that is, present yourself to people face-to-face)
3. titiro, whakarongo, …, korero (look, listen, …, speak)
4. manaaki i te tangata (share and host people, be generous)
5. kia tūpato (be cautious)
6. kaua e takahi i te mana o te tangata (do not trample over the mana of people)
7. kaua e māhaki (do not flaunt your knowledge)

The intention of these ethical guidelines is to foster respectful and mutually beneficial interactions between participants throughout the research process (Bishop, 1996; Berryman et al., 2013). In this research, these guidelines were also sustained as a code-of-conduct for analysing and discussing the collected narratives respectfully. This helped ensure the intentions of the participants were shared in a cautious way, considerate of their mana and their on-going relationship with me, the researcher-participant.

The safety of the participants' data (taonga) was important ethically. The recorded discussion was kept in a managed folder where only I had access. The recorded discussions were in three forms: audio file, visual file, and written transcription. These digital documents will be destroyed at the appropriate time. Stored in this secure file are also the invitations to participate and any other accompanying documents such as the signed consents which were scanned. Paper copies were then destroyed in a managed, secure paper destruction site. This focus on protecting their contributions is about aroha ki te tangata, manaaki i te tangata, and tūpatotanga.

There are several limitations of this research which include issues related to representation, generalisation, and interpretation. The initial research question wished to triangulate the experience of kaiako with the experience of lead advisors. The limitation of not being able to

include key narratives from lead advisors leaves a gap in this research. Also, having four participants in total means that the findings from this research are not representative of the mathematics teaching sector here in Aotearoa, and therefore cannot be generalised.

The methods of collecting the data also posed limitations on the research. Bishop (1996) and Sarantakos (1993) identify that the advantage of group discussion environments allows co-construction of meaning to occur. The issues created by group interactions is that some participants may dominate discussions, leaving little room for others to share. Furthermore, the group environment may cause participants to share only what they perceive as acceptable points of view. This inevitably leads to findings which hide the true intent of those who are part of the research narrative. In addition, the most limiting constraint on this research is my inexperience as a researcher. This constraint can only be developed by continual opportunities to conduct research.

## 4.7 Summary

To summarise, qualitative methods are used to meet the aims of this research. This chapter explained the research paradigm underpinning the exploration and the research theories which guided the way in which the research was conducted. This was followed by the identification of sampling methods used including introducing the participants to the reader. Gathering the data through group discussions was thought to be the best process for exploring understandings of mātauranga Māori and this data was analysed initially using thematic analysis. To better share the intent and meaning of the narratives, collaborative storying was used. Finally, this chapter examined the ethical considerations of this thesis, as well as the limitations.

The following two chapters will explore and discuss the key findings from the group discussion with the mathematics kaiako. These two chapters collectively aim to present an exploration into how the MOE directive of including mātauranga Māori is understood by English-medium mathematics kaiako from this study. Chapter Five will open the discussion pathway (huarahi) by sharing the educational experiences which have shaped the participants.

# CHAPTER 5 TE HUARAHI KI KONEI|THE PATHWAY LEADING HERE

Title definition: *Te Huarahi Ki Konei* translates to "the pathway leading here". The meaning of the word *Huarahi* can be better understood by looking at its parts: *hua* and *rahi*. A translation for *hua* is "to be fruitful" and *rahi* is "importance". A metaphorical representation of a journey of "one's path in life". *Ki Konei* is a locator term not only in space, but in time as well, it means "the here and now". The title of this section then means "the journey to the here and now," and the following focus will guide the reader through the journeys of four learners who become teachers, and four teachers who become kaiako.

The intention of this study is to explore the understandings of mātauranga Māori in mathematics teaching and learning for mathematics kaiako. The primary research aim is to understand the policy development leading to the directive of including mātauranga Māori. The second is to explore what mātauranga Māori means to kaiako. The third aim considers the connections between mātauranga Māori and mathematics teaching and learning. Chapters Five and Six will address more specifically the second and third aims of this research, respectively.

> *In qualitative research, the intent is to explore the general, complex set of factors surrounding the central phenomenon and present the broad and varied perspectives or meanings that participants hold.*
>
> *—Creswell, Research Design, 2014, p. 140*

The previous chapters laid the foundations for better understanding each aim and it is in Chapter Five and Chapter Six where the literature is joined together with the findings in a two-part discussion. The two Findings and Discussion chapters share the narratives of the four kaiako who participated in this exploration. Throughout the analysis of the kaiako narrative, it became clear that the message they wished to share was that they are enthusiastic about enriching the cultural depth of their teaching and learning in the mathematics classroom but were unsure how to do it. To share this message respectfully, this thesis will first journey through their experiences as kaiako that have led to the here and now. This chapter, Chapter Five is called *Te Huarahi Ki Konei*.

# FINDINGS AND DISCUSSION 1

## 5.1 Introduction

During the process of interacting with the narrative from the group discussion it became apparent that the most effective way to convey the intended meaning of the content was to structure the narratives in a way that leads through the journeys shared by the four kaiako. Consistent with the Latin meaning for the root term *datum*, which means "something given", it seemed like a more respectful process for treating their taonga than my original data handling method of thematising their kōrero. Although thematic analysis was an important process for getting-to-know the data intimately (Peel, 2020; Sarantakos, 1993) structuring my thesis content around these themes did not share the essence of the data. Furthermore, structuring it around the guiding questions did not work, as new questions were introduced as the collaborative stories grew. This chapter will share the school experiences of the kaiako as learners, what teaching looked like when they began their journey as kaiako, and how they have experienced the shifts in education over time. As a reminder, the kaiako in this exploration are Neil, O'Malley, Scott, and me as a researcher-participant, Gitana. Note: to allow their voice to shine I have indented their comments.

## 5.2 As a learner

This section begins the journey of the four kaiako with thoughts around their own experiences as learners, both in the classroom as a student and as a teacher. During my years at school, I was a passionate learner and reflect fondly on my school experience. This love of learning was supported by Neil who said, "you are talking to somebody who loved school". When reflecting on their experience, the kaiako recalled relationships with their own teachers that had fostered positive memories. Whanaungatanga is a Māori concept which can be used to describe relationships for pedagogy (Bishop et al., 2013).

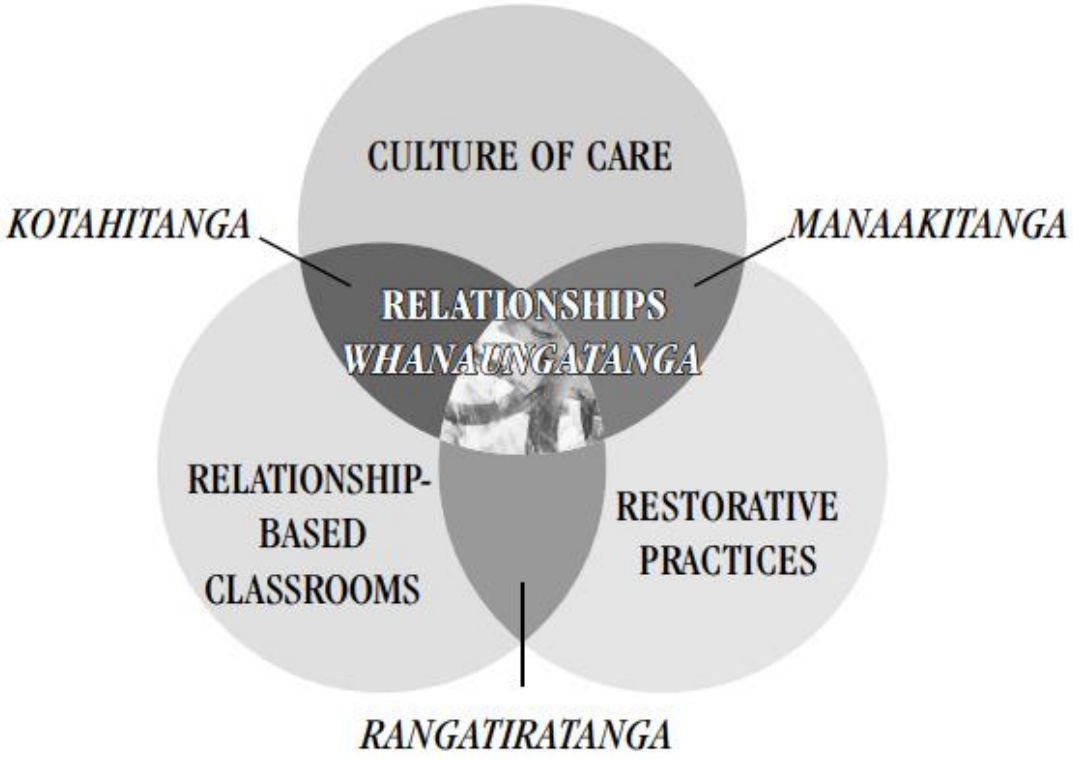
### 5.2.1 Whanaungatanga

Learning relationships formed with teachers can be impactful on the choices learners make. I recall a change in the kind of relationship I had with my secondary school teachers compared to primary school. Where primary school teachers were kind, authoritative, and curt, my secondary teachers were stern on occasion, but interacted with me as a learner in an

increasingly guiding manner. They were full of passion for their teaching subjects and were known for sharing those passions expressively. For Neil, they matriculated in the subject of languages because "it was down to the relationship I had with the teachers" (Neil). Learners who feel supported academically by their teachers are more able to be self-determining and are often brought into the learning environment through the teacher establishing whānau-like relationships (Bishop & Berryman, 2009). A model of key characteristics which create culturally safe schools, places relationships at the centre, illustrating its importance in the teaching and learning space.

Figure 2

*Creating culturally safe schools for Māori students*




*Note:* From "Creating culturally safe schools for Māori students" by A. Macfarlane, T. Glynn, T. Cavanagh, and S. Bateman, 2007. *The Australian journal of indigenous education*, *36*(1), pp. 65-76. In the public domain.

Experiences of the kaiako as a learner was not isolated to their past. As I grow in confidence in the classroom, I also grow trust in my learners. Letting go of feeling like I need to know all the answers to all the questions has been a slow shift, but it has been freeing. It has also allowed

me to invest more time in listening to my learners. Because of this I am more likely to assist their actual learning needs. In the past, my presumptions about their learning needs would have dictated the actions I took as a teacher. This resulted in lessons which were pitched "to all, and none" (Gitana), over-stimulating those who needed more guidance and underserving those who already had the prior knowledge. Discussing a recent experience in the classroom, Neil shared a learning interaction during a Year Nine geometry lesson where te reo Māori was used to explore the properties of two-dimensional and three-dimensional shapes. "It's that kind of exploring together and then them (ākonga) seeing me learn alongside them, which in mathematics possibly doesn't happen that often" (Neil). Often "they [ākonga] are experts already. You [kaiako] can learn from them" (Gitana). Neil had "caught that concept of reciprocity. We were finding that out together and getting quite excited" (Neil). In this interaction Neil is the learner, and their students are the teachers.

Ako is a reo Māori term used to describe both learning and teaching. More than a translation of learn and teach, ako is described as a reciprocal process where the lines of who is the expert is often blurred (Berryman & Eley, 2019; Riwai-Couch, 2022). The result of a classroom where ako exists is that perpetual learning is given space to grow and often is a sign that a strong foundation of whanaungatanga has been fostered. For the mātauranga Māori rich classroom, interactions like this are ideal for all learners, including teachers as learners. These interactions contradicted what the kaiako recalled when thinking about their own education as learners and their teaching college experiences.

## 5.3 Becoming a teacher in Aotearoa

Two topics of interest were discussed by the kaiako: "traditional" teaching and training to become a teacher. These two foci for this section explore the notions of "teaching how you were taught" (Gitana). This section also represents a direction in the collaborative story that was not planned. Questions probing the kaiako understanding of what traditional teaching looks like to them and if they could recall Māori-centric learning at teaching college were asked following the natural path of the discussion.

### 5.3.1 "Traditional" teaching

In the English-medium setting, there is a culture of traditional teaching practices that has shaped the way we view secondary education in Aotearoa. For me, the dictionary definition of *teacher* fully encompasses what "traditional" teaching is. *Teacher* is defined as "one whose

occupation is to instruct" (Merriam-Webster, n.d.). Consistent with this definition, traditional teaching practices looks like a person giving instructions which then implies that being a student is about following instruction. As a school student I was compliant and had the nature of someone who trusts teachers. I perhaps had the aptitude of someone who was a passive learner, content to have knowledge passed to me. The kaiako shared their constructed meanings of what traditional teaching practices are:

> The teacher imparting the knowledge onto the students, who's normally up at the board, showing some examples, and then the students practicing those examples. (Neil)
>
> Someone at the front, chanting times tables. Rote learning type of interactions. (Scott)
>
> Instructional teaching. That is, listen to the teacher for 20 minutes and sit in silence and work. (O'Malley)
>
> That you are compliant with me because I am a teacher …the belief was that learners come into class, the teacher tells them what to do, and they do it. (Gitana)

From the perspective of the student, the expectations in a Western model of education are that learners are quiet, compliant consumers of knowledge, gifted to them from the all-knowing teacher (Cho & Lewis, 2005; Kohn, 2006). Certainly, Neil and I recall that teachers from our past would have described us as good learners, not because we were critical thinkers, or particularly innovative, but because we followed instruction, and probably did it quietly. Confronting this kind of learner, Tejeda, Espinoza, and Gutiérrez (2003) suggest a social-justice perspective on growing learners who are critical and engaged in activities geared toward social advancement (see also Berryman & Eley, 2017; Milne, 2013). This decolonising pedagogy dismantles the learner whose identity exists in subordination and begins to construct learners who are self-determining thus challenging the power structures that work to maintain dominance.

From the perspective of the teacher, Martin (2012) discusses English-medium education as emphasising individual academic excellence, especially in the way they assess the learning. As such, a further question was posed as the kaiako contemplated the qualities of a traditional teacher and asked, "[d]o you think that traditional teaching has a culture?" to which Scott replied, "it has a white culture behind it I guess because the teacher has the power". In their discussion about decolonising pedagogy, Tejeda et al. (2003) argue that colonisation maintained Anglo-European dominance and control through activities such as education (see

also Chapter Two). Tate (1995) takes this concept a step further by calling what's been explored as traditional teaching practice as "foreign" pedagogy (original emphasis) and defines this as, "Typical mathematics pedagogy [which] emphasizes whole-class instruction, with teachers describing a technique to solve a problem and students listening to the lecture" (Tate, 1995, pp. 166-167). Foreign pedagogy is familiar to the kaiako as a normal state of a mathematics classroom. This agreed pedagogy has shaped their interactions as teachers.

### 5.3.2 Teaching teachers to teach

Challenging the role of learn-to-teach institutions to enhance the capabilities of kaiako to develop more wholistic pedagogical practices, particularly conscious of the unique position Māori have in Aotearoa, an additional question was posed asking if any cultural competency learning occurred when they attended teaching college. For me, I remember a lot of general learning around The Treaty of Waitangi. I had completed a degree in Māori Studies prior to teaching college and felt that I had adequate prior knowledge to support the new learning at teaching college. That said, there was little explicit Māori-centric learning in the primary teaching subject, mathematics, that I was being trained in. My second subject was te reo Māori. It should come as no surprise that mātauranga Māori existed there.

Three of the four kaiako completed their teacher training in Aotearoa. Their voices seemed to remember some cultural content learning in teaching college. They shared that cultural content was in the "generic teaching papers" (O'Malley) but remained absent of any notable cultural-based learning in the mathematics specific papers. Of their time at teaching college, the kaiako recalled the following:

> The practicum at a Church of England school was very traditional. You walked in and they would stand up and say, "good morning" and then they would sit down and listen to you. (Neil)
>
> …content focused on increasing understanding of Māori culture such as Treaty competence in education existed but not so much in the Maths specific course, but at that time, around 2012, there was a push to do things in a more problem-solving style. For example, rich tasks and explorative maths activities. (Gitana)

Scott, who has the longest tenure, could not recall Māori specific learning at teaching college but did recall learning the value of problem-solving activities. Neil did share their initial subject training as a language teacher and reflected on the pedagogical practice existing then as being discursive and interactive because "[a] lot of the language learning was discursive anyway. That

is, you could not just sit there and have a teacher talk to you in the language learning classroom, you had to practice, you must interact" (Neil).

These findings suggest that these kaiako were initiated into teaching without deliberate cultural competency learning, particularly for the learning subject of mathematics. As discussed in Chapter Two, the historical shifts over time from education focus on assimilation to our current education focus on parity for Māori highlights the long journey education has taken and continues to take as Aotearoa education focus remains on tino rangatiratanga. These shifting foci are incremental, and the values of teacher education institutions evolves alongside to match. There is a responsibility then for learn-to-teach institutions to shift toward learn-to-facilitate learning as a driver for shaping Aotearoa pedagogists who are culturally competent and able to contribute to enriching our cultural heritage as a country through actions in the classroom.

### 5.3.3 Into the classroom

Following teaching college, the journey of a newly trained teacher into their first classroom can be exciting and daunting. I remember applying for a position of a mathematics teacher at the secondary school I attended, and I may have called it "my dream job". This, perhaps, is an accolade to my secondary school and should be noted here. When I began teaching, there was already one other Māori mathematics teacher who was female. This may have contributed to me entering a department that was focused on forming collaborative relationships with each other. I found my formative years as a new teacher were well supported by colleagues who were shaping me into a kaiako. Conversely, at the beginning of their teaching career Scott noted an absence of collaborative interactions with other staff. As the participant with the longest tenure, Scott highlights teaching at an English-medium secondary school was initially an individual enterprise and says, "[w]hen I started, I did not come out of my classroom to talk to anybody else. I had to figure it out on my own". Following this, Scott shared how teaching is "different than how it used to be. When I came here, every teacher sat in their classroom. Now we work more closely together, [where] everyone is open to thinking and reflecting and developing as well. It is not like we are all resistant to change" (Scott).

Remembering what was expected of them as a new teacher Scott recalls that "[y]ou just talked to a textbook" (Scott). This reflection is consistent with Bishop, Ladwig, and Berryman (2013) who suggests that the classroom in a Western space is absent of connection and interactions

with others in any meaningful way. Tate (2005) also stipulated foreign pedagogy as overly reliant on textbooks as its only resources for learning activities and values working alone to solve problems (Tate, 1995). Shifting away from this style of pedagogy is discussed by the kaiako.

## 5.4 Shifts in education

Shifts in education was an area of discussion that the kaiako could all relate to. As they reflected on their time in the mathematics classroom, they highlighted three key shifts: power and its place in the classroom, the changes to how they grouped their mathematics learners, and finally, the impact manaakitanga (care) has on their practice.

### 5.4.1 Power

Power is a key theme evident in the findings. The kaiako explore their reflections of traditional teaching and learning in mathematics classrooms where the all-powerful teacher imparts their knowledge on the compliant and receiving children. My reflections on power as seen in teaching and learning have shifted over time. Initially, I was told at teaching college to ensure that I maintained control and dominance over my students lest they take advantage of me and riot. Contradictory to Māori culture, this "teaching tip" reflected teaching ideals that devalued the learner as a participant in the classroom and treated them more as people who need to be managed. Māori culture on the other hand values mana enhancing interactions (Crawford, 2018; Berryman & Eley, 2017; Riwai-Couch, 2022). The kaiako reflected on the role power has in the classroom and shared that "a lot of the time we have the answers prepared [to] a particular thing that we want them to discover" (Neil). Sharing the power then requires teacher's to "move away from feeling like you are the all-powerful one" (Gitana). In terms of the shifting role of the teacher, the kaiako highlighted the nature of teenagers as tending to be apathetic to learning at school. Gitana noted, "they are [teenagers], and that allows us to understand why they are being non-compliant rather than writing them off as defiant… you understand the changes that are happening in their brain."

Acknowledging the broader concept of hauora and how a teacher who uses their power to understand rather than reprimand their teenage learners can better support learning. Bishop, Ludwig, and Berryman (2013) synthesise literature from a range of sources which identifies power as being one of the key reasons why Māori continue to be less successful than others in education. Those in power tend to be part of the dominant and oppressive group. As the

participants' voice suggests, there is an air of control and dominance in the interactions they recall. Sleeter (2011, as cited in Bishop et al., 2013) provides a solution to power issues and suggests "that those who experience disparities know best what the problems are" (p. 9). As Māori are more likely to experience disparities, Māori advocate for a shift away from discriminatory practices in education such as generic ability grouping.

### 5.4.2 The journey away from streaming

The school that the kaiako were from were in their seventh year of shifting from ability streaming to mixed ability at the junior level of their secondary school. When I was a learner, I was streamed into a lower band at secondary school. I recall being an intelligent learner at primary school who was academically capable and engaged across all strands of the curriculum offered to me, so my groupings came as quite a shock. I had moved from a small rural primary into an urban school and for a long time I felt like I was not as clever as I had been led to believe. Learning about our history in education, I realise that there may be a more complicated explanation for my lived experience as a Māori learner. The kaiako share their memories of teaching the streamed classes:

> In the past there were some tricky classes. We banded in maths and had three bands – bottom, middle and top band. That turned into taking out one top class. I remember teaching bottom banded classes and they were challenging. (Neil)
>
> Going to mixed ability meant that you did not have all the challenging students in one class but spread throughout all the classes. The statistics have improved. (Scott)

Streaming is considered a racist action used to perpetuate discriminatory deficit theories about marginalised learners (Foster, 2019, Tronya & Williams, 1986; Zine, 2009). The common means for organising the top students to the bottom is often a single test, in Mathematics or English, or both. From these results, learners are grouped in descending order, and they tend to maintain these academic grouping throughout their school day in a range of learning topics and environments. Despite the perception that the test(s) are an objective measure of students' academic ability, if the groups are disproportionate there is evidence to suggest the test materials are culturally biased (Foster, 2009). The education practice of "colour-coded streaming" (Zine, 2009, p. 114) is a version of institutionalised racism. Institutionalised racism is where false stereotypes implicitly but directly impact decisions in an institution. These decisions are more likely to "categorize students as low-status, problem students…where they experience an inferior curriculum" (Foster, 2009, p. 18). Foster's (2009) notion of an inferior

curriculum is concerning and contradicts the Māori concept of manaakitanga. Manaakitanga is about caring for one's mana and since the kura had shifted away from ability grouping, a forced expansion of the curriculum for all has occurred.

### 5.4.3 Manaakitanga

In the English-medium setting, the shifts from traditional teaching practices as explored previously toward a dedicated focus on Māori learners is discussed by the participants. When I began teaching at this school, I entered a faculty who were dedicated to structuring learning opportunities in mathematics around their learners. Creating a faculty-wide program of integrating statistical learning with getting-to-know our learners seemed like an authentic way to engage with both mathematics and the children I would be teaching. O'Malley, Scott, Neil, and Gitana discuss manaakitanga as a visible value used to support the development of better relationships between teachers and learners in their setting. These shifts had been deliberate and organised by their school's leaders:

> We really awhi (support) our students along here. Everything has been trying to improve relationships. That is, senior leadership have been trying to create opportunities to improve relationships between students and the staff who are teaching and caring for them. (Neil)
>
> The maths faculty spends more time getting to know the students. In the junior program, we tried to have the first two weeks of getting to know students instead of jumping straight into maths learning. (Scott)
>
> Our maths teachers have changed. When I first came, it was a very aging staff so having youth in the faculty is positive. It is a very role model style faculty, and we all work together…even if it is not physically, we have got documents and things that everyone collaborates on. (Scott)

In the mathematics classroom, acknowledging the place of manaakitanga to support learning means that "teachers have moved away from just teaching skills toward teaching the history and maths stories to enhance connections" (O'Malley) which has "shifted the opportunities I have to get to know my learners" (Gitana). Manaakitanga in education is about our duty-of-care for the children we are teaching and ensuring they are safe and nurtured (Riwai-Couch, 2022). Crawford (2018) highlights that traditional Māori displayed kindness to their children to a level that was uncommon in Victorian England. Similarly, Berryman and Eley (2017) include relationships of care as a necessary context for learning in culturally relational and responsive practices.

To summarise, this initial journey of the kaiako from being a learner till now, a final question was posed to Scott who is acknowledged as the tuakana (older sibling, possesses wisdom beyond others) of the group. Valuing the knowledge and contributions of our tuakana is a large part of Māori culture. This tends to be related more intimately with age but is not limited to age. I asked the tuakana, what have you experienced from the start of your teaching until now, and where to next? While the first part of this question has been answered in this chapter, they responded with the following:

> I do not think we are ever going to get to the end point, it is always just going to keep evolving, the students change every year. (Scott)

## 5.5 Summary

This chapter titled *Te Huarahi Ki Konei|The Pathway Leading Here* shared the school experiences of the kaiako as learners, what teaching looked like when they began their journey as teachers in Aotearoa, and how they have experienced the shifts in education over time. The kaiako defined what Western traditional teaching practices looked like to them and reflected on how they were taught to teach. This exploration then led to their narratives on the shifts in education they have noticed such as an increased focus on developing learning relationships. This included relinquishing the concept of having to be in charge and moving away from ability grouping. Te Huarahi Ki Konei integrated core themes from the findings of whanaungatanga, traditional teaching, power, and manaakitanga.

The chapter to follow will discuss the findings from the four kaiako related to where they see mātauranga Māori fitting into mathematics teaching and learning. Titled *Te Huarahi Ki Mua|What Lies Ahead*, the themes of culturally relational pedagogy, the place of non-Māori, fear, and hope are shared over four sections. The first section is a meaning-making discussion around what the kaiako understand as mātauranga Māori is shared. Secondly, a discussion introduces what an English-medium secondary school who is unapologetically Māori looks like. Thirdly, their interactions in the mathematics classroom are explored before the final section of Chapter Six which presents the fear and hope the kaiako have of including mātauranga Māori in mathematics teaching and learning. This will conclude the journey of the kaiako and introduce a wero (challenge) for the future.

# CHAPTER 6 TE HUARAHI KI MUA|WHAT LIES AHEAD

Title definition: *Te Huarahi Ki Mua* translates to “the pathway forward”. *Huarahi* represents “one’s path in life”. *Ki Mua* is a locator term not only in space, but in time as well, it means “in-front”, or “in the future”. The gaps in research connecting mātauranga Māori in English-medium education and mathematics teaching and learning have meant that teachers are concerned that they may be finding their own way and that the pathway forward is unknown.

# FINDINGS AND DISCUSSION 2

## 6.1 Introduction

> *I don't know where to begin other than with what we've already been doing and looking at it from my perspective.*
>
> *—Neil*

This chapter introduces the second half of the findings from the focus group discussion between four English-medium mathematics kaiako who are at a Tairāwhiti secondary school. These findings address the second and third research aims of exploring what mātauranga Māori means to kaiako and considering the connections between mātauranga Māori and mathematics teaching and learning. Building upon the previous chapter which shared the experiences of the kaiako as learners, the teaching landscape when they began on their journey as kaiako, and their experiences of the changes in education over time, it explores the findings related to mātauranga Māori in the English-medium secondary mathematics space. Firstly, this chapter will share the kaiako-constructed definitions of mātauranga Māori. Following this, memorable learning interactions in the mathematics classroom will be linked to current pedagogy theory. To conclude this chapter, fear and hope will form the final findings and discussion topics. These two emotions became the most apparent themes of the discussion when exploring the directive of including mātauranga Māori in mathematics teaching and learning.

## 6.2 Mātauranga Māori as defined by the kaiako

> *Build your whare where you have three main pou to make it strong. …Content is one pou - but there are others. Mātauranga Māori is bigger than content - it is a way of being and engaging.*
>
> *—Morehu Nikora, personal communication, June 26, 2023*

This chapter opens with kaiako-constructed meanings of mātauranga Māori, directly addressing the second aim of exploring what mātauranga Māori means to kaiako. My understanding of mātauranga is weaving together diverse knowledges and ways of knowing. As a Māori wahine, who grew up surrounded by my Māori culture, and supported to participate in te ao Māori, I have never wondered what mātauranga Māori meant until the Minsitry of Education asked us to consider it while creating learning and assessment resources. To me, it is more than Māori knowledge, it has its roots in pre-colonial Māori practices, and it has the potential to shift the educational achievement of our Aotearoa citizens as well as shaping more globally competent people. The kaiako shared their initial thinking when asked about their understanding of mātauranga Māori:

> It's a way of bringing Māori ways of thinking into their classroom, ways of bringing more Māori culture into their classroom. (Scott)
>
> As a more general term it is knowledge and that way of engaging with things. (O'Malley)
>
> I often talk about mātauranga Māori as connecting with students as individuals and it might not always have Māori culture contexts, it might be more a teenage culture. So, trying to connect with students in terms of who they are. (Neil)
>
> I suppose it's about allowing the students to see themselves in the learning, connect with the learning - bring what they know already, in terms of themselves and their culture, to the learning. (Scott)

The kaiako were considerate of relating mātauranga Māori to teaching and learning explicitly. This illustrates how the term mātauranga Māori has dominated their lived experiences in education but had yet to be linked in their lived experiences outside the school context. Despite this observation though, their discussion recognised the space to enhance the place of te ao Māori in their classrooms, that it is connected to knowledge, and more strongly, relationships. Leading scholars (Durie, 2012; Mead, 2003; Metge, 2015; Ruru & Nikora, 2021) emphasise these relationships as being with and between people and things. The kaiako-constructed definitions of mātauranga Māori indicate that they are interested in seeing it more in their own

school. As such, the kaiako imagined what "a mātauranga Māori school" (Scott) would look like and Kia Aroha College was discussed.

## 6.3 An unapologetic Māori school

Scott and I form the narrative for much of this section. We are both leaders in the mathematics faculty of our kura and have participated as Strategic Change Leaders[2] in either Te Kotahitanga, Kia Eke Panuku[3], or Poutama Pounamu[4]. We have also been working toward post-graduate study with Scott working toward attaining a Master of Educational Leadership and my mahi toward a Master of Education. Our learning in these collective interactions has exposed a particularly memorable story of a principal who created an unapologetically Māori school called Kia Aroha College where Scott introduces it as "a bilingual school".

The creation of Kia Aroha College came from the merging of Te Whānau o Tupuranga and Clover Park Middle School. Anne Milne, the principal in question, documents the 25-year history of the two schools and utilised that whakapapa to create Kia Aroha College (see Milne, 2013). She led two mainstream schools and their communities toward "stepping outside education's 'white spaces' to create new spaces" (2013, p. v). In the English-medium setting, "white spaces" represent spaces where the dominant culture is exclusive. Gitana shares an observation about their own kura saying, "one struggle we have as an English-medium school is that we have a Pākehā whakapapa that's quite strong, quite traditional. How do you shift your own culture as a school?" Scott also recalls that learners at Kia Aroha College called their previous mainstream education institutions "Pākehā schools" (Scott).

From a governance perspective, The Education and Training Act 2020 outlines the expectation that boards of trustees will

> Ensure that the school gives effect to Te Tiriti o Waitangi, including by working to ensure that its plans, policies, and local curriculum reflect local tikanga Māori, mātauranga Māori, and te ao Māori, and taking all reasonable steps to make instruction

[2] *Strategic Change Leaders* are in-school leadership positions formed to support the professional development of school staff under the guidance of Te Kotahitanga, Kia Eke Panuku, and Poutama Pounamu.
[3] *Kia Eke Panuku* was an in-school professional learning opportunity which ran from 2013 to 2016. Its goal was to build on the success of Te Kotahitanga and continue to support secondary schools to operationalise the aspirations of Ka Hikitia-The Māori education strategy (Kia Eke Panuku, n.d.).
[4] *Poutama Pounamu* is a post-graduate learning opportunity run by The University of Waikato for educators. The goal of Poutama Pounamu is to promote equity, excellence and belonging across the education sector (The University of Waikato, n.d.).

> available in tikanga Māori and te reo Māori; and achieving equitable outcomes for Māori students. (Parliamentary Commentary Office, 2023, p. 32)

Similarly, Berryman and Eley (2017) suggest that transformative leadership supports reform through utilising the notion of power to enhance culturally relational practices, to develop confident and culturally connected young adults. Scott lists the memorable features of Kia Aroha College that differed from how their school operated:

> Tuakana-Teina: model of learning is set-up with the older ones mentoring the younger ones. (Scott)
>
> Knowing self as Māori: at the beginning of the year. It's all about immersing themselves, coming to school as a Māori, being Māori all day, and not leaving your Māoriness at the door. (Scott)
>
> Being successful: was not a choice…it was out there that they were Māori, and they were going to be successful. They were all engaged and dedicated to doing their best. (Scott)
>
> Decolonisation and oppression: are taught and spoken about explicitly. All around the walls there were things like "Māori students are successful students!" "Māori students can be leaders!" "Māori students can be!" (Scott)

As remembered by Scott, the intentional design of the new school is described by Milne (2013) as a "reclamation of educational sovereignty and cultural identity of non-white learners" (p. 45). As discussed in Chapter Three, the role critical pedagogy has in growing learners who are empowered to act on issues of inequity is a memorable value at Kia Aroha College (Scheurich & Young, 1997; Tejeda et al., 2003).

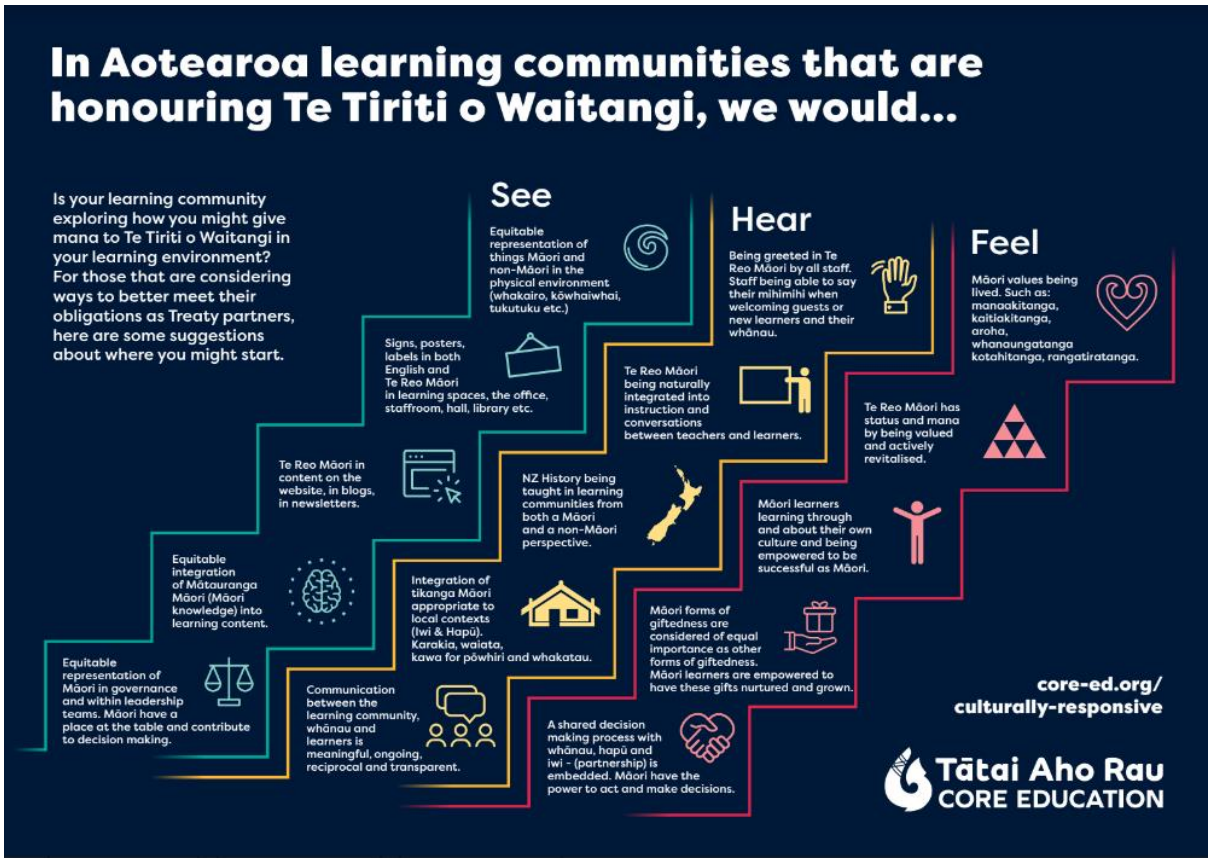
Kia Aroha College also gave life to the aspirations of the community, to the hapū, to the iwi, and whānau of the school. Berryman and Eley (2017) stipulate that educationally powerful connections with home communities are necessary to create unapologetic Māori schools. Educationally powerful connections demand collaboration between home and communities, and school for impactful change (Berryman & Eley, 2017). Certainly, whānau involvement in setting educational aspirations can impact the success of learners' (see Berryman, et al., 2018; Bishop & Glynn, 1999; Bonne & Hotere-Barnes, 2015; Riwai-Couch, 2021).

Learning communities who honour Te Tiriti o Waitangi can be a powerful beginning for schools who are unsure about where to start. Riwai-Couch (2021) discusses what this might look like and shared that educators and learning communities "reflect the bicultural heritage of Aotearoa New Zealand" (p. 43). Indeed, this focus for better reflecting the founding cultures

of current Aotearoa are assisted by facilitators of professional learning. Core Education offer a framework for supporting schools to shift toward honouring Te Tiriti o Waitangi (see Figure 1, Core Education, 2022).

Figure 3

*Learning communities that are honouring Te Tiriti o Waitangi*




*Note:* From "Cultural Capability for Educators" by Tātai Aho Rau Core Education, 2023. (https://core-ed.org/en_NZ/professional-learning/english-medium-facilitation/cultural-capability/). Image attributed with thanks to Tātai Aho Rau Core Education.

Moving toward being a mātauranga Māori school begins with honouring Te Tiriti o Waitangi. For a mathematics teacher, creating a learning environment where interactions in the classroom are reflective of our bicultural Aotearoa requires equitable Māori representation, where Māori culture is not only visible, but is lived and integrated into all facets of classroom interactions.

## 6.4 Interactions in the mathematics classroom

Interactions in the classroom dominated much of the discussion time as all kaiako reflected on moments that had a significant impact on their view of teaching. Te Kotahitanga is widely discussed by the kaiako and is linked to major shifts that had occurred at their school. Building on a newfound conscientisation of their Māori learners, and the schools ongoing aspirations to support Māori achievement further, the kaiako also aspired to design and execute interactions in their classes which were more explicitly linked to the lived experiences of the learners in front of them, especially in the mathematics classroom.

### 6.4.1 Te Kotahitanga

My participation as a new teacher in Te Kotahitanga was pivotal in shaping my teaching practice and becoming critically aware of my role in assisting Māori learners to succeed as Māori. This professional learning opportunity introduced me into a pro-Māori frame of thinking from the start of my teaching career. Established at the school the participants were at, in 2010, “Te Kotahitanga was up and running when I first started as a teacher so it shaped the way I teach, and that could mean that I do not know any different” (Neil).

As discussed in Chapter Two, the education policies of the past have led us from assimilation to biculturalism, then toward tino rangatiratanga. The kaiako reflect on the visible similarity of the directive to what their education focus has been over recent years. The school the kaiako worked in had been involved in Te Kotahitanga, a research and professional development project aimed at enhancing the educational outcomes of Māori learners in English-medium classrooms (Bishop & Berryman, 2010). The kaiako recognise that shifts in their school are now more inclusive of te ao Māori content and contexts, since the school’s participation in the Te Kotahitanga project. As a Te Kotahitanga observer, Scott noted the classroom environment changed from tables in rows to groups. Scott also observed teachers moving around the classroom instead of standing at the board or sitting at their desk. Neil, also, noted a “two-way teaching and learning process being valued in Te Kotahitanga, shifting from traditional to discursive practice”.

Te Kotahitanga valued culturally responsive and relational pedagogy[5] (CRRP). As shared in Chapter Three, CRRP consists of contexts for learning:

- power is shared
- culture counts
- learning is interactive and dialogic
- connectedness is fundamental to relations
- there is a common vision of excellence for Māori in education (Bishop & Berryman, 2006).

The assimilation of these contexts for learning into the everyday language the kaiako used is evident in the discussion. Neil recognises the space to empower learners in the classroom and shares a message to ākonga: "You're curious, you are reflective, you are thinking, you're not just doing it because someone told you to." The aspiration for Neil as a kaiako is that ākonga are "solving a problem that needs to be solved, that hasn't already been solved". Gitana challenges the kaiako to consider if there is a common vision of excellence and asks, "what are you getting out of this experience as a learner?" This seeks the continual questioning of curriculum to ensure learning is relevant and purposeful to the ākonga.

Scott recalls that "through Te Kotahitanga, we learned that what works for Māori works for everybody." A noticeable impact was the shift away from rote learning, whole class interactions, and teacher-led instruction as sole methods of interacting with learners in class. Berryman et al. (2018) refers to this as "transmission teaching" (p. 5). Transmission teaching as an interaction in the mathematics classroom began to be less common as the kaiako reflected on a journey toward diversifying the ways they interacted with their learners. Building on the learnings from Te Kotahitanga, the kaiako imagined what other interactions in the mathematics classroom they could introduce and discussed linking their mathematics learning to more "real life" situations.

### 6.4.2 More "real life"

Pedagogy concerning the teaching and learning of mathematics has substantial literature as discussed in Chapter Three. As a mathematics kaiako, I have battled a society that

[5] Cutlurally responsive and relational pedagogy is also discussed as cultural relationships for responsive pedagogy as described by Berryman, Lawrence, and Lamond (2003).

simultaneously hyper-values mathematics learning while also openly sharing their struggles as mathematics learners. This societal frame of mind filters into learners who believe that being good at maths is either a skill you have or do. Making learning relevant has always been an aspiration for the mathematics teacher. Relating specifically to the third research aim of connecting mātauranga Māori with mathematics teaching and learning, the kaiako hypothesised ideal teaching and learning interactions in the mathematics classroom. Scott wanted to see mathematics learning as "something that hasn't been made up but is connected to their lived experience in the moment". O'Malley suggested similar interactions such as those in other curriculum areas like Health "… where a survey [is] conducted, meaningful questions are asked, and learners propose solutions for the problems found" (O'Malley). Neil went on to say that "[t]here's so much going on around us …There is potential to tap into some rich and complex maths… such as relating different strands of mathematics". In an example of mathematics learning empowering a learner outside the classroom Gitana shares a story of her daughter:

> She used her learning from the Achievement Standard "Apply trigonometry to solve a problem" when she visited the AA building to do her Learners license. Noticing a dangerously steep step, she calculated its gradient using trigonometry. I thought, "you've been empowered with the maths you've learned in class, to solve a problem that occurred naturally".

As discussed in Chapter Three, effective pedagogy seeks to integrate the learner's lived experience and the mathematics they may utilise to solve problems they connect to (see Anthony & Walshaw, 2009; Berryman et al, 2003; Gutiérrez, 2017; Metge, 2015; Ministry of Education, 2023). The kaiako acknowledge the capacity for their interactions with mathematics to better suit their learners in the here-and-now (Hynds et al., 2016). This is contrary to current practice in the mathematics classroom which provides learning for "the potential lived experience when they are thirty" (Gitana).

## 6.5 Managing expectations

> *The race to embed as much knowledge as you can into the curriculum is not the right approach…it's Ministry of Education-driven and it shouldn't be.*
>
> *—Morehu Nikora, personal communication, June 26, 2023*

As discussed in the Introduction chapter, there exists confusion about what mātauranga Māori looks like in mathematics teaching and learning (see Ministry of Education, 2021b). For me, it

has always been clear. Seeing the world through an indigenous lens awards me the privilege of knowing what mātauranga Māori looks like in teaching and learning interactions in the classroom. The struggle has been explaining what I know in a culturally relational way so that my colleagues do not feel ostracised by this concept. In recent years I have engaged in numerous conversations with colleagues questioning mātauranga Māori as they work toward understanding something that I take for granted. Through analysing the narratives, the themes of fear and hope presented themselves through the use of terms like “scared”, “I don’t know”, “connect”, and “valuing culture”. These narratives are discussed in terms of a non-knower of Māori culture interacting with Māori concepts.

### 6.5.1 Tricky ground

Developing an understanding of the difficult position a non-knower of Māori culture when trying to make sense of a reo (language) they do not understand, has been essential in my interactions with other kaiako. I hear fear about not knowing what it is, and it tends to come out as anger. I hear confusion about why it is necessary and it tends to sound defensive. I see passionate mathematics teachers doubt their practice and attempt to add in Māori content or, avoid it completely. The participants share the kinds of conversation topics I have been involved with that illuminate these interactions:

> When people hear it [mātauranga Māori] for the first time, they just start thinking from that Māori context, Māori domain, and then get scared because of their sense of inadequacy, perhaps. It just seems so big. (Neil)
>
> I think we're already doing things, but I don't know if it fits that brief. (O’Malley)
>
> It's like it's a new idea, but is it a new idea? …[S]uddenly, there’s a directive of bringing mātauranga Māori into the classroom but haven't we already been trying to teach Māori in a way that is good for them? (Scott)

Linda Tuhiwai-Smith’s concept of “tricky ground” (2005) describes the place of non-Māori interacting with kaupapa Māori concepts (see also Hotere-Barnes, 2015). Fear of interacting with Māori culture and getting it wrong, possibly causing offence, seemed to be implied when the kaiako used terms such as “token” and “inadequacy”. Hoskins and Jones (2023) discuss this notion of superficially added cultural content as risky for Māori, where their “intellectual, philosophical, and political dimensions of te ao Māori, which is not limited to material signs, words, names, and designs” (para 30) are overshadowed by others’ perception of what Māori

culture is. Fearful that mathematics learning would be overshadowed by Māori concepts, the kaiako said:

> We don't want to lose the abstract concepts in maths for the sake of tokenistic Māoritanga. (Gitana)
>
> How do we go from that surface level change to deeper change without being tokenistic? (Neil)
>
> I feel like it's so out of my realm of my own experience, particularly as a foreigner in New Zealand. (Neil)

Tolich (2002) identifies an outsider being unsure of how to interact with Māori as Pākehā paralysis. Disengaging from Māori looking or sounding interactions, the paralysed Pākehā believes that their non-interactions are safer culturally than their attempt to interact would be. When discussing post-graduate research involving Māori, Tolich and Davidson (1998) highlight an issue that is pervasive in education at secondary level, saying that "[a]side from the question of whether non-Māori can ever understand the Māori world in its own terms, there is a serious question about whether they even have *the right to attempt to*" (original emphasis, Tolich & Davidson, 1998, p. 171). They clarify that this finding does not exclude non-Māori from involvement and interactions with Māori and Māori culture but rather, state that this involvement should have the quality of allyship. Bishop and Glynn (1992) describe this involvement as supporting Māori aspirations and meeting their obligations as treaty partners.

One supporting concept for connecting non-Māori kaiako to mātauranga Māori is whakapapa. Through the initial analysis process of placing the discussion into themes, the identity of the kaiako and engaging with learners in the mathematics classroom is discussed by the kaiako under an overarching theme of whakapapa. For me, whakapapa begins with knowing who I am by knowing who I come from. My whakapapa allows me to make connections with others through links to their whakapapa. Whakapapa is the next layer that is built on manaakitanga and whanaungatanga. It can create a foundation for learning based on linking histories with the present. In discussing the theme of whakapapa, including knowing self, Scott shares, "[s]upporting Māori is about knowing yourself. Having a strong connection to self and self-awareness". Linking the identity of kaiako and ākonga to mathematics is also discussed by Gitana who said, "[f]rom a mātauranga Māori perspective, knowing the history of mathematics helps us make connections to mathematics".

Hoskins and Jones (2023) discuss the role identity of self plays in a teacher's capacity to indigenise their practice. Although specific to a university space, their discussion around how non-Māori connect with a concept like mātauranga Māori is clear. They assert that mātauranga Māori is an invitation to "be Pākehā" (para 76). This means that non-Māori are "more competent at being, and understanding, themselves — who they are, how they are of this place and on this land, and how they're entangled in its histories and with the histories of their own people" (Hoskins & Jones, 2023, para 75). Mātauranga Māori welcomes the inclusion of stories from the past. As discussed in Chapter Three, mathematics has a rich and diverse history. Bringing the whakapapa of kaiako and ākonga to mathematics can create connections that are long lasting and based on bringing all three together with the goal of building knowledge. In contrast to this concept, the kaiako felt alone while attempting to understand mātauranga Māori and its role in mathematics teaching and learning.

### 6.5.2 On our own

Directly relating to how MOE has supported kaiako to give life to mātauranga Māori in mathematics teaching and learning, the kaiako share their concerns of being left to figure it out themselves. Working with MOE on the changes to assessments in the senior secondary level, I noticed that there was a lot of work being done on ensuring we were cognisant of the directive while creating learning and assessment resources. There were amazing people in roles dedicated to challenging our resources and it was great to be a part of a process that valued the input of the "everyday teacher" as opposed to using a process of "hiring experts". I could see examples of mātauranga Māori. That said, the resourcing seemed to end at the Wellington doors of MOE. A method for linking the work being done in Wellington and the mathematics teachers across Aotearoa seemed to be lacking. Carrying the load of sharing the directive of integrating mātauranga Māori in mathematics teaching and learning seemed to rest on the shoulders of independent mathematics associations, for example. The kaiako give evidence to the notion of being alone:

> It is hard because every individual school must produce their own understanding. (Neil)
>
> Someone else might have already cracked it and we are just sitting here mucking around. (O'Malley)
>
> As a school we need to have an opportunity to be with other schools… learning what the whole thing is about by learning from one another. (Neil)

> When the Ministry is giving us this directive, what is the outcome they are expecting? (Scott)
>
> We want to see what it looks like. We have ideas of what it might be, but we don't know. (O'Malley)
>
> The issue is the 'how'. It is the 'how' that we are missing. As teachers this is what we focus on, is the 'how', how can we do this? (Scott)
>
> I do not know what the end goal is. The Ministry has said to do this but is not going to tell us what it is or how to do it. You will discover how to do it, but I would rather just be told, model it for me, what is the end goal? (O'Malley)

As discussed in Chapter Two, Ka Hikitia – Ka Hāpaitia: The Māori Education Strategy is the current policy guiding our education focus here in Aotearoa. Since its inception in 2008, there has been a shift toward increasing English-medium education's Māori cultural competency, with the aspiration of Māori succeeding as Māori. Yet, in a review of the outcomes of implementing Ka Hikitia, the Auditor-General found that, "[d]espite gradual improvement, delaying and inadequately implementing Ka Hikitia has led to negligible progress since 2009" (Provost, 2013, part 5, section 5.36). They go on to recommend that "better implementation will require specific implementation and communication plans, more co-ordination with education agencies, and more practical guidance for schools" (Provost, 2013, part 6, section 6.7). Similarly, seeking more opportunities to learn from others' knowledge, the kaiako were aware that there exists good practice that exemplifies what mātauranga Māori in mathematics teaching and learning looks like. Creating collaborative partnerships with successful schools is a recommendation the Auditor-General shares (General, 2016). This shift in responsibility from MOE to individual schools is reflected in the kaiako discussions.

### 6.5.3 From teacher to kaiako

Managing the expectations of integrating mātauranga Māori in mathematics teaching and learning involves a belief that Māori should experience successful educational outcomes. As such, hope and enthusiasm could be heard in the kaiako narrative. The findings that were grouped into a theme of hope had notions of the kaiako feeling they were on a positive trajectory. They share that the journey they had been on had already positively impacted Māori learners at their school and they were hopeful about shifting the achievement of Māori learners further.

My explicit shift from a teacher to a kaiako came relatively recently. I had been asked to share my understanding of mātauranga Māori to mathematics leaders at a local conference. While

creating resources I decided to use te reo Māori as a framework for dissecting mātauranga Māori to assist non-Māori understanding. This taonga of te reo lead me to add a seemingly insignificant section to my PowerPoint where I introduce the difference between a teacher and a kaiako. By definition, a *teacher* is an "instructor", while a *kaiako* is a "facilitator of learning". This finding shifted the way I viewed my role. Prior to this realisation, I used teacher and kaiako interchangeably. The kaiako describe facilitating learning as the following:

> Allowing: students to see, to connect, to bring what they know themselves in the learning environment. (Scott)
>
> Connecting: [Learning content] linked to their lives outside school with their whānau, or something that's relevant to them. (Neil)
>
> Connecting: with the learning and bringing what they know already in terms of themselves and their culture to the learning. (Scott)
>
> Giving life to the Ministry directive: to give examples of what it looks like such as getting to know your learners and asking whānau what their aspirations are. (Gitana)
>
> Valuing culture: because every culture has different ideas of success. For example, an Aboriginal family may not really care if their child can count to 100, but if they can drop a child off and their child can find their way home, that was more important than adding one and one. So, what is important? (Scott)
>
> Learning outside the classroom: and taking it home, does it come back to what learning whānau value? (Neil)
>
> Whānau voice: is great. Currently, we dictate what they learn, and we decide what's in our curriculum. There's no co-construction of that at all, it's already pre-planned. (Scott)

Adding to the literature discussed in Chapter Three about effective pedagogy for Māori mathematics learners, Berryman and Eley (2017) share a system for shifting pedagogy to support the goal of ensuring learners are successful which seem to mirror what the kaiako are saying. *Ako: Critical Contexts for Change* is designed through three contexts working together. Culturally responsive and relational practices, deliberate professional acts, and collaboration between home, school, and community form "simultaneous success trajectories" (Berryman & Eley, 2017, p. 102). The purpose of considering these critical contexts is to enhance the ability for students to be successful learners while maintaining and sustaining their cultural identities.

Earlier and up to this point, the kaiako cycled through thoughts about the place of traditional teaching practices. As introduced in the previous chapter, the kaiako described traditional teaching as something they had worked hard to move away from. Initially, they suggested that

good mathematics teaching and learning looked like group work and non-traditional practices. For me, lecture style, independent work, individual tasks, instruction and task conducting interactions are all part of a range of pedagogical strategies that a kaiako can implement in the classroom. The idea that traditional teaching is "bad" is criticised by the kaiako:

> We've vilified traditional teaching practices, but you can do individual learning and that's mātauranga Māori rich too. (Gitana)
>
> There is still a place for traditional teaching in Maths. Some things must be told and practiced. (Scott)
>
> There is lots of nutting problems out together, but you've also got to have strategies to be able to do it on your own…so that you can be successful in multiple facets. (Neil)
>
> There is a whole array of ways [to learn], but the ultimate is that it needs to stick so you can apply that independently. (O'Malley)

They had interrogated the concept of traditional teaching and in the end realised that mātauranga Māori asked for pedagogy that was used purposefully. Improvements to educational success for all students can be made if education values more holistic ways of participating in learning and assessment opportunities (Bell, 2004). This concept is called Adaptive Expertise by Berryman and Eley (2017) and requires the pedagogist to apply "deliberate professional acts" responsively (p. 103). Berryman et al. (2018) also reiterate the necessity of responsive pedagogy saying that "[i]t is the over-reliance of any one strategy over others that is problematic" (p. 7).

Expectations of integrating mātauranga Māori in mathematics teaching and learning is discussed by the kaiako as being undefined. Because of this, they struggled to make connections to the directive and were fearful of getting it wrong. Simultaneously, they were hopeful of integrating "naturally occurring mātauranga Māori" (Gitana) through better connections with whānau and relevant learning opportunities.

## 6.6 Summary

This chapter titled *Te Huarahi Ki Mua|What Lies Ahead* presented the findings related to the meaning of mātauranga Māori from the perspective of the four kaiako involved in this study. Following this, an exploration of the classroom interactions they recalled were discussed in relation to current pedagogy literature. Finally, their emotions of fear and hope in relation to managing the seemingly ever-changing expectations of them in their practice as mathematics

kaiako in an English-medium setting, were synthesised leading to an acknowledgement of the purposeful and deliberate use of a range of pedagogical strategies.

The two findings and discussion chapters resolve the second and third research aims. The second research aim was to explore what mātauranga Māori means to kaiako. The third research aim was to consider the connections between mātauranga Māori and mathematics teaching and learning. Although the lead advisors were not able to share their voice for legal reasons (see Chapter Four), the narratives of O'Malley, Scott, Neil, and Gitana showed that there was a genuine desire to do better for their Māori learners. They also shared their apprehension for the undefined MOE directive of mana ōrite mō te mātauranga Māori. They had identified key shifts in education that had already occurred over their own tenure and hypothesised about future shifts. They recalled actions and changes they had made to their practice since becoming a kaiako. A final question was posed to the kaiako asking what it would look like if mātauranga Māori was visible in mathematics teaching and learning. Neil responded,

> "Everybody loves life, loves learning! The grades are great, there is no gap, and nobody leaves school early."

# CHAPTER 7 WHAKAARO WHAKATAU|CONCLUSION

Title definition: *Whakaaro Whakatau* translates to “closing thoughts”. The root words *aro* and *tau* are important. *Aro* is to “think” and *tau* in this case is used to mean “settle”. Settle thoughts may be a literal translation of this section and represents the concept of drawing a conclusion.

## 7.1 Introduction

This study explored the understandings of mātauranga Māori in mathematics teaching and learning for current mathematics kaiako. The three research aims were the following:

1. To understand the policy development leading to the directive of including mātauranga Māori in Aotearoa education.
2. To explore what mātauranga Māori means to kaiako.
3. To consider the connections between mātauranga Māori and mathematics teaching and learning.

This final chapter, Whakaaro Whakatau|Conclusion collates and summarises the two findings and discussion chapters. To do this, the major findings relevant to the three research aims will be shared. Following this, I will discuss the relevance and implications of the findings from this study to mathematics teaching and learning in Aotearoa, and for Māori learners. Finally, I will dedicate the final synopsis space for theorising future research opportunities.

## 7.2 Major findings from research

The findings and discussion chapters shared the journeys of four kaiako. Their narratives were thoughtful, and shared passions for learning, mathematics, and Māori learners. This section highlighted these narratives with respect to the three research aims which guided this thesis. While the research process seeks answers to questions posed, the answers found have raised further problems to investigate. That said, the kaiako narratives of hope and fear are shared. The findings from this research illuminate the need for continued observation and analysis concerning mātauranga Māori in mathematics teaching and learning.

### 7.2.1 A vision of equity and excellence

This thesis draws on critical education literature. As such, a major strength that this researcher relies upon is the belief that indigenous learners are capable of excellence in mathematics. To

clarify, excellence in this case refers to the description used by Gutiérrez (2017) as a state of being, a desire to learn that goes beyond grades on a test. As participants discussed, there is a potential for teaching and learning practices to enhance mathematics education, particularly for Māori learners. These narratives highlight a desire to strengthen mathematics learning and achievement for Māori, particularly for secondary learners in English-medium settings.

As discussed in previous chapters, the state of mathematics education in Aotearoa does not meet the needs of many Māori learners. During the focus group discussion, it was evident that the kaiako had been on a journey of being considerate of their school's Māori population and that there had been many shifts in their practice over the years toward better provision for their Māori learners. The kaiako reflected on a time when teachers used predominantly what they called traditional teaching such as directed instruction and non-discursive activities. Through participation in Te Kotahitanga, they had introduced pedagogical practices which allowed learners to be actively included in the learning environment. This looked like sharing power, being culturally relational, and allowing sense-making through discourse. These interactions enhance opportunities for mathematics learners to self-define excellence.

Building on seeking excellence in mathematics, mātauranga Māori allows learners and kaiako to participate in a culturally rich and distinct learning environment, enhancing equity. Recalling positive relationships with their own teachers, the kaiako recognised the impact whanaungatanga and manaakitanga have in the classroom. These perspectives reflected the work of Bishop and Berryman (2006), Durie (2011), Riwai-Couch (2021), Smith (1992), for example, as they encourage education partnerships between school and home to empower Māori learners, their whānau, and kaiako to meet their aspirations. The kaiako in this study were passionate about purposeful and relational learning opportunities demonstrating a hopeful perspective. The following three sections discuss the narratives of fear of the unknown.

### 7.2.2 Kaiako perspectives on mātauranga Māori

The second research aim was to explore what mātauranga Māori means to kaiako. The kaiako initially shared apprehension about what they knew about mātauranga Māori and eventually constructed interpretations associated specifically with activities within the classroom. As a first-time researcher, I missed an opportunity to investigate further why mātauranga Māori tended to relate to teaching and learning for the kaiako, and not to more general interactions

outside the school environment. My interpretation of this finding is that mātauranga Māori is a concept lived in Aotearoa education and has yet to be understood outside of that space. That said, the kaiako-constructed definitions of mātauranga Māori were considerate of ākonga and their participatory role in mathematics teaching and learning. Similarly, the kaiako showed understanding of the potential benefits to learning that whānau can contribute and hoped to connect mathematics learning to the aspirations of whānau and life outside the classroom. They also discussed an example of an unapologetically Māori school in Kia Aroha College as they tried to conceptualise what a mātauranga Māori school looks like.

Initially anticipated, the complexity of the term mātauranga Māori was reflected in the discussion content from the participants. This complexity without adequate support or clear definitions means that kaiako are essentially making their own meaning. Providing clarity around definitions of mātauranga Māori in mathematics teaching and learning, including examples, was discussed as a possible way to avoid unnecessary fear and confusion. Participants felt that MOE had offered little support. However, as discussed in the literature review, the complexity of what mātauranga Māori means makes it difficult to define in simple terms and attempting to do so may limit the potential the term has on mathematics education in English-medium secondary settings. While this thesis project is small, it highlights the lack of confidence the kaiako participants have in understanding what mātauranga Māori looks like in the mathematics classroom.

### 7.2.3 Te ao pāngarau and te ao Māori

Emerging in the research process was confusion around the connections between te ao Māori and te ao pāngarau. Relating to the third research aim of connecting mātauranga Māori to mathematics teaching and learning, it was difficult for the participants to make explicit links between mathematics content and Māori knowledge that went beyond contexts alone. These concerns highlight two things: firstly, that the meaning of mātauranga Māori is misunderstood as being pre-colonisation Māori knowledge, and secondly, that mathematics is accultural.

In the first concern, where the meaning of mātauranga Māori is misunderstood as being pre-colonisation Māori knowledge, the participants discussed a fear of being inadequate, and that they “don’t know any different” (Neil). English-medium education as it looks today grew through a whakapapa of targeted assimilation policies. Despite working on introducing and implementing Treaty of Waitangi principles, and seeking bicultural solutions to

underperforming Māori learners, educators are still somewhat stuck in a colonial system. To shift this, the direction of implementing mana ōrite mō te mātauranga Māori focuses education actions on ensuring Māori are safe to be Māori in their learning experiences. However, this poses challenges for kaiako who are simultaneously uncertain about the components of Māori culture and have been educated within the system to which they now belong, as highlighted by Neil's statement.

The second concern relates to the accultural nature of the school discipline of mathematics. There is a misconception that mathematics serves as an open door to all cultures, leading to the belief that there is no need to give special attention to one culture over others. This misunderstanding ignores literature defining mathematics as a multiculturally constructed discipline (Kindersley, 2019; Lukoff & Núñez, 2000; Niss, 1994). This perspective also ignores the overrepresentation of indigenous learners across the globe who are ostracised from mathematics learning. Although only one part of the picture toward equity and excellence, the achievement data makes an argument for accultural mathematics difficult. Certainly, our data implies mathematics teaching and learning privileges non-Māori learners. Having discussed the impacts of shifting away from streaming in mathematics as a solution, the kaiako acknowledged how introducing more contexts linked to “real life” can assist purposeful mathematics learning.

### 7.2.4 Recommendations

During the focus group discussion, it became clear that there had been a lack of support that went along with the directive of mana ōrite mō te mātauranga Māori. An extra question was posed to the kaiako asking what support they needed to enable them to meet the MOE directive. O’Malley challenged MOE to establish professional learning opportunities across Aotearoa to support learning to understand how the directive is implemented in teaching and learning. This perspective highlights the ambiguity of the directive in terms of how it translates into deliberate acts within the classroom.

Beginning as teachers and growing into kaiako, a surprising finding involves the role learn-to-teach institutions have in growing kaiako from the start of their careers. All kaiako participants reflected on their teaching college learnings as being notably absent of cultural competency, particularly in the mathematics specific course. It comes as no surprise then, that the kaiako are making meaning of the directive themselves. Increasing the capacity of tertiary education

to train teachers to facilitate learning in the mathematics classroom in a way that is more reflective of our bicultural Aotearoa would also grow kaiako who are critically aware of all cultures.

Thus far, MOE have introduced webinars aimed at sharing discussions centred around mana ōrite mō te mātauranga Māori which can be found on their NCEA webpage, but these resources were yet to be delivered when the focus group discussion occurred. The recent release of the Common Practice Model which describes how to teach effectively uses education praxis literature such as culturally responsive and sustaining, critical pedagogy, communicative, and planned learning opportunities. This resource is hoped to provide kaiako with pedagogical practices that enhance their capability of opening their classrooms to mātauranga Māori.

## 7.3 Relevance of findings

As discussed in Chapter Three, the achievement of a nation's learners in mathematics is an indication of its success as a nation (Golding, 2018; Niss, 1994). Success in mathematics is of particular interest, and the achievement of indigenous learners in mathematics is an issue for many nations globally. Thus, the findings of this study are relevant. They provide a challenging depiction of how secondary mathematics teachers in English-medium spaces are receiving the directive of mana ōrite mō te mātauranga Māori. Although specific to the experiences of teachers in Aotearoa, these findings are an informative addition to both local (Aotearoa) and international literature where the mathematics education of indigenous learners are concerned. This research demonstrates a common confusion regarding the implementation of mātauranga Māori in mathematics classrooms, and the ongoing dedication and hope kaiako have of doing better for their Māori learners. Perhaps due to the complexities of definitions around mātauranga Māori, this research rests on the potential implication of clarifying this concept and thus, alleviating confusion within the mathematics teaching sector here in Aotearoa. From an international perspective, this research offers a warning to state education policy writers of ensuring timely support for any changes to teacher expectations is part of the implementation plan from the beginning. Finally, this research provides an insight into the potential mātauranga Māori has in extending mathematics as a discipline. The role of MOE will be to ensure mathematics kaiako are well supported, resourced, and guided to do this without fear.

As discussed previously, there exists ample literature regarding mathematics education, and a growing literature base about mātauranga Māori. Although rare in comparison, the literature connecting mathematics education and mātauranga Māori is growing too. With changes to curriculum and assessment in Aotearoa education occurring currently, it is vital that research both reviews and explores the impacts of these shifts to ensure better outcomes for learners. This research has added to the current literature in terms of exploring the understandings of mathematics teachers but there remains unanswered questions that can be explored in future research.

## 7.4 Suggestions for further research

Although this research is satisfied that its core question of sharing the story of mathematics teachers of Māori ākonga in terms of mātauranga Māori in secondary mathematics teaching and learning has been answered, there remains a significant amount of research yet to be done in this area.

One suggestion for future research would be to complete the initial research triangulation with lead advisors at MOE. As enactors of the strategic changes occurring in mathematics assessment and curriculum, their perspective would have offered a more rounded investigation. Despite this, the findings from this thesis offers a foundation for future research into the explicit inclusion and integration of mātauranga Māori in English-medium mathematics classrooms, and indeed, in other English-medium learning contexts.

Future research which will assist in exploring explicit inclusion and integration of mātauranga Māori in English-medium mathematics classrooms could involve gauging learner's experience. Although this thesis sought the understandings of educators, a gap in the literature existed where learner experience was concerned. Any research into understanding learners' perception of mathematics teaching and learning would be a great benefit to education literature. Similarly, to be investigated further, is the academic impact of integrating mātauranga Māori into mathematics teaching and learning. For all research into education, consideration must be given to the impact on student achievement. Notions of equity and excellence can be utilised as measurement tools to broaden the scope of what success in academia is. Investigation that solely focuses on data attained from assessment systems will not offer a full picture of success in education. This is particularly true for indigenous learners.

Future research in this area would also benefit from increasing the sampling size and sample frame. As this research is concerned with the understandings of mathematics kaiako who teach Māori learners, this research would have been enhanced if other participants had been invited. Also, as this thesis was built around the experiences of the researcher's whānau of interest (see Chapter Four), there exists an opportunity to enhance findings by posing the research questions to members outside this whānau. For example, other schools across Aotearoa may have liked to participate in this study. Their contribution would have offered depth to the findings.

It must not be forgotten that a significant part of the investigative phrase this thesis stems from has been deliberately left out of this exploration. Mana ōrite provides ample opportunity on its own for future research. A study considerate of its inclusion would benefit the literature. Mana ōrite mō te mātauranga Māori is worth time and resources to explore the implications of this change on education here in Aotearoa. These findings would then be applicable to any minority and indigenous group who are ostracised from education.

A final area of interest that was brought up in the later stages of the focus group discussion was the relationship between Kura Kaupapa Māori and English-medium education experiences. There exists some literature on mathematics education in Māori-medium settings which this thesis relied upon. However, there is limited literature that compares or connects Māori-medium mathematics learning with English-medium learning. There is potential here to open doors to both settings to seek understanding, sharing knowledges, and ensuring the education we provide our learners benefits them.

## 7.5 Closing thoughts

Exploring the understanding of mātauranga Māori for mathematics kaiako has been a thought-provoking experience. Although this thesis has been a difficult task to undertake alongside the needs of having a full-time teaching workload (including extra-curricular responsibilities) and managing a demanding homelife, the conversations that have occurred from its development have shifted the way I think. For this, I am grateful and hope that within this piece of writing lies the potential to shift the thinking of others.

Overall, the exploration of mātauranga Māori found that there is a diverse and rich definition. Moving toward an understanding of mātauranga Māori as a dynamic and evolving system of

knowledge creation (Mead, 2012) suits its literal meaning as the weaving together of knowledges. Weaving together our shared journeys as kaiako, this thesis highlights an opportunity for the Ministry of Education to better support the shifting education culture here in Aotearoa. For me, this research offers two challenges. Firstly, I am challenged to support English-medium kaiako to be comfortable with the concept of mātauranga Māori, particularly in Mathematics. Ultimately, I am challenged to advance Māori in Mathematics.

# TE PUNA KUPU|GLOSSARY

Title definition: *Te Puna Kupu* is a metaphor for this glossary of Māori terms. Its literal translation is “the pool of words”.

To help understand a title, word, or sentence, meanings of Māori words have been provided in the text if necessary. Translations of Māori words have been provided in brackets after their first use unless they appear in a quotation.

The English translations of Māori words in the glossary are taken primarily from the Te Aka Māori-English, English Māori Dictionary (Ngata, 1993).

| | |
|---|---|
| ako | reciprocal learning, teach, learn |
| ākonga | learner, used to identify school student(s) |
| Aotearoa | common Māori name for New Zealand. Means “land of the long white cloud” |
| ara | path |
| aroha | deep caring, love, compassion, empathy |
| aroha tētahi ki tētahi | look after each other |
| awhi, āwhina | to assist, help |
| huarahi | path, pathway, direction |
| iwi | extended kinship group tribe nation people |
| Ka Hikitia | To Raise: The Māori Education Strategy |
| kaiako | facilitator of learning |
| Kaupapa Māori | Māori ideology - a philosophical doctrine incorporating the knowledge skills attitudes and values of Māori society. |
| koha | gift |
| Kōhanga Reo | language nest, Māori language preschool. |
| kōrero | to speak, a speech story, discussion |
| kura | school |

| | |
|---|---|
| Kura Kaupapa Māori | school operating under Māori custom and using Māori as the medium of instruction |
| mana | Prestige, authority, control, power, influence |
| mana motuhake | separate identity, autonomy |
| manaaki | to support, take care of |
| manaakitanga | hospitality, kindness, caring |
| Māori | indigenous person of Aotearoa New Zealand, normal |
| Māoritanga | culture practices and beliefs related to being Māori |
| mātauranga | to weave knowledges to create new knowledge |
| Pākehā | New Zealander of European descent |
| pou | support beam, pole |
| rangatiratanga | sovereignty, chieftainship, right to exercise authority |
| rāranga | to weave |
| reo | language |
| tangata | person |
| tangata Tiriti | Treaty partner, refers to signatories of The Treaty of Waitangi |
| taonga | treasure, treasured |
| tapu | be sacred, prohibited, restricted, set apart, protected |
| Te ao Māori | the Māori world |
| Te ao Pāngarau | the world of maths |
| Te reo Māori | the Māori language |
| Te Tāhuhu o te Mātauranga | Ministry of Education |
| Te Tiriti o Waitangi | the Māori-language treaty signed in February 1840 by representatives of the British Crown and various Māori chiefs from the North Island of NZ |
| teina | younger brother (of a male) younger sister (of a female) younger cousin (of the same gender) |
| tiaki | to guard, keep |
| tikanga | correct procedure, custom |
| tino rangatiratanga | self determination |

| | |
|---|---|
| Treaty of Waitangi | the English-language treaty signed in February 1840 by representatives of the British Crown and various Māori chiefs from the North Island of NZ |
| tuakana | elder brother (of a male) elder sister (of a female) older cousin (of the same gender) |
| wānanga | to meet and discuss. Seminar conference forum a tertiary institution school |
| wero | challenge |
| whakapapa | genealogy |
| whānau | to be born, extended family, group |
| whanaungatanga | relationship, kinship, sense of family, connection |
| whare | house, building |

# PUNA KŌRERO|REFERENCES

*Puna Kōrero* is a metaphor for this reference list. Its literal meaning is the "pool of readings". This title acknowledges the beauty and depth of the literature that has been utilised in this exploration.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# APPENDICES

## Appendix I Research Information

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato
TE WĀNANGA TOI TANGATA
DIVISION OF EDUCATION

### *Research Information*

**The mātauranga Māori in Mathematics directive: Exploring the place of mātauranga Māori within mathematics teaching and learning.**
**Researcher** – Jessica Williams

1. This project is part of a Master of Education thesis being undertaken in the School of Education at the University of Waikato. This research proposal has also been approved by the Human Research Ethics Committee of the School of Education.
2 I would like you to participate, for approximately 1.5 hours, in a focus group setting to discuss your understanding of mātauranga Māori and mathematics teaching and learning, focusing on what this means to you.
3 Prior to the focus group discussion, a whakawhanaungatanga hui will be held with individual participants to allow time and space to question the research and clarify concerns associated with the consent form requirements.
4 Two weeks following the focus group discussion, a written transcript will be reviewed by individual participants to assess the accuracy of the transcription.
5 I would like to audio-visually record the group's discussion so I can accurately capture the narrative you share. You will have control over how long you would like the discussion to be. You will be given the option to delete or alter your own contributions to the group discussion so long as it does not impact on another participant's contribution. Where it does, the research will negotiate with affected participants to gain mutual agreement.
6 Your recording will be stored in a password-protected USB drive. Only myself and my supervisor will have access to the recordings.
7 You can remain anonymous in this research if you wish. You may choose a pseudonym, or one will be chosen for you.
8 The research will involve one group discussion at a venue of the group's choice, or it can be arranged. The data will be gathered from the discussions had in the group discussion.
9 The method of data collection is dialogic, conversative, and reflexive (a) through a semi-structured group discussion (b).
    a. Dialogic, conversative, and reflexive allows an exploration of thought to occur, collectively constructing meaning.
    b. A focus group discussion allows you to utilise and build on each other's thinking.

10 We will hold joint copyright over the recording that results from the discussion.

11 If you agree to take part in this discussion, you have the right to:

a) refuse to answer any particular question, and to terminate the discussion at any time;

b) ask any further questions about the discussion or research project that occurs to you, either during or at any other time;

c) remain anonymous should you so choose – anything that might identify you will not be included in conference papers, academic articles or any other report about the findings of the research; and,

d) take any complaints you have about the discussion or the research project to the researcher in the first instance (contact details below). If the complaint remains unresolved, seek assistance from the research supervisor (contact details below).

Please consider participating in this research. Follow-up contact will be arranged in two weeks to allow you adequate time to consider participating. You will also have an opportunity to ask questions and clarify concerns.

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*This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 13 April 2022. Approval number: FEDU016/22*

# Appendix II Invitation and Information Letter

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato
TE WĀNANGA TOI TANGATA
DIVISION OF EDUCATION

## Invitation and Information Letter: Principal

Kia Ora *Leader Name*,
My name is Jessica Williams. I am a mathematics teacher at Gisborne Girls' High School and have been teaching for ten years. I am currently working toward a Master of Education and am conducting research into mātauranga Māori in mathematics teaching and learning.

I would like to discussion three mathematics teachers from your school and would like you to extend support for your staff to participate.

To explore this topic, I will conduct a group discussion with the participant teachers. This research will be undertaken within a culturally responsive framework, informed by critical and Kaupapa Māori theories. Supporting participation in this study will help contribute to the field of knowledge around teaching and learning designed to improve outcomes for Māori students in English-Medium settings in Aotearoa.

What do you need to do? I need the schools support to conduct this research. If you support this research project, please let me know. Once your support is received, I will approach and invite teachers to participate. You can also support this research by allowing the group discussion to be conducted within your school in a space chosen by the participant teachers. The school's Covid procedures will be followed.

I am happy to answer any questions or concerns you may have regarding supporting participation in this research project.
Ngā mihi mahana,
Jessica Williams


**Research Supervisor**

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*This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 13 April 2022. Approval number: FEDU016/22*

# Appendix III Consent Form

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato
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DIVISION OF EDUCATION

## Consent Form for individual participants

This is a consent to participate in the research project titled *Exploring the place of mātauranga Māori within secondary mathematics teaching and learning*, conducted by Jessica Williams who has discussed the research project with me.

I have received, read, and kept a copy of the information letter. I have had the opportunity to ask questions about this research and I have received satisfactory answers. I understand the general purposes, risks, and methods of this research.

- I agree to participate in a focus group discussion at an arranged time and place that suits.
- I understand that it is my free choice to participate, and I can withdraw my participation and/or my individual data at any time up until I have approved the group discussion transcript.
- The researcher will work with me to handle the withdrawal of data as carefully as possible and if necessary, consult again with the participants who are remaining in the study to ensure a complete and appropriate final transcript after the removal of contributions.
- I understand that the discussion will be audio-visually recorded but that the use of a pseudonym for written data is an option to protect my identity in any material gathered from this project.
- I understand that I have a responsibility to protect the confidentiality of all participants including their identity and the content of our discussions.
- I understand that contact tracing for COVID affects my anonymity.
- I consent to the information obtained being used as part of the requirements of the researcher's thesis and any subsequent publications and/or conference papers.
- I understand that while every effort will be made to protect the anonymity of all participants, this cannot be guaranteed.

**Name:** _____ (please print)

Signature:

_____

Date: _____

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# Appendix IV Focus Group Consent

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato
TE WĀNANGA TOI TANGATA
DIVISION OF EDUCATION

## Focus Group Consent

**The mātauranga Māori in mathematics directive**

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, my questions 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 understand that I have an obligation to respect the privacy of the other members of the group by not disclosing any personal information that they share during our discussion.
2. I understand that all the information I provide will be kept confidential to the extent permitted by law, and the names of all people in the study will be kept confidential by the researcher.
3. I understand that there may potentially be other participants such as language experts or support people who attend the focus group discussion or confidentially translate the data.

*Note: There are limits on confidentiality as there are no formal sanctions on other group participants from disclosing your involvement, identity or what you say to others in the focus group. There are risks in taking part in focus group research and taking part assumes that you are willing to assume those risks.*

4. I agree to participate in the focus group under the conditions set out in the Information Sheet attached as Appendix I.

**Declaration by Participant:**

I _____ [print full name]_____ hereby consent to take part in this study.

**Signature:** _____ **Date:** _____

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## Appendix V Confidentiality Agreement

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato
TE WĀNANGA TOI TANGATA
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# Confidentiality Agreement

Language expert

Project title: The mātauranga Māori in mathematics directive: Exploring the place of mātauranga Māori within mathematics teaching and learning.
Project Supervisor: **Katarina Edmonds**
Researcher: **Jessica Williams**

- ○ I understand that the discussions meetings or material I will be asked to translate is confidential.
- ○ I understand that the content of the discussions meetings or material can only be discussed with the researcher.
- ○ I will not keep any copies of the translations nor allow third parties access to them.

Language expert's signature :
.....
Language expert's name :
.....
Language expert's Contact Details (if appropriate):
.....
.....
.....
.....
Date:

**Contact information**


**Research Supervisor**

| | |
|---|---|
| Name | Katarina Edmonds |
| Role | Lecturer |
| University Dept | Education |
| University | Waikato |
| Email | katarina.edmonds@waikato.ac.nz |
| City | Hamilton |
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**Researcher**
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Appendix VI Guiding Questions

THE UNIVERSITY OF WAIKATO
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TE WĀNANGA TOI TANGATA
DIVISION OF EDUCATION

# Guiding Questions

Project title: The mātauranga Māori in mathematics directive: Exploring the place of mātauranga Māori within mathematics teaching and learning.
Project Supervisor: **Katarina Edmonds**
Researcher: **Jessica Williams**

**The overarching questions that will guide this research**
What do teachers of mathematics understand about mātauranga Māori within mathematics teaching and learning?

**Key questions guiding focus group discussion**

1) What is your understanding of mātauranga Māori?

2) What similarities can you draw between mātauranga Māori and mathematics teaching and learning?

3) What differences can you draw between mātauranga Māori and mathematics teaching and learning?

4) What connections can you make between mātauranga Māori and mathematics teaching and learning?

**Are there any questions you think will be beneficial to discuss?**

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