Ethics of Care in the Mathematics Classroom

A thesis presented in partial fulfilment of the requirements for the degree of Masters in Education (Māori Education)

at Massey University, Palmerston North, New Zealand.

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Date: 20 February 2022

Abstract

Ethics of care is a complex and critical element of educational theory and practice which is commonly misunderstood by teachers across all subject areas. Teachers understanding and mindset towards ethics of care is reflected in their utilisation of classroom practices of care. Whilst there are numerous indigenous voices championing various approaches to care for those working with Māori and Pāsifika students, implementation of these practices in the New Zealand educational context is inconsistent and there remains significant achievement gaps between different groups of ethnicities. One programme aiming to address the way in which care practices are utilised in mathematics is Developing Mathematics Inquiry Communities programme of professional learning and development.

Through the lens of relational and critical race frameworks as influenced by feminist theory this study used a qualitative approach to examine the elements of teacher mindset toward ethics of care in mathematics and explored the impact which participation in professional learning and development has on these mindsets. Through semi-structured interviews, practices of care utilised in the classrooms of mathematics teachers of year five and six students were identified. In total three teachers at varying stages of their teaching careers and varying lengths of Developing Mathematics Inquiry Communities participation were interviewed.

An examination of literature relating to ethics of care, Developing Mathematics Inquiry Communities professional learning and development, and current practices of care in the context of New Zealand mathematics classrooms was undertaken. This identified several practices of care currently used by New Zealand mathematics teachers working with Māori and Pāsifika students such as: use of mixed-ability grouping, student-centred learning practices, community and whānau involvement in mathematics learning, and place-based mathematics contexts. Utilisation of each of these practices was described by interview participants as a response to their participation in professional development.

Through better understanding of the nature of ethics of care, how professional development impacts on teacher mindset toward ethics of care and identifying successful practices of care for teachers of Māori and Pāsifika students in mathematics classrooms, teachers engaging in professional development will be better equipped to implement and enhance practices of care in their own classrooms.

Preface and Acknowledgements

I would like to extend my utmost thanks and appreciation to all of those who have made this journey to getting my masters possible.

There are not words to convey the level of support I have received from both Dr Roberta Hunter and Dr Jodie Hunter. Dr Roberta Hunter's unwavering belief in my capacity to achieve this goal has been a motivating force throughout. Your kind words and encouragement have kept me moving even during times where I thought I may never reach the end. Dr Jodie Hunter's ability to offer just the right push at the right moment or suggest the perfect reading to unstick what had become stuck was invaluable. You have both pushed me to achieve more than I thought I was capable of, and I will be forever grateful.

A number of schools, principals and teachers were involved throughout the course of this research. Without their enthusiastic support and gracious sharing of their time and knowledge, none of this would have been possible. I look forward to nurturing and continuing these relationships throughout my teaching career.

Thirdly, I would like to acknowledge Massey University and the Massey University Institute of Education for gracing me with the Pathways Scholarship and the Massey University Masterate Scholarship respectively. The support provided by these scholarships has enabled me the resources and freed up time to dedicate to my studies that would not have otherwise been available.

Finally, I want to thank my family for all they have been through with me on the path to graduation. My mum, Diane who has been there for both me and for my daughter at times when I could not be. My partner Shayne who has persevered, been supportive, and acted as a sounding board so many times I'm sure he feels like he's earned a masters himself.

To everyone who has helped me achieve this momentous goal, know that this is your achievement as much as it is mine.

Table of Contents

List of Tables

List of Figures

1.0   Introduction

1.1   Introduction

This chapter provides the context of the current study. It looks into the New Zealand educational environment, in which this research takes place. Section 1.2 examines the contextual aspects such trends in the mathematical achievement of New Zealand students, persistent inequity of attainment levels between ethnicities, and foundational inequalities in the mediating structures of the education system. The need for further research into ethics of care is delineated. These aims are set out in the research objectives of section 1.3. In section 1.4 definitions of critical terms used throughout this thesis are circumscribed. Section 1.5 provides an outline of each chapter's contents.

1.2   Context of study

In recent years the mathematical attainment of New Zealand students has been declining in many of the national and international monitoring tools. In the Programme for International Student Assessment [PISA] the scores of secondary school aged students in New Zealand has dropped 29 points since 2003 (Education Counts, 2021). Similarly, the Trends in International Mathematics and Science Study [TIMSS] has shown a decline in year nine mathematical achievement year on year beginning in 1994 (Te Kete Ipurangi, 2020). The National Monitoring Study of Student Achievement [NMSSA] has consistently reported a decline in the percentage of New Zealand students meeting minimum curriculum expectations in mathematics between years four (81%) and years eight (45%) (Te Kete Ipurangi, 2019).

In addition to the ongoing decrease in New Zealand's mathematical achievement overall, there is significant evidence that the education system is failing its Māori and Pāsifika students at even greater rates (Gutiérrez, 2006; Milne, 2013; Penetito, 2010). The latest PISA results display a 56-point difference between Māori and Pākehā achievement scores with the average New Zealand student scoring 494 points. Pākehā

students scored on average 507, Māori students 451 and Pāsifika 433 (Education Counts, 2021). In 2018 a UNICEF study found that New Zealand has one of the highest rates of inequality in education, finishing well into the bottom third of the 38 developed countries included, across early childhood, primary and secondary education (Chzhen et al., 2018).

An overwhelming avalanche of academic literature and educational experts agree this inequality is woven into the mediating structures on which New Zealand's education system was built (Gutiérrez, 2006; Milne, 2013; New Zealand Human Rights Commission [HRC], 2017; Penetito, 2010). Efforts to combat these inequalities have led to researchers developing programmes of professional learning for teachers which aim to address issues of culturally sustaining practice. One such programme, Developing Mathematics Inquiry Communities [DMIC], is constructed upon ethics of care (Hunter & Hunter, 2017).

Ethics of care appears to be an area with limited examples of current research in the New Zealand environment. Expansion of research into this subject is important for programmes of teacher learning and development which aim to address care practices in mathematical teaching aimed at Māori and Pāsifika students. A large majority of teachers in New Zealand are Pākehā (Ministry of Education, 2020). There are numerous challenges and ethical complexities for teachers from a dominant and colonial culture working with students of marginalised cultures (Assembly of Alaska Native Educators, 1998; Bennoun et al., 2018; Gutting, 2013; Heath et al., 2019; MOE, 2013-2017; Pratt, 1991). Understanding key kinetics of ethics of care and pinpointing elements of successful care practices in mathematics teacher's exchanges holds practical value for application in shifting the direction of the New Zealand education system (Dison, 2018).

Consequently, this research aims to examine the enactment of ethics of care practices within the classrooms of teachers involved in programmes of professional learning and development [PLD] in mathematics. It seeks to identify important components of ethics of care in action. This study aspires to add to the cumulation of New Zealand

research into care based PLD programmes such as DMIC and provide direction for ethics of care practices in mathematical teaching and learning.

1.3 Research Objectives

The main objectives of this study are to explore ethics of care and the enaction of practices of care within New Zealand year five and six mathematics classrooms. Understanding which care practices are being used by teachers who have participated in culturally sustaining PLD will help teachers beginning such PLD journeys as those within DMIC, to understand and more easily emulate successful practices of care in their own mathematics teaching.

Therefore, the study has been constructed to address the following qualitative research questions:

- What do teachers who have undertaken ongoing professional learning and development in mathematics perceive as critical aspects of ethics of care?

- What practices do mathematics teachers use to enact ethics of care with Māori and Pāsifika students in New Zealand classrooms?

1.4 Definition of Terms

The following definitions are set out to remove ambiguity by illuminating the intent of their use throughout this research study thus creating a shared understanding between the author and the audience:

Māori, is used throughout this research study as an ethnicity intended to define any person who can whakapapa (genealogically link) back to ancestors migrating from Hawaiki (Smith, 2011). Māori are tangata whenua, the indigenous people of New Zealand, whose ancestors lived in Aotearoa prior to the arrival of Europeans in 1642 (Ministry for Culture and Heritage, 2019; Wilson, 2005). In Te Reo, the word Māori did not exist until after contact with Europeans occurred. Prior to this Māori referred to

themselves using the names of their Iwi and hapū to distinguish different groups of (Māori) people. Its meaning stems from the need to distinguish Māori people, as a group disparate from European, or Pākehā, people. In Te Reo, Māori means ordinary, usual or common (Māori Dictionary, 2003-2020a). Although referred to under a single term, the word Māori is acknowledged as representing a non-homogenous group made up of many Iwi, hapū and whānau groups all of whom have unique characteristics (Jones, 2017).

Pāsifika, is also an ethnic appellation which encompasses a range of diverse groups. New Zealand as a country has the largest population of Pāsifika people in the world and use of the word Pāsifika is unique to New Zealand. Other countries most commonly use the term Polynesian to refer to those of Pāsifika origin (Lemanu, 2020). In Aotearoa, the term is used to include indigenous peoples from Pacific islands other than New Zealand and Australia (whose indigenous peoples are referred to as aboriginal). This includes both first generation immigrants and those of multi-generation Pāsifika lineage born in New Zealand. The Pacific islands include (but are not limited to) Fiji, Samoa, Tonga, the Cook Islands, Tuvalu, Tokelau, and Niue. The peoples of the Pacific islands share ancestral links with New Zealand's Māori peoples, but each have their own distinct cultural traits, traditions and languages (Te Kete Ipurangi [TKI], n.d.).

Pākehā, is a term with a history of controversy. It is used throughout the current study to denote a person of European heritage dating back to the arrival of Europeans to New Zealand in the 17th and 18th centuries (Ministry for Culture and Heritage, 2020). According to Mitcalfe (2008), Morrison (2019), and Ranford (2015), the word Pākehā came into common usage prior to 1815 and was used by the Māori people to distinguish the new European settlers from the Māori iwi who already inhabited the land. Pākehā itself is a word originating from Te Reo Māori language which forms some of the objection by those who assert that their ethnicity should be labelled from within their own language (Marcetic, 2018). Morrison states that others contend the word itself carries an offensive meaning and was derived as an insult. Ranford espouses that the exact genesis of the word Pākehā has been lost with time. However, the most

widely held history of the word suggests it occurred as an abbreviated form of pakepakehā, mystical beings who were said to take pale forms and possess waka that could change into sailing boats (Māori Dictionary, 2003-2020b). Ranford suggests experts who have delved into its history have found no originating connection to derogatory terms. In accordance with the work of Mitcalfe, this study makes use of the word Pākehā to draw on the fact that New Zealand citizens of European descent are distinct from and inhabit a differing ethnicity from British citizens of today as well as to distinguish them from other ethnic groups residing within New Zealand. Like Mitcalfe, it also draws on the bicultural nature of Aotearoa society and emphasises both the connections and differences between Pākehā and Māori, the concepts of which each rely on each other in shaping their meaning.

1.5   Chapter Overview

Chapter two provides a succinct overview of existing literature and research relating to the current study. Firstly, it examines the current knowledge base on ethics of care. Next, an overview of the DMIC programme for teacher PLD is outlined. Finally, current ethics of care practices used in New Zealand classrooms are given detailed exploration.

Chapter three outlines the study's research design and methodology including justification for utilisation of qualitative interviews and video recording. The role of the researcher is also defined. The setting, sampling and timeline are supplied along with explanation of data collection processes and data analysis procedures. Lastly explanation of the reliability, validity and ethical tenets of the study are set forth.

Chapters four and five present the findings of the study and provide discussion of the interview analysis in relation to the literature presented in chapter three. The analysis is presented through four key themes. The themes of teacher mindset and perceived student response to practices of care encapsulate perceptions of care and are explored in chapter four. Chapter five discusses the themes of teacher

implementation of practices of care and contexts of care which incorporate enaction of care.

In chapter six the implications for these findings are set out; how ongoing PLD can support shifts in teachers' mindsets toward ethics of care, and the value of identifying specific practice of care used in the mathematics classrooms to guide teachers at the beginning of their professional development journeys. The limitations of the current study are acknowledged before potential future research directions stemming from this research are mapped out. Lastly, the researchers concluding thoughts are expressed.

2.0   Literature Review

2.1   Introduction

This chapter elucidates the rationale for the chosen research direction by examining the body of available research and literature both current and historic (seminal). In section 2.2 the preponderance of misunderstanding amongst educationalists and the importance of ethics of care as a decolonising agent within the education system is explored. Section 2.3 supplies an outline of the DMIC teacher PLD programme and the literature supporting its use within Aotearoa (New Zealand). Ethics of care practices in current use within New Zealand's educational contexts are examined in section 2.4. Finally, section 2.6 provides a summarisation of key points.

The works explored cover research from both New Zealand and international contexts. Whilst the body of research encompasses all sectors of education from early childhood through to tertiary, this study will have a particular focus on primary level schooling (years 1-8).

2.2   **Ethics of Care**

Ethics of care is delineated within the literature both as a crucial part of teaching mathematics, and as critical to quality teaching as a whole (Bennoun et al., 2018; Nicholson & Kuruez, 2019; Noddings, 2005). However, it is also highlighted as an area populated with commonly held misunderstandings by Hunter and Hunter (2017), Macgill and Blanch (2013), and Tosolt (2008). Hunter and Hunter admonish that such misunderstanding by teachers can lead to misapplication of pedagogy and a break down in the attempted implementation of care. To define ethics of care, it must first be understood what is meant by both 'care' and 'ethics'. There are many nuanced and differentiated definitions from many different authors for both terms.

Care is an ingrained part of human social interaction and a key part of what makes us human (Heidegger, 1962). Noddings (2005) explains care as an exchange between people in which one attentively perceives the others need/s and acts to alleviate the identified need/s. This is met with a response from the recipient to show that care has been received. According to Noddings, care is both relational and contextual, ergo it is an impossibility for care to occur in the thoughts or actions of an individual independently. Rather, care requires a reciprocity between both the 'carer' and the 'cared for' (Tosolt, 2008). In situations where a 'carer' performs actions intended as caring, but which are not received or perceived as caring by the 'cared for', Noddings specifies that caring cannot be said to have occurred. For care to take place Noddings asserts, there must be both action of the carer (elicited through motivational displacement) and reception, recognition, and response to the action on the part of the cared for. Thus, rather than being an action or virtue that is performed, Noddings views care instead as the state of a relationship.

An important point made by Noddings (2005) in relation to the labels of 'carer' and 'cared for' is that these titles are transmutable and non-fixed. Care is given and received by both parties with each acting as both carer and cared for interchangeably.

Whom this relationship exists between is debated throughout the literature. Whilst some experts such as Noddings (2005) views a relationship of caring as a familial one between two parties, such as that of a mother and child, others, like Tronto (1993), diverge by suggesting that a caring relationship is able to exist between a carer and multiple cared for parties. In addition to this, Tronto considers caring relationships as also occurring outside of familial bonds such as the example of a teacher in the role of carer with numerous students in the role of cared for.

Another key point raised by both Noddings (2005) and Tronto (1993) in relation to care is the individual nature of each care relationship. Tronto discusses how it is important to recognise that individuals perceive care differently dependent on their own cultural, emotional, gendered, political, economic, and experiential backgrounds. Therefore, caring relationships require awareness and careful navigation of ethical

elements and where applied successfully, can act as a decolonising practice (Hunter & Hunter, 2017).

Ethics is concerned with the decision-making processes behind conduct as well as the rationalisations of such conduct. Ethics stems from the axiology branch of philosophy and holds its base in the notions of what is right and what is wrong (Fieser, n.d.). Whilst ethics deals closely with moral philosophy in its inquiry into questions of human morality, Malone (2020) emphasises it as a distinct intellection from the concept of morals. Malone contends, amongst those working in education there is often confusion between these two concepts leading to a commonality of teachers mistaking personal morals for ethics.

Morals are individual beliefs and values which fuel individual choices and decision-making, often influenced by professional, societal, cultural or community norms. The values which make up an individual's moral code vary greatly from person to person (Malone, 2020; Merriam-Webster Incorporated, 2020).

Ethics, however, is a system or framework of collective rules and principles within which moral reasoning is enacted. It acts as a broader guideline for moral decision-making often over a particular group or professional body of people (Malone, 2020; Merriam-Webster Incorporated, 2020). Due to the common confusion of morals and ethics, Kaufman (2008) emphasises the need for educational organisations to explicitly set out their ethical aims whilst Malone (2020) expresses the importance of teachers knowing, understanding and enacting their institutes ethical code/s.

Ethics of care can be described in relation to education as the decision-making process undertaken by teachers in relation to their perception of student needs resulting in pedagogical action. However, this is only part of the equation, with student response and teacher perception of student response eliciting further decision-making and further action. This combination of teacher mindset and teacher actions interacting with student mindset and student actions has the potential to enable or disable student learning in mathematics (Noddings, 2005).

Education is highlighted in the literature by Macgill and Blanch (2013) and Sykes and Gachago (2018) as a meeting and mixing ground for the power dynamics and inequalities of society. For teachers in mathematics classrooms there are many resultant ethical complexities, particularly for teachers engaging with students outside of their own cultural background (Hunter & Hunter, 2017). In teacher-student relationship building between individuals from differing cultural backgrounds, there needs to be conscious recognition of privilege and power and acknowledgment of difference as acceptable and desirable (Assembly of Alaska Native Educators, 1998; Gutting, 2013; MOE, 2013-2017). Macgill and Blanch state it is critical that non-indigenous teachers are aware of the complexities surrounding ethics of care. Recognition and accommodation of different ways of giving and receiving knowledge and care creates a space where all students are able to exist comfortably as themselves without feeling as though they have to mask or suppress parts of their identity in order to conform to the 'white spaces' of the education system (Milne, 2013; MOE, 2011; Patara, 2012; Si'ilata, 2015). Macgill and Blanch as well as Hermsen and Embregts (2015) urge that teachers must take an active role in opening a bridge between a student's identity and culture and the education system.

A repeated theme in this branch of literature addressed by Hermsen and Embregts (2015), Nicholson and Kuruez (2019), and Tosolt (2008) is the uniqueness of every individual and their responses when it comes to care. Hermsen and Embregts alongside Sykes and Gachago (2018) warn there is a widely held voice of caution when it comes to narrowing ethics of care into an overly specific framework. According to Hermsen and Embregts, there is no specific step by step guide to enacting ethics of care nor should there or could there be, as actions that create a balance of kindness and caring in one circumstance may well create the opposite in another.

Instead the work of Tronto (1993) has pinpointed four key elements of care; attentiveness, responsibility, competence, responsiveness. According to Bennoun et al. (2018), this was later expanded to five elements of care after an additional element,

trust, was proposed by Sevenhuijsen (1998) and accepted by Tronto as outlined in
Table 1.

Table 1

Tronto's Elements of Care

Tronto's Elements of Care	
Element one: *'attentiveness'* or *caring about*	Element two: *'responsibility'* or *caring for*
What is it? Recognising the needs of another and that they should be met. This requires looking at a situation from the position of the other. In teaching it can be seen in actions such as taking time before a lesson to give consideration to the needs of participating students (Bennoun et al., 2018; Tronto, 1993).	**What is it?** Once the need has been recognised, for care to result, responsibility for meeting the identified need must occur. This is recognising the actions that one should take in response to the identified need of the other and accepting responsibility for undertaking that action. This occurs irrespective of obligation (Bennoun et al., 2018; Tronto, 1993).
What does it look like? "What will my students need in order to complete this task?" "What do my students need to feel comfortable in this situation?"	**What does it look like?** Making the decision to provide food at parent teacher meetings next week, in respect of showing manaakitanga to students whānau.
Element three: *'competence'* or *care giving*	Element four: *'responsiveness'* or *caring receiving*
What is it? Ensuring that the identified action/s are completed and that they have meet the identified need/s. This is a comprehensive element and as such partial, incomplete or superficial fulfilment of the identified need/s cannot be said to meet the threshold of competence (Bennoun et al., 2018; Tronto, 1993).	**What is it?** Being alert to the response of care recipients to action/s intended as care. It cannot be assumed that the identified need has been met because the response action was decided on and undertaken. The response of the care recipient is crucial as to whether care has or has not taken place (Bennoun et al., 2018; Tronto, 1993).
What does it look like? Teachers engaging in reflective practice to ensure they are meeting the needs of their students and identifying areas for future improvement.	**What does it look like?** Requesting feedback from students. "What worked well in today's lesson?" "What would be helpful to change next time?"
Element five: *'trust'* or *caring with*	
What is it? Building trust is the critical component which connects each of the care elements. Trust is required to build relationships and relationships are crucial to care in an educational environment (Bennoun et al., 2018; Suikkanen, 2020; Tronto, 1993).	

What does it look like? Teachers that make authentic connections with not only students but also their whānau and with the community and value the inputs that each brings to the education of an individual student.

Being able to fulfil these elements of care is a complicated balance of the negotiation and navigation of a teacher's understanding of the cultural values and traits of their students and the way in which these are woven into the teacher's mathematic pedagogies and day to day classroom decision making in meeting learning needs (Hunter & Hunter, 2017). The careful negotiation of ethics of care ensures that students have their cultural values respected, acknowledged, and uplifted whilst also having meaningful participation and development of essential mathematic skills and knowledge (Noddings, 2005).

The New Zealand Curriculum sets out its vision for educators to grow and develop New Zealand's students as full members of society (MOE, 2007). Where ethics enters the picture is in consideration of whose societal vision is reflected in the education system.

Historically the New Zealand education system has been constructed upon the ideals of the Pākehā and middle-class majority (Thrupp, 2007, 2008). The original conception of schooling in New Zealand was a means to socialise Māori children into European culture (Royal, 2005; Shields et al., 2005; Smith, 2011; Stephenson, 2000). A stark example of this was the banning of speaking Te Reo Māori in schools until the 1960s enforced through punishment of students overheard using Māori language (Calman, 2012).

There is much outcry through the writings of Māori academics, such as Maaka (2019), Penetito (2010), and (Walters, 2019), who have produced literature showing that a system build on such inequalities cannot meet the needs of Māori or other minority cultures within the schooling environment. These three authors espouse, a system designed and run by the individualistic dominant culture to meet the needs of the dominant culture is unlikely to be able to bend enough to adapt to the needs of those

who do not fit within the limited constructs of that culture. Jahnke (2011) and Penetito assert that such an unequal foundation will always result in a system which privileges and advantages some groups over others ultimately impacting on educational outcomes.

The New Zealand education system has not been built on cooperative relational foundations and is therefore not built to show care. For teachers who are of Pākehā culture teaching children of Māori or Pāsifika heritage in such an environment of unequal power relations, this raises questions of how to go about ensuring their duty to show care can be met (Hunter & Hunter, 2017; Noddings, 2005; Tronto, 1993). The literature makes clear the empirical emphasis for teachers of mathematics to enact strong pedagogical practices grounded in the aspects of care which are constructed upon the cultural values of students (Berryman & Bishop, 2016; Fraser, 2016a; Hunter & Hunter, 2017; Penetito, 2010; Rubie-Davies et al., 2016).

2.3   Developing Mathematics Inquiry Communities

DMIC is a programme of professional learning development [PLD] aimed at building culturally sustaining practices in New Zealand mathematics classrooms (Massey University, 2017b). DMIC PLD is aimed at equipping teachers to support and empower Māori and Pāsifika students in mathematics. This is achieved through teaching mathematic strategies and skills (explaining, representing, justifying claims, using symbols, defining terms, making generalisations, and modelling situations) based on a framework of participation and communication which is built upon students' cultural identities (Hunter & Hunter, 2017; Hunter et al., 2018). Schools whose staff have engaged in DMIC PLD have shown a marked increase in Māori and Pāsifika students' achievement in mathematics (Education Counts, 2020).

The research-based model of Hunter et al. (2018) consists of both teacher PLD and pedagogical change in the classroom. Hunter et al. focuses on shared solving of challenging mathematical tasks through connections to big mathematical ideas, and the teaching of collaborative group work skills such as asking questions, voicing of

friendly arguments or polite disagreements, and valuing mistakes as part of the learning process. A DMIC influenced approach does away with ability grouping and views all students as competent mathematicians working within a collective emphasising the nature of a family where members support the group by sharing their thinking, checking in with each other and challenging ideas through questioning (Hunter & Hunter, 2017).

Commitment to a DMIC approach requires whole school buy in and co-operation across the teaching team (Hunter et al., 2018). Teachers are encouraged to team teach and team plan, regularly checking in with each other for support. This takes place through a supportive network both within schools, across syndicates and in connection to other schools utilising DMIC PLD (Education Counts, 2020). During the third year of the programme, teachers collaboratively plan a lesson before observing the lesson being taught. Afterwards the teaching session is discussed, and feedback given. Following this feedback, the lesson is taught by another teacher and again observed by the team to provide further feedback and assess how the changes have worked. In this way, teachers can learn from and support each other. Part of the professional development of DMIC involves a mind-set change from teachers as knowledge holders and disseminators, into teacher as facilitators of both their own and student learning (Hunter & Hunter, 2017).

Hunter and Hunter (2017) describe DMIC as encouraging teachers to build classroom learning cultures where knowledge comes from and is built upon by the students themselves in collaboration with each other. This differs significantly from traditional teacher-led structure of mathematics learning in which the teacher is viewed as the knowledge holder who transmits that knowledge to their students (Cazden, 2001; Duchesne & McMaugh, 2016). In contrast mathematics teachers experienced in DMIC PLD recognise the value of knowledge already held by students and bought into the classroom (Barker & Buntting, 2016). This method of teaching asks students to draw upon their knowledge funds as a starting point on which to construct new mathematical knowledge (Civil & Hunter, 2015; Hunter et al., 2019). A large body of New Zealand and international based research into positive methods of teaching for

indigenous and minority students backs up this call for a shift in direction (Averill et al., 2010; Berryman & Bishop, 2016; Moschkovich, 2018; Penetito, 2010). Where students are allowed to explore their ideas rather than having a teacher step in, to immediately correct mistakes, a greater understanding of mathematical concepts is constructed by the learner (Education Counts, 2020). According to Hunter and Hunter, it is here that the importance of the nature and challenge of the mathematical tasks presented to students comes into play.

Hunter and Hunter (2017) and Brough and Calder (2014) challenge educators to construct mathematical problems and tasks which are student-centred through connection to students' lived experiences. Where students are making connections between the mathematical ideas and their own lives, there is greater intrinsic motivation and engagement with learning (Duchesne & McMaugh, 2016; Fraser, 2016a). This adds a level of complexity to the teaching of mathematics meaning as Hunter and Hunter point out, teachers must plan collaboratively and develop a deeper understanding of their students and wider community and cultural connections to produce appropriate and engaging mathematical contexts for their students. It also eliminates the ability to take a 'paint by numbers' approach to the teaching of mathematics. As no individual student or group of students are exactly alike to another, it is not possible to pluck problems from textbooks and utilise them from year to year or day to day. Hunter et al. (2020) emphasises that school-based contexts are not enough to fulfil this requirement. According to and Hunter et al., and Brough and Calder, teacher's must construct problems based on sound knowledge of their own students'; identity, interests, concerns, community or national events and cultures. Hunter and Hunter accentuate this as bringing excitement and engagement back into the math classroom.

A second concern for teachers in constructing challenging mathematical tasks is ensuring there are multiple entry points and levels of difficulty (Hunter & Hunter, 2017). The DMIC programme is substantiated by an assembly of research such as the work of Hunter et al. (2020), Shah and Crespo (2018), Zevenbergen (2003) which shows the significant benefits in doing away with ability level grouping. Mixed ability

grouping better aids students in being able to learn from each other and offers access and exposure to different ways of thinking and mathematical strategy (Education Counts, 2020). According to Shah and Crespo, traditional ability structured grouping not only results in a classroom learning culture of academic haves and have nots, but also actively maintains a hierarchy of knowledge in which a student is not permitted to access 'advanced strategy' until they have mastered entry level strategy. This results from teachers' deficit thinking biases which whether held consciously or unconsciously, are of detriment to student learning (Meissel et al., 2017; Peterson et al., 2016; Rubie-Davies et al., 2016; Rubie-Davies & Peterson, 2016).

Hallam Ireson & Davies's (2004) study showed that students in ability levelled classroom groupings are acutely aware of their status in relation to the hierarchy of knowledge. Hunter and Hunter (2017) alongside Boaler (2013) emphasise that students in low level grouping consequentially absorb the idea that they are bad at or cannot do math. The literature has repeatedly shown that students of Māori and Pāsifika backgrounds are continually over-represented in lower-level groups due to inherent racial biases permeated throughout the education system stemming from wider social discourse (Shah & Crespo, 2018). According to Hunter and Hunter, problems and strategies presented to students in lower-level groups are routinely less engaging, demand a lower level of mathematical reasoning and present fewer opportunities for critical thinking.

By comparison, teachers who have undertaken DMIC PLD have expressed discovering use of high level of mathematical strategy by students that would have previously been assigned to lower level grouping when they are included into non-levelled math groups and asked to solve multi-levelled math tasks (Education Counts, 2020). This is important as ability based grouping has been shown to decrease teachers' perceptions of student capacity and result in teachers holding lower expectations for students in lower groups (Campbell, 2017; Mazenod et al., 2019). Therefore, careful consideration needs to be used in constructing tasks to ensure that they can be tackled by students and solved using multiple mathematical strategies. In working together and ensuring that all members of the group contribute, students are advantaged by learning

different mathematical strategies from each other and viewing a mathematical task from multiple angles (Education Counts, 2020).

An overall advantage of these two facets of mathematical teaching is a removal of the competitive nature of the mathematics classroom (Hunter & Hunter, 2017; Shah & Crespo, 2018). Where students work in familial like groups with no ability divisions, they instead learn to solve problems collaboratively and cohesively (Hunter & Hunter, 2018; Hunter et al., 2018). Sharing knowledge is accepted as an important part of learning with and from each other. All students are posited as mathematicians and all students have something important to contribute.

Friendly arguing is a concept emphasised in DMIC PLD as an important skill for mathematical learning. Hunter and Hunter (2018) encourage teachers to explicitly use talk moves and other discourse tools for cooperative participation and contribution. Hunter and Hunter also point out, the idea that you can disagree with someone's math without disagreeing with that person directly or causing offense by being rude is of particular importance to Pāsifika but also Māori students for whom a culture of respecting elders and those in trusted positions such as teachers can be a barrier to participation. For Pāsifika students, showing open disagreement with someone's ideas can be seen as rude, impinging on their mana, or causing them to lose face (Civil & Hunter, 2015; Hunter & Hunter, 2017; Hunter et al., 2019; Moschkovich, 2018).

Teaching skills of how to ask questions of someone where you have not understood or where you disagree with their explanation is especially important (Hunter & Hunter, 2018). When working as a group to solve problems there is clear emphasis on each individual to question if they do not understand, as well as a responsibility to ensure that everyone else in their group understands so that no one is left behind (Education Counts, 2020). Literature shows that specifically addressing the skills needed for participation with students is a common missed step in traditional transmissive teaching pedagogies with students often assessed for retention of knowledge (summative assessment) and as a way of pinpointing areas of knowledge gaps for future teaching (formative assessment) but rarely is consideration given to whether

students have the knowledge and skills of how to learn (assessment for learning) (Bell & Cowie, 2001; Earl & Giles, 2011; Hunter & Anthony, 2010; McCrone, 2005).

Differences in the communication and participation styles of students in comparison to teaching styles can affect student opportunity for engagement and participation in mathematics (Black, 2004; Hunter, 2007; Hunter & Hunter, 2018). Communication styles and norm are often linked to culture and learned through implicit transmission. Teachers who have undergone DMIC PLD are made aware of the benefits of explicitly teaching students skills to confidently participate in sharing their mathematical thinking and reasoning. (Carroll, 2017; Erath, 2018; Jorgensen & Dole, 2011; Shah & Crespo, 2018).

The DMIC PLD model teaches strategies which go further than changes to day to day classroom operation and rather takes aim at systemic change of the way in which the New Zealand education system functions when it comes to mathematics (Hunter et al., 2018). It is premised on more than promising culturally responsive teaching and instead is constructed on culturally sustaining teaching practices that affirm and uplift student learning by teaching through students' cultural ways of being (Averill, 2018; Hunter et al., 2019).

In viewing education as a contact zone for cultures, DMIC PLD recognises and seeks to address the associated challenges this presents. Remembering that care must be both given and received to have successfully taken place, education presents a ground in which care executed well can enhance learning and uplift the classroom atmosphere but conversely also presents opportunity for misattributed care to create indifference or at worst to do harm to student learning and educational outcomes (Hunter & Hunter, 2017; Noddings, 2005).

Much of the DMIC literature highlights commonplace teacher misunderstanding of the tenets of ethics of care as well as teacher inexperience with inquiry and community type pedagogies as the teachers of today's workforce for the most part experienced their own education through teacher led, transmissive strategies of learning (Hufferd-

Ackles et al., 2004; Hunter & Hunter, 2018). Dison (2018) characterises this as a need for the institution to learn from the students as the students learn from the institution, with the aim to construct a transformative, decolonising and culturally sustaining approach to mathematics education.

2.4   Current Practices of Care

Some of the key practices of care stemming from research and literature currently being utilised the New Zealand classroom context are explored in this section. These practices are mixed ability grouping, student-centred learning, community and whānau involvement, and place-based education. These practices have been shown to be highly effective for Māori and Pāsifika students.

2.4.1   Mixed Ability Grouping

In consonance with Abercrombie (2015), Anthony et al. (2016), and Victoria (2020), a care practice for which there is much research in support of but little implementation in New Zealand classrooms is that of mixed ability grouping. Much of the available literature defines ability grouping as the practice of teaching sets of children with similar assessment scores both within and between classroom cohorts (Clarke, 2021; Taylor et al., 2020; Webb-Williams, 2021). Abercrombie asserts that mixed ability grouping is set in antithesis, with group selection based on social compatibility, random selection, or deliberate inclusion of participants with diverse assessment scores. According to Anthony et al., the Education Gazette Editors (2021), and Francome and Hewitt (2020), ability grouping practices are rooted in individualised learning conventions whereas mixed-ability groupings encourage collaborative learning approaches which are culturally sustaining for students of Māori and Pāsifika backgrounds.

There is thorough documentation of the relationship between ethnicity and ability grouping with Māori and Pāsifika students being disproportionately represented in low level groupings within New Zealand schools (Barker Vermeer, 2021; Education Gazette Editors, 2021; Victoria, 2020). Literature shows that decisions such as group

placement are often based on deficit theorising and teacher's preconceived notions rather than students' substantiated abilities (Bishop, 2012; Bishop et al., 2009; Rubie-Davies, 2018; Webb-Williams, 2021). Research by Clarke (2021), Francome and Hewitt (2020), and Venkatakrishnan and Wiliam (2003) has shown that whilst ability grouping holds slight advantages for high achieving students over a mixed ability approach, there is a significantly larger disadvantage carried by lower and middle achieving students. Abercrombie (2015), Francome and Hewitt, and Venkatakrishnan, found groups labelled as lower achieving are provisioned with fewer engaging learning opportunities in the mathematics classroom which perpetuates low achievement and results in minimal movement between groupings.

In juxtaposition, use of a mixed-ability approach has exhibited increases in achievement for low to mid attaining students (Francome & Hewitt, 2020; Rubie-Davies, 2018; Venkatakrishnan & Wiliam, 2003). Case studies of mixed-ability teaching practices have shown significant positive impacts on achievement and engagement in mathematics for Māori and Pāsifika students (Barker Vermeer, 2021; Education Gazette Editors, 2021). A key advantage of mixed-ability grouping is opportunities for students to be exposed to the strategies and mathematical reasoning of their peers through collaborative tasks (Clarke, 2021). Other benefits include the reduction of hierarchical social comparison between peers and a shift away from deficit thinking to balance in teacher expectation levels across students (Abercrombie, 2015; Clarke, 2021).

2.4.2   Student-centred Learning

Claiborne and Drewery (2010) characterise student-centred learning as an ethos of teaching and learning which stems from both constructivist and humanist theories. According to Bishop (2012) and Brough (2011), it is based upon viewing the student/s as a whole with lived experiences both within and outside of school being interconnected to the learning process. At its heart student-centred learning can be viewed as a de-colonising teaching methodology as in concordance with Duchesne and McMaugh (2016) and Fraser and Paraha (2002), it centres around collaboration

and shared decision-making power between teacher and student/s. Brough and Fraser and Paraha explain, as student-centred learning practices begin with student knowledge as the base on which to co-construct learning, there are multiple learning pathways and room for divergent viewpoints and knowledges to co-exist. Bishop, Claiborne and Drewery, and Duchesne and McMaugh outline this as increasing student empowerment and self-agency whilst also bringing validation to student identity and culture.

New Zealand curriculum documents and policy are well set up to support student-centred learning. The vision, principles, values and key competencies in the New Zealand curriculum document, which are designed to be interwoven through every subject area of teaching, align with components of student-centred practice by emphasising values of diversity, community, and collaborative participation (Brough, 2008; Brough & Calder, 2014; Ministry of Education, 2007). The professional codes and standards for New Zealand teachers is underpinned with much of the same language of student-centred learning. It specifically speaks about commitment to culturally responsive pedagogy and the responsibility to uphold the Treaty of Waitangi, affirming student identities, inclusive teaching practices, and collaboration (Education Council New Zealand, 2017). The documents developed specifically relating to Māori and Pāsifika education such as Tātaiako, kahikatea and Tapasā explicitly cite student cultural identity, shared-decision making power, strengths-based positioning, and community and whānau connections as crucial tenets of education (Ministry of Education, 2011, 2013-2017, 2018).

Researchers have shown that despite these ongoing pushed for student-centred teaching, teacher's preferences for traditional modalities of transmissive teaching remain strongly entrenched (McCarthy, 2015; Wells, 2016). A study by Kaymakamoğlu, (2018) uncovered disparity in teachers espoused beliefs about student-centred teaching practice and the observed enaction of such practices. Kaymakamoğlu showed teachers to primarily utilise transmissive or teacher-centred pedagogical strategies despite their endorsement of student-centred teaching philosophy. The results of these studies indicate that although the importance and

value of student-centred learning practices is well recognised and many teachers perceive themselves as holding a student-centred teaching philosophy, the realities of day-to-day classroom practices show the existence of fundamental misconceptions and these beliefs do not translate into classroom actions (Duru, 2015).

2.4.3   Community and Whānau Involvement

Involving students' community and whānau members in school settings is a practice of care accentuated throughout both literature and New Zealand's educational policy documents. The literature emphasises whānau as children's foundational social support system and first educators, with reports showing that up to 60% of a child's learning is whānau based (Biddulph et al., 2003; Cunningham et al., 2005). Therefore, it is crucial for schools and teachers to be active in building reciprocal relationships with whānau and in the community (Assembly of Alaska Native Educators, 1998; Brooking, 2007; Controller and Auditor General, 2017). Community and whānau involvement in education has positive impacts on student engagement with education (Ministry of Education, 2011; Patara, 2012; Powers, 2004; Si'ilata, 2015).

In New Zealand education this is particularly pertinent as whilst interconnectedness is fundamental to the learning of Māori and Pāsifika students, the prevailing norm for these students is having a teacher of a differing cultural background to their own (Mika, 2016; Ministry of Education, 2020). This reality presents a likelihood of disconnect between home and school with schools often overestimating the effectiveness of their relationships with whānau and community (Controller and Auditor General, 2017). Participation of whānau and community members in education offers students role-models which reflect their own identities and lived experiences and presents practical implementation of their learning (Brough & Calder, 2014; Taylor, 2017). This holds significant benefit for Māori students as schools have historically failed to spotlight examples of Māori succeeding as Māori (Hāwera & Taylor, 2013).

Schools gain benefit from actively building these relationships as it connects teachers with a new knowledge base of cultural, historical and local information that they may not otherwise be able to draw from, providing deeper and broader educative opportunities for students (Poole, 2010). These actions are perceived by the community as a commitment from the school to collaborative relationships and an acknowledgement of the knowledge value held outside of school settings (Controller and Auditor General, 2015; Manning, 2012; Tahuri, 2007). This creates a positive cycle of barrier removal in which stronger whānau and community relationships lead to higher student engagement which continues to build stronger relationships (Powers, 2004).

Both the *Ka Hikitia* and Tātaiako documents which are cornerstone components of New Zealand's Māori education strategy emphasise the importance of relationships between schools, Whānau and community (Controller and Auditor General, 2016; Ministry of Education, 2011, 2013-2017; Te Kete Ipurangi, 2014). However, because of the subjective nature of much of New Zealand's educational policy, the success of such interventions lies in the willingness and capacity of individual schools to implement (Pihama, 2010). Despite positive intentions and some successes, it is widely acknowledged that the current education system of New Zealand is not meeting Māori educational goals and would benefit from improved enaction of strategies to build strong whānau, school and community connections (Controller and Auditor General, 2016; Maaka, 2019).

2.4.4   Place-based Education

A recurrent idea emerging from the literature with strong connection to community engagement is that of place-based education. This builds on the foundation of teaching through and with a child's culture to incorporate utilisation of local history, traditions, and geographical features as the contextual medium through which to teach curriculum subjects, including math (Jahnke, 2011; Penetito, 2009). For both Māori and Pāsifika cultures there is a strong relationship between place and identity (Dickie, 2005; Herrmann & Keene, 2016; The Pacific Community, 2021). Place-based

education has been described as a decolonising teaching practice which is under-incorporated and underutilised in the systemic, documentative and actuated practices of New Zealand education (Jahnke, 2012; Macfarlane et al., 2019; Ritchie, 2015).

Rather than teaching about Māori culture from a perspective of looking inward from the outside, place-based education accepts this knowledge as the starting point upon which to build other learning (Jahnke, 2012; Ritchie, 2015). Thus, student identity is situated as a natural platform on which future knowledge is constructed. This differentiates place-based learning from historic teaching practices which attempted to mould Māori and Pāsifika students into fitting an image of the dominant middle-class Euro-Western cultural norms (Macfarlane et al., 2019; Milne, 2013).

2.5 Conclusion

The ethics of care branch of philosophy as developed by Noddings and worked on by Tronto is concerned with the decision-making process underpinning actions. Care is fundamental to the teaching of mathematics as it has the potential to act as a decolonising agent within the mathematics classroom. De-colonising educational contexts is crucial for the educational success of Māori and Pāsifika student for whom the education system of New Zealand has historically marginalised. Ethics of care is grounded in relational connections which are a cornerstone of both Māori culture and Pāsifika cultures. Academics from indigenous cultures have long called for the education system to embrace and uphold the cultural values of its students. Teaching mathematics through culturally sustaining practices of care has strong potential for positive impacts for the mathematics achievement of all students in New Zealand's mainstream education system. However, research into ethics of care shows that misunderstandings are common amongst New Zealand teachers.

DMIC is a PLD programme for mathematics teaching in New Zealand schools developed by Hunter. The DMIC programme is constructed upon ethics of care considerations and encourages teachers to utilise care as the basis from which teaching pedagogies are selected. It has been revolutionary in Māori and Pāsifika

education and is based on culturally sustaining practices which empower all students as mathematicians by working from their cultural base and situating mathematical ideas within their every-day lives. DMIC champions removal of ability grouping and hierarchical structures from the mathematics classroom, instead working from a view of culture as strength and rejecting notions of deficit thinking. Alongside big mathematical concepts, the skills of participation, discussion, mathematical reasoning, and justifications are explicitly taught. Students are encouraged to work as a collaborative family with each responsible for their own understanding as well as the understanding of their group's members. Teachers hold the role of facilitator and are crucial in creating the atmosphere by demonstrating aspects such as questioning and friendly disagreement.

Culturally sustaining practices of care emphasised in New Zealand literature from Māori and Pāsifika academics include teaching mathematics through non-ability-based grouping, operating from a student-centred ethos, active involvement of community and whānau in students' education and, using place-based education to make connections between learning and location. There is varied employment of these pedagogies across New Zealand schools but overall, they are underutilised despite research being clear of the benefits they hold in comparison to more traditional teacher-centric and ability-based, practices for not only Māori and Pāsifika students, but for all students.

Given the importance of care as a tenet of culturally sustaining PLD programmes such as DMIC, and the poor understanding of ethics of care by teachers in New Zealand, alongside the underutilisation of successful care pedagogies, there is scope for an investigation into the implementation of ethics of care practices in classrooms of teachers who have undergone culturally sustaining PLD. This would provide benefit to the wider corpus of DMIC literature as well as teachers staring out in culturally sustaining PLD programmes.

3.0   Methodology

3.1   Introduction

Care has been accentuated as an important factor in establishing equitable and culturally sustaining environments of learning and teaching in the mathematics classroom. Within the body of literature examined there is little exploration of the practical mechanics of care practices within New Zealand classrooms. This chapter lays out the research methodologies used to conduct a study into the day-to-day practices of care utilised by New Zealand mathematics teachers who have undertaken or are undertaking the DMIC PLD programme.

Section 3.2 provides justification of the chosen qualitative semi-structured interview and video observation methodologies. Section 3.3 explorers the role of the researcher as an interviewer and a participant-observer. In section 3.4 the setting is established, and sampling rationale laid out. A diagram of the study design is supplied in section 3.5. The timeline of data collection is set out in section 3.6. Section 3.7 explains the data collection process before section 3.8 details the systems of data analysis used. Section 3.9 delineates the validity and reliability of the collected data. Finally, the ethical implications and considerations which act as the foundation of the study are traversed in section 3.10.

3.2   Justification of Methodology

The study followed an observational and cross-sectional design with non-probability purposive sampling using only primary sources of data (Adams et al., 2014; Campbell et al., 2020). Two qualitative data collection methods were utilised in the forms of semi-structured interviews and video recorded observations. However due to impacts of the Covid 19 pandemic, video data was unable to be included in the final study.

A qualitative design was selected for this study over a quantitative format because of the relational, and subjective nature of ethics of care (Adams et al., 2014; Noddings,

2005; Tronto, 1993). The research questions were descriptive and sought answers with both depth and high levels of complex detail, therefore it was unlikely to be satisfactorily answered with quantitative data (Braun & Clarke, 2006).

A mixed-methods study was not chosen because the small benefit gained from the addition of quantitative data did not merit the complexities of implementing a mixed-methods design and the research questions could be satisfactorily answered using a solely qualitative design (Clarke, 2017; Creswell, 2015). In addition to this, the timeframe requirements to satisfy prerequisites for a master's thesis also placed constraint on the researcher to be able to conduct multiple forms of data collection with both small and large sample groups as would be needed for a mixed-method project (Adams et al., 2014; Clarke, 2017).

Interviews were selected as a data collection method because according to Schensul and LeCompte (2013), they have compatibility with obtaining rich qualitative information from participants. Existing relationships between the researcher's supervisor and schools utilising the DMIC PLD programme meant potential interview participants were easily accessible. Schensul and LeCompte proclaim interviewing as an effective way to maximise the range of participant variability. This was important for the current study as capturing either entirely beginning teachers or entirely experienced teachers may have caused significant gaps in the data. This would also have been true of capturing data from only teachers new to the DMIC programme or failing to capture any data from teachers new to the programme. Interviewing allowed for purposive selection of participants (Campbell et al., 2020).

The choice to undertake video observations was made because as discussed by both Angrosino (2012) and Kawulich (2005), it is typically considered to be a minimally harmful practice as it is non interventive and allows rich data to be collected in an authentic and natural setting. Angrosino also considers that for the researcher, the authentic setting provides real life context to reinforce the themes arising from interviews. It also provided the opportunity to explore relationships, concurrences and incongruencies between espoused teacher beliefs and teacher practices (Fang,

1996; Guerra & Wubbena, 2017; Kaymakamoğlu, 2018). Having video recordings of observations gave the benefit of being able to undertake multiple viewings which allowed the researcher to consider data from differing viewpoints and multiple focuses (Hidson, 2017; Podmore, 2006; Rogoff, 2003). This also minimised disadvantages of observations associated with observer memory and selective recall (Bernard, 1994).

3.3   The Role of the Researcher

Whilst the schools selected for the study are practising DMIC PLD with their staff and have pre-existing relationships with the DMIC research community, the researcher for this study is unknown to them. Therefore, all study participants, both teachers and students, were unknown to the researcher at the commencement of the study.

An important role of the researcher in any study is to be as aware as possible of assumptions and personal biases (Kawulich, 2005). This is especially relevant to this study as the researcher is a Pākehā working in the context of Māori and Pāsifika education (Ormond et al., 2006). To address this concern, the researcher engaged in reflective practice and a process of cultural consultation throughout the research process to ensure that culturally safe and affirming practices were adopted and implemented at all times. The impossibility of remaining neutral is also accepted and acknowledged as all individuals operate from a perspective of personally held worldview stemming from their geographic, ethnic, political, cultural, religious, and gendered background (Absolon & Willett, 2005; Burman, 2007; Morss, 1996; Smith & Payne, 2016).

During the interviews the role of the researcher was to use prompts and probes to elicit in depth answers from participants whilst remaining as neutral as possible so as to maintain validity and reliability (Fowler, 2014; Punch & Oancea, 2014). Another important role was to keep participants on topic whilst also following up any interesting leads or ideas introduced by the participant in answering interview

questions (Rubin & Rubin, 2012). In order to keep the interview on track and to follow any potential diversions from the interview guide, it was important for the researcher to hold a sound and thorough knowledge of the interview topics and be clear on the purpose of the interview (Kvale, 2007).

The role of the researcher during the video observations was to maintain a strong and clear observational focus (Kawulich, 2005). It was also important for the researcher to ensure they maintained their role as an observer and not become drawn into participation (Angrosino, 2012).

3.4   Sampling and Setting

Data collection for this study was carried out at two primary schools referred to throughout this study as 'School A' and 'School B'. School A is a contributing primary school (years 1-6) in a small rural community of the Taranaki region. It has a roll of around 100 students made up of 33% Māori, 67% Pākehā and 6% other ethnicities. School B is a full primary school in an urban area of the Wellington region. It has a roll of approximately 250 students made up of 27% Māori and 67% Pāsifika ethnicities. Both schools are taught in English medium. Two teachers from School A were selected to be interviewed and one teacher from School B. Following the teacher interviews, information and consent forms were distributed to the parents of these three teachers' students. Seven students from one classroom at School A participated in a video recorded observation.

Schools invited to participate in this research were selected based on their involvement with the work of Dr Bobbie Hunter and their usage of the DMIC PLD programme for their staff. Time utilising the DMIC programme was also a factor as the researcher sought both experienced schools and schools at the beginning of their PLD journey. Convenience of location to the researcher was also a consideration when selecting schools. However due to non-availability of schools fitting the afore mentioned criteria, schools were also sought outside of the researcher's home region.

Teachers within each school were selected based on their involvement with the DMIC programme and the age of students they taught. The study focused on years five and six to ensure potential student participants were of sufficient maturity to give informed consent (consent was also sought from parents/caregivers). The teachers represented a diverse range of teaching experiences from a beginning teacher to a teacher with more than forty years' experience. All three of the teachers interviewed were of Pākehā ethnicity.

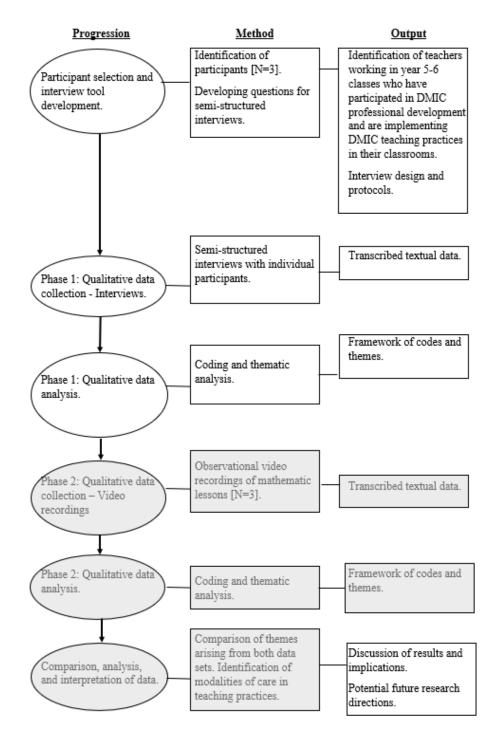Students were invited to participate based on their year level and enrolment in a participating teacher's classroom.

3.5   Diagram of Study

Adapted from the explanatory sequential design diagram of Creswell and Plano Clark (2018, p.85).

Figure 1

Flowchart of Study Design.

*Shaded sections were unable to take place or were omitted from the study results due to impacts of the Covid 19 pandemic.

3.6 Timeframe

Data for this study was gathered in three interview sessions occurring within a seven-week time window during June and July of 2021. The first two interviews took place face to face. The third interview was held via telephone call due to distance. The first video recording session was conducted in July 2021. Arrangements were made to conduct the second and third video sessions in August. However, due to the Covid-19 pandemic and resultant national lockdown, these were unable to take place. Due to the lateness in the year and the ongoing Covid-19 protocol restrictions, it was decided to cancel the remaining video sessions and omit the collected video data from this study. Table 2 summarises the schedule of data collection.

Table 2

Summary schedule of data collection

Data collection Timetable	
Location:	Taranaki and Wellington Regions
Commencement date:	3 May 2020
May 2 – May 8	Visiting and liaising with schools
May 9 – May 15	Visiting and liaising with schools
May 16 – May 22	Visiting and liaising with schools
May 23 – May 29	Arranging interview times
May 30 – June 5	Arranging interview times
June 6 – June 12	Conducting interviews
June 13 – June 19	Conducting interviews
June 20 – June 26	Interview transcription
June 27 – July 3	Interview transcription Arranging video times
July 4 – July 10	Presented interview transcription to participants and amended as required Conducted video recording
July 11 – July 17	Arranging interview times
July 18 – July 24	Conducting interviews
July 25 – July 31	Interview transcription
August 1 – August 7	Interview transcription
August 8 – August 14	Presented interview transcription to participants and amended as required Arranging video times
August 15 – August 21	COVID 19 Lockdown
August 22 – August 28	COVID 19 Lockdown Video recordings cancelled
August 29 – September 4	COVID 19 Lockdown
September 5 – September 11	COVID 19 Alert level 3/red
September 12 – September 18	Interview data analysis
September 19 – September 25	Interview data analysis
Completion date:	24 September 2021

3.7   Data Collection

The first part of this research study involved qualitative semi-structed one on one interviews with three individual participants from the identified target group (teachers of year five and six students who have completed PLD in DMIC) (Kvale, 2007; Schensul & LeCompte, 2013). The interviews were conducted by the researcher and voice recorded electronically. The interviewer used a pre-prepared list of open-ended questions (see Appendix A for full list) as a guideline but remained flexible and adaptable in allowing participants to deviate as required as well as asking follow-up questions to ensure information gathered was broad and deep enough for the purposes of the study. Following the interview, the recordings were transcribed into text format by the researcher.

The interviews took place in locations convenient to the participants. In two cases this was the participants schools with the other interview being conducted via telephone due to distance and Covid 19 pandemic restrictions. Arrangements were made with each school to set up a space where interviews could be conducted ensuring participant privacy. Interview times were arranged with participants to be convenient to them. This minimised interruption to teacher workload and avoid disruption of student learning. Participants were encouraged to bring a support person if they would like to. Kai was provided before and/or during each interview and a small koha was given to participants as acknowledgement of their time and knowledge contributions. Demographic information such as level of teaching experience, gender, age, and ethnicity was also recorded.

Semi-structured interviews have been identified as one of the most common and essential data collection techniques in qualitative research (Kakilla, 2021; Leavy, 2014; Punch & Oancea, 2014). Put simply, semi-structured interviews allow for gathering of rich and deep data directly from the participants perspective through the participants own voice (Kvale, 2007; Spradley, 1979). Interviewing allows researchers to discover thought patterns and gain information that would not otherwise be accessible through other data collection methods such as observation (Kvale, 2007).

The project's second phase was video recordings of classroom math lessons conducted by the interviewed participants. One recording was intended to be made for each participant. However, only one video session was able to take place. As the remaining two video sessions were unable to occur, the video data that was collected was not transcribed or analysed and was ultimately omitted from the results of the study.

3.8   Data Analysis Method

Analysis processes and filters raw data, giving it structure and order, sifting out patterns so that sense can be made from the swirls of information (Greene, 2007). Greene (2007) characterises the data analysis process through a series of stages involving; cleaning, reduction, transformation, correlation and comparison and drawing out conclusions and inferences.

All data collected in this study underwent thematic analysis in accordance with the tenets of Braun and Clarke (2006), and Vaughn and Turner (2016). Once collection was complete the researcher familiarised themselves with the data by reading and re-reading the raw data. The interviews were then transcribed into text and stored in a Microsoft Word document. Each text chunk was then assigned initial thematic codes utilising the notes feature of Microsoft Word. The data was then re-coded with initial codes being revised, merged, and grouped. After final amending for accuracy and consistency, these codes were analysed for emerging common themes. The themes identified from each data set were reviewed, refined, and named. The themes from each data set form the basis for the discussion and analysis section outlining findings of this study as well as identified potential future research directions.

3.9   Validity and Reliability

The concepts of validity and reliability concerns themselves with how true and therefore how defensible the data is (Bashir et al., 2008). The application of tools

relating to validity and reliability in qualitative research is an area of contention in academic literature (Noble & Smith, 2015).

Qualitative research seeks to uncover the perceptions and meanings that participants derive from phenomena (McGill University, 2022). According to Morss (1996) two individuals may bring differing or even opposing meanings to the same phenomena. Morss and Aiolfi (2015) discuss Foucault's work on the paradigm of post-structuralism as suggesting many interpretations and meanings can be simultaneously applied to a single phenomenon. Aiolfi and Feilzer (2010) explain the paradigm of critical constructivism as asserting the argument that there can be no singularly objective reality. These understandings underline Morss's view of the complicated and multi-faceted nature of knowledge and its relativity. Qualitative reliability and validity, therefore, seek to ensure that data is of a high enough quality to generate a creditable understanding of meanings in often complex situations whilst acknowledging the indistinct boundaries of knowledge itself (Bashir et al., 2008; Stenbacka, 2001).

Reliability measures the consistency of results obtained from the employed data collection method/s (Fowler, 2014). The nature of quantitative research lends itself easily to evaluation of reliability in such that measures like the consistency of results, stasis versus changes over time, and similarities or divergences are easily quantifiable (Bashir et al., 2008). In contrast, qualitative research presents a challenge to standardised measures of reliability because of its inherent subjectivity (Noble & Smith, 2015). Stuhlman, Hamre, Downer & Pianta (n.d.) point out for example that no qualitative observation tool will produce 100% validity or reliability.

Validity provides confirmation that the data collected measured what it was intended to measure (Angrosino, 2012; Fowler, 2014). It is an assessment of how well the data collection tools provided data which was able to answer the research question/s of the study (Noble & Smith, 2015). Table 3 sets out the strategies utilized by the researcher to ensure the validity and reliability of the current study guided by the criteria of Lincoln and Guba (Lincoln & Guba, 1985).

Table 3

Validity and Reliability Components

Criteria	Strategies implemented
Reliability (*Consistency/Neutrality*)	• Each interview was conducted from the same pre-prepared question list ensuring consistency (Fowler, 2014; Stuhlman et al., n.d.). • Terms potentially unfamiliar to participants such as 'ethics of care' were defined in information sheets handed out prior to interviews. The interviewer also defined these briefly at the start of each interview (Fowler, 2014). • Care was taken to ensure interview questions did not include or imply example answers (Fowler, 2014). • All interviews were conducted by the same interviewer (the researcher) to maintain consistency (Stuhlman et al., n.d.). • A diary of the research analysis (see Appendix B) was kept by the researcher to ensure transparency (Noble & Smith, 2015). • Data was coded multiple times and compared for consistency (Stuhlman et al., n.d.).
Validity (*Truth value*)	• Prior to conducting interviews, the researcher reflected on their personal biases and engaged cultural consultation (Ormond et al., 2006). • During interviews the interviewer refrained from offering their own opinions during conversation to avoid risk of influencing the data collected from participants (Fowler, 2014). • Participants were aware of their anonymity in the published thesis through use of pseudonyms (Fowler, 2014). • Potential errors in measurement or memory were minimised through use of electronic recordings (Bashir et al., 2008; Fowler, 2014). • During the interview, the interviewer used rephrasing and confirmation probing to check for inconsistencies in their understandings (Rubin & Rubin, 2012). • Participants were able to view their interview transcripts and amend for errors and inconsistencies (Bashir et al., 2008; Noble & Smith, 2015).

3.10   Ethics

Ethics plays an important role in a study with a focus on social research by setting out the duty of care to minimise potential harm to participants (Springer, 2010). This is of strong importance for research occurring in educational institutions involving children (Massey University, 2017a). Therefore, throughout the course of this study, thorough consideration has been given to potential harms for both educators and students. The researcher has been guided in setting out the ethical framework for this study by the following documentation set out by Massey University; *The Massey University Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants*, *Pacific Research Principles* and, *Te Ara Tika Guidelines for Māori Research Ethics*. Key ethical concerns in carrying out this study were participant autonomy, avoidance of harm, privacy, and confidentiality, manaakitanga (cultural and social responsibility), and reciprocity.

Before proceeding with data collection, approval was sought and granted through the Massey University Online Human Research Ethics Application process. Identification and analysis of ethical concerns was carried out, and the study was submitted under low-risk ethics notification 4000023464. The application was reviewed by the Research Ethics Secretariat in May 2021 and given low risk ethics approval.

Informed consent was sought from all participants through provision of information in a clear manner, utilising language understandable to the potential participants. Care was taken to ensure that potential participants were not under pressure or coercion to participate. Potential participants were able to take written information away from meetings and take time to consider it before agreeing to participate.

Prior to commencement of data collection, the researcher met with the principal and teachers of the schools involved to discuss the research aims and seek consent for participation. Potential teacher participants were provided with detailed information sheets outlining the research study (see Appendix C). The sheet included study aims, invitation for participation, data management procedures, participants rights and, the

escalation process for any arising issues. Separate consent forms were signed for the interviews (see Appendix D) and the video observation sessions (see Appendix E).

Student participants were under the age of sixteen and therefore classified as children thought all child participants were over the age of eight and therefore of sufficient maturity to understand what it means to participate (Massey University, 2017a). The researcher sought consent from the parents/guardians of all student participants (see Appendix F). Parents/guardians were provided with information sheets detailing: the researchers background and contact details, particulars of the research aims, specifics of participation, data management and protection procedures, participant and parent/caregiver rights, and information regarding the escalation process for any arising issues (see Appendix G). These sheets were handed out and collected by the students' classroom teacher.

In all cases, the information sheets explicitly stated the rights of teachers, parents, and students to decline to participate as well as the right to withdraw from the study or revoke permission to use their recorded data at any time without having to specify reason/s and with no consequence. Confidentiality assurances were specifically laid out making participants aware of the use of pseudonyms to ensure their names, any locations or other identifying details would not be included in the published research.

To create minimal disruption for teacher participants, interviews were held onsite at their schools at times convenient to the participant. Interviews were held kanohi ki te kanohi (face to face) apart from one interview which took place via telephone due to physical distance. At face-to-face meetings food was provided in keeping with the concept of manaakitanga (Hudson et al., 2010). At the conclusion of the interview, participants were given a small koha (gift) in the form of a local café voucher as acknowledgement of their time and contribution.

The video recording session took place during a normal mathematics lesson in the students' own classroom to ensure the classroom routine was not interrupted. No student/s were excluded from lessons. All students received the same learning

opportunities they would have received had the research not been occurring. Non-consenting students were positioned off camera and any verbal responses were omitted from written transcripts and data analysis.

Teacher embarrassment of being videoed and having their teaching practices analysed was identified as a potential harm. To minimise this, following data collection teachers had the opportunity to review footage and transcripts for accuracy and authenticity before signing a release form giving permission for the data to be included in the researcher's thesis.

The ongoing reciprocal nature of relationships formed with the schools and their communities through this research are acknowledged by the researcher. The researcher has remained available after the conclusion of the research for any follow up or future discussions that may be required (New Zealand Council for Educational Research [NZCER], 2013).

3.11 Conclusion

Qualitative research methods were selected for use in the form of semi-structured interviews and video observations because of their capacity for collection of rich and complex data in natural settings whilst being achievable within the required timeframe.

The research occupied many roles throughout this study including data collection, transcription, and analysis. The researcher provided checks and balances for validity and reliability of data whilst maintaining an awareness of and reflecting upon their own geographic, ethnic, political, cultural, religious, and gendered positions and biases.

The school settings were chosen as a representation of the classrooms of teachers involved in the DMIC PLD programme. Purposive sampling was undertaken to ensure breadth of representation in terms of teaching experience and time in the DMIC

programme. However, the sample was homogenous in terms of ethnicity and gender of participants. Whilst the researcher acknowledges this presents a potential for divergent viewpoints outside of the data captures in this study, it is an accurate presentation of the typical New Zealand classroom where an overwhelming majority of Māori and Pāsifika students are taught by teachers of Pākehā ethnicity.

At all stages of this research validity, reliability and ethics were at the forefront of decision making. Although the Covid-19 pandemic had a significant impact on this study during the data collection phase, the data collected met justification criteria for validity and reliability in relation to the overarching questions and aims of the research. The ethical requirements of *The Massey University Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants*, *Pacific Research Principles* and *Te Ara Tika Guidelines for Māori Research Ethics* have been adhered to at all times to minimise potential harms. Participants gave informed consent which was able to be withdrawn at any time. Pseudonyms were used to protect confidentiality and maintain anonymity. Participants had opportunity to review and amend collected data prior to its usage.

4.0 Perceptions of Care

4.1 Introduction

This chapter presents and discusses findings related to teachers' perceptions of care and their perceptions of students' responses to care. It explores their thought patterns, beliefs, understandings, and decision-making for planning, relating to care and care practices in their teaching of mathematics.

Comments related to the specifics of carrying out teaching practices or enacting care within the classroom were not included in this theme as teacher perception of care canvases the intangible, internal, 'behind the scenes' occurrences related to care as distinct from enaction of practices of care which is explored in chapter 5.0.

There were two key areas of perceptions identified from the participant data. Section 4.2 reports the findings on teacher mindset and discusses them in relation to the literature explored in chapter 2.0. Section 4.3 discusses the findings related to teachers' perceptions of student response to care and makes connections between the findings and current literature. The findings and discussions are then summarised in section 4.4.

4.2 Teacher Mindset

The theme of teacher mindset examines the beliefs and understandings held by teachers in relation to ethics of care. Comments on teacher mindset arose in interview responses from every participant (n=3). Over all 22% of responses were coded as relating to teacher mindset.

Five sub-themes emerged from the teacher mindset data. The sub-theme of *Teacher Understanding of Ethics of Care* will be explored in section 4.2.1, *Teachers' changing perspective of ethics of care* will be examined in section 4.2.2, *Teachers' changing perspective of students* in section 4.2.3, *Changes to teachers' beliefs on teaching mathematics* in section 4.2.4, and *Collaborative teaching* in section 4.2.5.

4.2.1 Teacher Understanding of Ethics of Care

When asked directly about their understanding of ethics of care respondents found it difficult to articulate. Many of the responses were phrased as questions rather than concrete statements of knowledge. Participant A, a beginning teacher who is new to DMIC, spoke about their struggle to define this concept stating, "My understanding I would say is quite limited". However, when speaking about their teaching practices, the interview participants indirectly showed solid understanding of ethical components relating to care and care practices. Participant C, an experienced teacher, who was able to articulate a strong current understanding, spoke about their historic struggle with understanding ethics of care as a concept, saying, "It took me a wee while… I thought, what is she talking about?".

The data appears to support that teachers, particularly those early on in their teaching journey, find it difficult to explicitly articulate a clear definition of what ethics of care is but that prolonged involvement with PLD leads to a deeper and more easily articulated understanding.

4.2.2 Teachers' Changing Perspectives of Ethics of Care

All participants described their perspective of care changing in response to undergoing PLD. Participant B stated, "it's totally transformed me" and continued, "I think everything has transformed. I've been redeemed". Participant C said, "your little world is tipped upside down".

Key mindset changes identified from the data were increased noticing of student response to care and self-reflectivity on improving care actions, altered preference from valuing ability streamed grouping practices to favouring mixed ability grouping, a shift of focus from individualised achievement to collaborative learning goals, and movement from positioning themselves using traditional teacher led pedagogies to facilitating learning through student-centred teaching practices.

Participant C, the interviewee with the longest involvement in PLD, commented three times on the significant differences between their current perspective on care and their mindset both prior to PLD and in the early days of their engagement. Referring to videos taken in the earlier stages of the DMIC programme, this participant stated, "Some of these things that I'm talking about you won't see in those videos that I made because they are four years old or five years old".

The data substantiates the conclusion that participation in PLD has a significant impact on teacher perspectives of ethics of care and, that teachers view these changes over all as positive for their mathematics teaching.

4.2.3   Teachers' Changing Perspectives of Students

Two interviewees made significant comment on their changing perceptions in view of their students' abilities as mathematicians since undergoing PLD. Both spoke about their perceptions shifting from a mindset of viewing students as those who have the capacity to achieve well in mathematics and those who do not, to a genuinely held recognition of every student's ability to learn and do well in mathematics. This was best exemplified by participant B who said, "Not seeing my kids as those that have it and those that don't and not seeing them in deficit but seeing what level are they coming in at and where can I help them to grow from that level". Both participants described these mindset changes as 'transformational' to the way in which they teach mathematics with participant C describing the changes as, "a really significant journey. It would be the most significant PD in my however many, 40 years of teaching".

Participants attributed these changes to transition into mixed ability grouping which allowed them to see greater student potential, particularly from those students who had been previously placed into low ability groups. Participant B described the change in comparison to their ability grouping practices saying,

> Those children who last year would have been in my low ability group are just
> shining. That's been transformational in my ethic of care for them. I think that

realisation has helped me see that everybody has the ability to do well in some aspect of math.

This data appears to show that PLD has potential as a tool to address deficit thinking and unconscious teacher bias about students' abilities in mathematics.

4.2.4 Teachers' Changing Beliefs on Teaching Mathematics

Participants also spoke about experiencing changes to their views on teaching mathematics. These changes focused on shifts from a mindset of teachers as mathematical knowledge holders and students as knowledge receivers to a recognition of student held knowledge as a base for learning. Participant responses showed movement from viewing teachers as leaders in learning, to seeing the teacher as a facilitator of student-led learning. Changes from envisioning math as a subject of individual capability and individual achievement to seeing it as a communal activity which necessitates collaboration were also espoused. These shifts were embraced by participants who expressed positivity about a renewed focus on meeting students where they are at rather than categorizing students as good or bad at mathematics.

Participant C spoke about their perspective on math as a subject itself and the magnitude of shifting their mindset away from traditional math teaching practices saying,

> For me it was more significant that it was math. If you'd said to me maybe in literacy or maybe in social studies 'okay, you're just going to be facilitating and going to be drawing out from the kids what they know.' I would have gone 'oh okay, I can probably do that'. But maths no no no no no. In my brain, in my silly old-fashioned brain, no no no hang on I fill kids up, we do our maths lesson, and we explore a strategy, and we practise using the strategy and I show you the strategy and yeah. So, this was absolutely world upside down.

From the data genuine change can be seen. Many comments referring to prior ways of thinking were underpinned by assertions of conviction in the teachers' changed

viewpoints such as participant C who stated, "we're trying to battle that decades and decades of not only Māori and Pāsifika but all of us thinking it's okay to say that we're not good at maths which actually is so not true." And participant A who said,

> Instead of having everyone at the same level and splitting them because no matter how much you disguise it, they know. Everyone knows oh I'm the bottom maths group and it's like those kids in the top maths group they're like 'oh I'm better than you at maths' but really, you're just at different stages of your journey and you don't need that distinction between it. I think that's really cool.

These comments show how participants adopted new ways of thinking about mathematics after participating in PLD.

4.2.5   Collaborative Teaching

Participant C, the teacher with the longest involvement with PLD spoke at length about the value of collaboration not only for students but also for teachers. This participant talked about the importance of having cultural mentors and utilising the knowledge within the school, local community, parent, and student populations. The participant gave the following example,

> Sometimes I think in my arrogance that I know about a context... for example I did a problem it was about a taro garden that had a fence around it. I used one of the kids because I knew they had taro at their place and as soon as he read out the problem, the son of the person I'd used in the problem said, '*name of participant* it's not a taro garden, it's a taro patch and it never has a fence'. He said, 'it only has a fence in Samoa to keep the pigs out, it doesn't have a fence here'. So, it was like yeah 'yeah okay right' and that's exactly why we do need to [collaborate].

Participant B, a teacher recently beginning PLD, expressed the importance of having peer mentorship as a support system saying, "If you're talking to somebody who's done it well and found the success in that it can be really encouraging so you definitely need to talk to teachers who have done it as well".

The data appears to substantiate that teachers, particularly early in PLD programmes, view peer support as critical to their ability to embrace changes to their mathematical worldviews and mathematical teaching practices. It appears that over the course of a teacher's PLD journey they embrace collaborative practice by building a network of cultural knowledge holders which strengthen and support the teachers mathematical and cultural practices in the classroom.

4.2.6   Discussion of Findings on Teacher Mindset

The findings of the current study indicate culturally sustaining programmes of PLD improve teachers' understandings of ethics of care. The data showed that following participation in PLD, teachers increased their mindset of the importance and value of ethics of care to classroom practice. The participants showed a reduction in deficit theorising toward students and displayed changed views on approaches to mathematics teaching. These results provided insight into what teachers perceive as critical aspects of ethics of care.

The results of the current study concurred with the work of Tosolt (2008) in finding that ethics of care is a concept which teachers frequently struggle to understand and which they find difficult to articulate it's connection to their teaching practices. The implications of the current study are that through participation in culturally sustaining PLD teachers gain understanding of both what ethics of care is and how it relates to and enhances classroom practice for cultural responsiveness and sustainability. As discussed in the literature review chapter, this is a cornerstone tenet of much of New Zealand's educational policy including commitment to meeting Treaty of Waitangi obligations (Education Council New Zealand, 2017; Ministry of Education, 2007, 2011, 2013-2017). Therefore, the results hold significance for schools and individuals seeking to enhance the cultural sustainability of their teaching practices in mathematics.

As previously discussed, deficit theorising is detrimental to student achievement and often linked to erroneous hegemonic conceptions of ethnicity's correlation to mathematical achievement (Meissel et al., 2017; Peterson et al., 2016; Rubie-Davies & Peterson, 2016). The results of the current study showed, teachers who had undergone PLD for cultural sustainability held mindsets rejecting notions of deficit theorising. The studies conducted by Kaymakamoğlu (2018) and Duru (2015) showed that espoused teacher mindset does not always transfer into shifts in classroom practice. The results of this study did not replicate this and will be further discussed in chapter 5.0, section 5.2.7.

4.3   Perceived Student Response to Care

Section 4.3 explores teachers' perceptions of their students' response to implemented care practices. It should be noted these are the views and perceptions of teacher participants in relation to their students and therefore are not representative of the viewpoints of the students themselves. Perceived student response to care was the second most frequently occurring theme with 27% of participant responses containing references relating to student reaction to teaching practices.

Five sub-themes emerged from the responses to care data. These sub-themes are examined in the following sections: *Awareness of student needs* (section 4.3.1), *Negative student response* (section 4.3.2), *Positive student response* (section 4.3.3), *Changing student response* (section 4.3.4), and *Cross-subject transference* (section 4.3.5).

4.3.1   Awareness of Student Needs

Teacher awareness of student need was the most frequent aspect of student response raised by participants. Across student response related comments 37% contained elements of student need awareness. Thus, the data indicates this is a highly important component of practice for teachers who have participated in the PLD.

Participant comments about awareness of student need canvassed putting concentrated consideration of student need into their lesson planning, maintaining an awareness of student anxiety levels, and ensuring they provided an adequate level of support to students.

Specific practices utilised by participants included consciously observing behaviour and understandings during math sessions. Participant A gave an example related to learning needs explaining,

> with equivalent fractions, we're doing something where they had to add quarters and eighths together and they just disregarded the quarter. I was like oh we know this is a general thing that I've missed to teach you that we all need to go over…I think you can generally pick out where you've missed something. I'll be like oh everyone's doing this, what have I missed?

Another practice used was specifically seeking responses to teaching from their students with participant C commenting, "one of the really important ways I seek responses is in the share back part of the lesson" and expanding by saying, "actually seeking a big range of responses". Participant C also emphasised their efforts to, "tap into kids who may not necessarily be the ones that are heard enough".

The data indicated teachers who had undertaken PLD had a strong awareness of student needs in terms of both content learning needs and emotional learning needs such as cultural connection and an environment of safety. Participants espoused their invoking of practices to both assess and address student needs.

4.3.2   Negative Student Response

The least mentioned sub-category, making up 8% of comments, described negative student responses. In comparison 27% of comments described positive student responses and 20% of comments described transitional student responses. Eight out of the thirteen comments relating to negative student response described early

responses from students, one comment described ongoing student response and four comments were from a non-specific time period.

Participants described students expressing difficulties with teaching practices shifting from an individualised to a collaborative model of mathematical teaching, such participant A who said, "In the beginning, they still wanted to be individually doing math." This participant went on to comment, "it's taken some of them especially the ones that are quite high up in maths they have had a lot of trouble with the community but now we're getting there which is good."

The data supports the presence of student resistance to changes in mathematical teaching pedagogies implemented by participant teachers in the initial stages. The absence of participant comments about continuing student anxiety later in their PLD journey could suggest an early adjustment period characterised by anxiety and resistance which lessens over time.

4.3.3   Positive Student Response

Comments on positive student responses to teaching practices implemented following PLD, made up 27% of responses. Fifteen out of forty-three comments detailed a perceived increase in student confidence coupled with nine comments expressing increases in student participation and engagement levels. This was exemplified by participant A who described how, "you can see that they're engaged in the task and once they get the task and they're in their buddy, they are actually, they would never tell me this, they are actually engaged".

Other responses included perceptions by teachers of increased student enjoyment of math, students expressing feeling safe and valued in the math classroom, and improved classroom relationships. Two participants spoke about increases in the mathematical attainment of their students. One participant talked about experiencing increased teaching satisfaction.

With forty-three comments relating to positive student responses in comparison to thirteen perceptions of negative student responses, the data supports the conclusion that participants overall viewed pedagogical changes following PLD as contributing positively to their students' dispositions and engagement toward mathematical learning.

4.3.4 Changing Student Response

Participant comments on transitional student responses all documented a shift from negative reactions toward embracing and becoming positive. There were no comments in which teacher perceived students having initially responded positively to pedagogical changes before shifting to a negative response. Participant B spoke about this change by saying "Dispositions is huge. There was a lot of negative talk initially. 'I've got nothing to offer.' 'I'm dumb at math.' 'I don't know this.' 'This is hard.' 'I'm stressed out.' But there's none of that now." Participant C described the change as, "I think the more that we have cultural practices for the problems the more they just see that maths is just everywhere and it's problems worth solving for them".

This may indicate the negativity stemmed from reaction to change itself rather than the specific alterations in practice. It could also be indicative of the benefits of changes in practice taking time to become apparent to students.

Participants identified changes in student responses as shifting from a position of low confidence in their mathematical abilities to a position of recognising their strengths. This was described by participant A as, "just seeing their confidence grow and they're taking more risks and answering questions" and participant C as, "we have student who can speak really confidently about themselves as a mathematics learner".

Another change noted in students was a shift from mindsets of an individualised approach to mathematics to a relational and collaborative approach. Participant B explained this as,

I don't think we're in factions anymore. Last year we were the have the smarts and the don't have the smarts. This year I see a lot more different relationships interacting. I see a lot more care initiated by them.

Participant B went on to describe, "Children are offering to help each other so much more and just not trying to assert themselves as the top of the class anymore because there's no top of the class anymore".

The data shows that changes in mathematical pedagogies implemented by classroom teachers following their involvement in PLD have led to lowered peer group competition and increased collaborative knowledge sharing amongst students. The data supports a pattern of initial resistance followed by enhanced positive perspectives on mathematical learning and increased engagement experienced by students.

4.3.5   Cross-subject Transference

Although not asked directly about broader application of their mathematical teaching practices, each participant (n=3) indicated during their interview that students had made use of these learning strategies during lessons focussed on other curriculum areas. Participant A described students utilising language they had introduced in mathematics during both writing and spelling lessons. They commented "I think DMIC goes across all", before going on to explain,

We do word lab, which is spelling but the syllables are always highly contested. Is it one syllable or two? Someone will go, 'actually, I disagree with that because….' So, they bring the language through. So, it's not just math. It's like it can happen anywhere which is cool.

Participant B stated, "It's transformed my whole classroom in all other areas as well".

The data highlights a potential area of future research possibilities into cross-subject transference of mathematics PLD teaching practices. There is potential capacity for culturally sustaining PLD to be applied to curriculum areas beyond mathematics. As of yet, there appears to be little research available beyond mathematical applications.

4.3.6 Discussion of Findings on Perceived Student Response to Care

The findings on perceived student response to care delineate programmes of PLD designed around a focus on culturally sustaining practice as increasing teachers' awareness of student response to care. Participants indicated they were highly aware of the impetus to consider student needs and that following on from PLD involvement, their consideration of student need had increased when planning for mathematics teaching. The data showed some negative response from students to changes in teaching practice. However, these negative responses occurred early on in teachers' PLD journeys and were largely transitional. Participants described perceiving overall positive responses to changes in practice such as seeing increased dispositions toward mathematics and an uplift in student engagement. The findings confirmed student response to care as an aspect which these teachers perceived as important to ethics of care and which featured frequently in their ongoing practices for teaching mathematics.

The works of Noddings (2005) and Tronto (1993) as discussed in chapter 2.0 pinpoint response to care as a requirement in the enaction of ethics of care. Similarly, the later studies of Bennoun et al. (2018) and Tosolt (2008) found student response to care was a fundamental component of the care relationship. The results of the current study found, following PLD, teachers were shown to hold mindsets of increased awareness of the importance of student response to their implemented practices of care. Teachers employed specific practices such as actively observing students with the aim of noticing both learning needs and monitoring emotional and social wellbeing during implementation of new teaching strategies. Participants also utilised practices which sought out responses from students directly. These results hold interest for schools looking to bring relational and responsive attributes to their teaching of mathematics (Berryman & Bishop, 2016; Biddulph et al., 2003). This is of particular relevance to those seeking ways to implement concrete methods of cultural sustainability for their Māori and Pāsifika students (Hermsen & Embregts, 2015; Macgill & Blanch, 2013).

Hermsen and Embregts (2015) and Nicholson and Kuruez (2019) spoke about the uniqueness of individual people in their response to care, indicating how different people can and will respond to the same act of care in differing ways. In concordance with Hermsen and Embregts and Nicholson and Kuruez, the participants in the current study described perceiving various responses from students toward their practices of care. These perceived responses canvassed negative, positive, and transitional reactions to enacted practices of care. The perceived negative responses primarily related to behaviours and comments from students pertaining to anxiety and resistance. These responses were described by participants as being seen early on in teachers PLD journeys and subsiding over time. Perceived positive responses to care outnumbered negative responses at a rate of over 3:1. Teachers perceived an increase in student enjoyment and engagement in mathematical learning. Transitional responses perceived by participants moved from initial negative responses into positive responses over time with students expressing less instances of negative competition and hierarchy between peers and an increase in observed collaborative behaviours and knowledge sharing. Shah and Crespo (2018) discussed the positives a decrease in unhealthy student competition through jostling for first position whilst Hunter and Hunter (2018) emphasise the benefits of a collaborative classroom on student achievement and well-being.

Absent from the literature appeared to be the topic of cross-subject transference of skills and practices implemented by teachers following their cultural sustainability focussed PLD. However, all participants (n=3) described their students as spontaneously choosing to utilise learning strategies implemented in mathematics during curriculum subjects. This presents an exciting possibility as a future research direction.

4.4 Conclusion

In exploring mathematics teachers' perceptions of care after participating in culturally sustaining PLD, this chapter has examined the themes of teacher mind and perceived student response to care.

Within the theme of teacher mindset towards ethics of care several key subthemes were identified. Teachers were able to articulate their understanding of ethics of care and its importance in relation to their classroom practices. They also reflected on their struggles with and consequential shifts in mindset towards the concept of ethics of care as the result of participation in PLD.

Teachers identified changes in mindset toward ethics of care generally, their perceptions of their students' potential for mathematical attainment, and shifts in the way they viewed teaching mathematics. This highlighted the success of culturally sustaining PLD in building teachers' knowledge and application of ethics of care.

Teacher perceptions of student response to care revealed various anticipated responses in line with the literature reviewed and one unexpected response. Participants showed increased awareness of student needs and described taking actions which observed and expressly sought out student needs in response to this awareness. Teachers perceived the majority of student responses following changes in practice stemming from their ongoing PLD as positive. Some student responses were perceived as negative. Participants reflected that over the course of time negative student responses had transitioned, becoming positive as change related anxiety decreased and students embraced new classroom norms. An unforeseen student response was teachers observing students spontaneously transfer their newly introduced mathematical learning strategies and apply them to tasks in other curriculum areas.

The implications stemming from these findings are that PLD programmes aimed at culturally sustainable practices in mathematics are successful in enhancing teacher understanding of ethics of care and impacting teacher mindset toward active use of ethics of care in their planning. Findings also showed that participants displayed increased awareness of the importance of seeking feedback responses from their students in relation to practices of care. Teachers perceived their students as having an overall positive response to changes implemented as the result of undertaking such

PLD. This has the potential to be a positive force for teachers of Māori and Pāsifika students as many of New Zealand's educational policy documents explicitly or implicitly incorporate the responsibility for teachers to hold culturally uplifting mindsets and use culturally sustaining practices. Engaging in programmes of culturally sustaining PLD will result in teachers with a genuine commitment to upholding their students' cultural wellbeing and contribute to ensuring schools are able to meet the cultural needs of their students.

5.0 Enaction of Care

5.1 Introduction

This chapter adduces and descants findings in connection to participants' enaction of care through two emergent themes, practices of care and contexts of care. It examines their classroom pedagogies and actions through which mathematics teaching is carried out as well as the contexts through which mathematical learning tasks are situated.

Section 5.2 reports the findings on practices of care before discussing their relationship with the literature explored in chapter 2.0. Section 5.3 examines the findings related to context of care and illuminates the links between the theme's findings and the reviewed literature. Finally, section 5.4 summarises both the findings and discussions.

5.2 Practices of Care

Section 5.2 explores teachers' practices of care in the mathematics classroom. These actions are the concrete fruition of the aspects of teacher mindset explored in chapter 4.0, section 4.2. Practices of care was the most frequently raised theme by participants with 35% of interview comments linked to classroom actions.

Six sub-themes developed from the practices of care data. These sub-themes are individually explored in the following sections: *Teaching skills of participation* (section 5.2.1), *Inclusion of identity and culture* (section 5.2.2), *Relationship building* (section 5.2.3), *high expectations* (section 5.2.4), *Collaborative learning practices* (section 5.2.5), and *Valuing and utilising student knowledge* (section 5.2.6)*.*

5.2.1   Teaching Skills of Participation

Although not asked directly about teaching students' skills for participation in the maths classroom, in response to questions about ethical practice, every participant (n=3) raised this as an important practice of care.

Comments relating to the explicit teaching of skills for participation had strikingly little variance between participants. The most commonly mentioned concept was giving students instruction in how to collaborate successfully in a group. For many students working collaboratively was a new experience and required careful navigating as described by participant A who stated, "My class they just did not know how to cope for a while there, but we broke it down, so they were only working in buddies".

Participant B spoke about putting this into practice saying,

> I'm verbalising a lot of that polite talk stuff and that collaborative learning teaching throughout the whole day now… We focused on 'you need to turn and face your buddy' what a good working buddy looks like. Everyone's ideas are valued. This is how we are an audience.

The next most spoken about aspect was setting and communicating norms and standards for behaviours, particularly in the early stages of implementing changes to the structure of their math classrooms. When asked about advice they would give to a teacher beginning their PLD journey, some participants stated the importance of setting these expectations. Participant B stated,

> When you first start DMIC you're focused on how to run in in the classroom not necessarily what sort of norms to set up in the classroom. You don't really realise until you're partway through that actually the norms are just as important as the knowledge or the procedures that you're teaching.

Participants also frequently raised the importance of supporting students in their mathematics learning by offering reassurance and ensuring that students knew where and how to access help. This was best summated by participant A who said,

> It is different, this is different to how you are used to doing maths and that's okay. We've just going to go with it and take the time in the beginning… I like them to know where to go for help and how to ask for help.

This data appears to support the need for an ethics of care framework for teachers embarking on PLD programmes as participants spoke about both student benefit from guidance in the skills of participation and anticipated teacher benefit from guidance in implementing skills of participation teaching practices, particularly early on in their PLD journeys.

5.2.2   Inclusion of Identity and Culture

Every participant (n=3) spoke at length about the importance of weaving culture and identity into their mathematical teaching practices. The most often raised points were creating connection and relevance between mathematics and students' lives, ensuring an atmosphere of cultural safety in the mathematics classrooms, and building students confidence as mathematicians.

Uncovering the connection between students' every-day lives and mathematics was raised by participants as foundational to mathematical learning. Participant C iterated this by saying, "find out more about your kids, about their lives and what's important to them and tap into that". Participant A espoused mathematical contexts should be "something relevant to them instead of something that's only relevant to me or only relevant to someone else". Participant C expressed similar sentiments stating,

> [Using] the contexts that they are experts in, and they can see that there's maths in their every-day life and in their worlds and in their cultural practices. That's really actually I think where we sometimes underestimate how important that is.

Creating a culturally safe environment was articulated as important by all interview participants. Participant A described this as a classroom where, "everyone feels like they and their culture and where they come from is valid". Participant B expressed thinking about and teaching students 'respectful interactions' and 'respecting each other's values' as examples of ways in which they created cultural safety in their classroom stating, "I want my whole teaching to be acceptable to all those cultures and communities". The same participant reflected that "I feel quite horrified that I

taught like I did last year. I got results but I was perpetuating the cultural norm…I feel like I'm redeeming the whole put you into a box thing".

The third key teaching area of practice relating to student culture and identity spoken about by participants was building students confidence and self-belief in their capacity as mathematicians. Participant C summed this up in stating, "I think the most important ethical concern is that they see themselves as confident, confident mathematicians. Māori mathematicians or Samoan mathematicians or Tokelauan mathematicians".

Specific teaching practices participants spoke about using in their classrooms included beginning lessons by asking students to highlight the strengths that they and others bring into the mathematics classroom, expressing their own confidence and trust in students to rise to mathematical challenges and using tuakana/teina relationships for students to share their knowledge and learn from their peers.

From the data it is evident that PLD programmes which influence teachers to adopt mathematical teaching practices supported by indigenous researchers, show a significant shift in classroom practice towards positively supporting and validating student identities and cultures. Interview responses highlighted the contrast between teachers' current and historic mathematical teaching practices in relation to PLD participation.

5.2.3   Relationship Building

When speaking about relationship building several participants indicated this was a well-established element of their practice prior to entering the PLD programme. However, they also commented on how participation in PLD had enhanced their relationships with both students and their whānau members. In particular, participants bought up PLD's influence on strengthening the connections between school and home. Participant C explained this as "it's really building up those

relationships so that I can bring a little bit more understanding to the relevance of the learning and that maths is huge in their world".

Participants also indicated that their involvement in the PLD programme had evoked changes in classroom-based relationships. Participant A spoke about PLD as leading to them making a shift in teaching practices which enabled them to have more interaction with each student by explaining,

> In previous math lessons you just kind of do your teach and then they go off and you just kind of make sure they look like they know what they're doing…But [after] DMIC I go around quite a few times to the groups and get them to explain their thinking.

Key relationship building teaching practices influenced by the DMIC programmed identified from participant responses were making it safe to ask for help by explicitly encouraging students to do so and emphasising mistakes as an important part of learning in mathematics, taking an interest when students spoke about their families and lives outside of school and building these interactions into a connection between mathematics at school and students real-world lived experiences.

From the data it can be seen that whilst relationship building had long been a crucial part of their teaching practices, involvement in PLD bought in an added dimension and tangibility, illuminating and cementing the value of relationship building to mathematics teaching in the mindset of the study's participants.

5.2.4   High Expectations
Key classroom teaching practices, as influenced by teachers' participation in the DMIC programme, raised by participants included setting mathematical tasks that challenge students to rise to both a high level of engagement and mathematical achievement, overtly challenging, deconstructing and rejecting stereotypes around who can and cannot be good at math, the use of mixed-ability grouping, and writing of mathematical tasks with multi-level entry points.

Participant C spoke of attributing their beliefs and classroom practices around high expectations to their involvement in the PLD stating "When I think of that, I have Bobbie's [Hunter] words echoing in my mind that she got us really early on. She said, 'it's never about low achievement, it's only ever about low status'".

Participants spoke about the increased level of consideration they put into their lessons, planning for high expectations, since undertaking PLD. This was summed up by participant C who said, "It's so much thought going into raising the status of the kids and mathematicians solving a worthwhile problem". The same participant later commented,

> We always have level four problems and that's an ethical response to how many years of Māori and Pāsifika kids not achieving well in math or not seeing themselves as mathematicians…. Well, the kids in my class, they don't think twice about it, the level four problem. They just think they can solve it.

The data suggests that holding high expectations of math students as the result of PLD can spark genuine change in the classroom practices of mathematics teachers. The data showed teachers' conscious awareness of the importance of holding high expectations and challenging hegemonic stereotypes about who can be successful in mathematics. This appears to have been translated into specific and intentional pedagogical actions.

5.2.5   Collaborative Learning Practices

Collaborative learning practices were extensively spoken about by participants as the third highest element of teaching practice mentioned. Teachers indicated that they utilise practices of setting mathematical tasks which fundamentally require groupwork to solve in addition to specifically teaching the skills of collaboration whilst promoting collective responsibility, as teaching pedagogies for collaborative learning.

Participants described the planning and intent they put into ensuring the challenging math tasks they write and use, require groupwork by design, with participant C explaining "it's a real ethic of care to make the problem really tricky so that no one person in the group can solve it by themselves. They actually need to work together and talk together". Participants reflected that this was a significant change to classroom practices they had employed prior to their PLD, such as participant B who commented, "Everyone has the smarts, and we need the smarts from everybody, and no one has all the smarts so we can put our smarts together to work out the problems. That's been transformational". The same participant spoke of the satisfaction they have discovered in this way of planning saying, "I enjoy writing tasks. I find it intellectually stimulating to try and put all these layers within my task, so you've got the low floor high ceiling".

Other pedagogies employed included giving students direct instruction in how to build group participation skills. For example, participant A who said, "we talk about everyone's helping each other's learning". Iterating and reiterating strategies for group participation was a common response with participant C stating, "we would be talking about it in your family or our waka or in our crew just supporting each other to be able to solve that problem together". This participant set aside a specific time at the beginning of the lesson to go over participation skills. Another practice used by the teachers to build collaborative skills was assigning of group roles to each group member with participant C explaining "Sometimes I'll give students a special job to do in the group… So, I'll say 'hey so and so, can you please be the challenger in the group?'".

The data supports PLD as positively influencing the deliberate use of classroom practices to foster collaborative learning. Teachers interviewed reflected on a shift toward collaborative learning pedagogies and away from individualised practices. They attributed this shift in practice to their participation in the cultural sustainability focussed PLD.

<u>5.2.6   Valuing and Utilising Student Knowledge</u>

The least often spoken about aspect of ethics of care practice was student knowledge. However, the range of answers given by participants was broad and detailed. Teacher practices included actions to draw out student's prior mathematical knowledge by constructing mathematical teaching from a starting point of student's already held knowledge. Participants often highlighted the mathematical applications in familiar whānau and community's activities as well as sharing and praising student's successful math strategies with the whole class. Participants used practices to encourage students to share their knowledge and learn from each other. Another teaching strategy used was to organise lesson structure to deliberately situate themselves as a facilitator to allow student autonomy over their mathematical learning.

Participants expressed putting thought and effort into utilising student knowledge and capturing student voice. This was encapsulated by participant C who said, "I've been thinking really quite hard about how I do that. How I hear student voice as much as possible in that time".

Several participants spoke about their experience of PLD shifting their mindset toward the importance of student knowledge. Participant C explained, "that was world upside down. That was like what do you mean I don't fill kids up with math? What do you mean I draw maths out? How can they know about that?" the same participant later reflected on their current practices in relation to this starting point by saying, "so really trust the process but also trust that the kids have got this, and they actually do know. If you draw it out in the right way, it's up to you to draw out what they know". Combined these two comments indicate the movement of the teacher's stance over the course of their PLD from being an imparter of knowledge transiting into the role of facilitator. Participant A explained this as,

> You can just see it happen. Instead of having the teacher explain it to you, you've got your friend explain it to you and you can just see it. I think that's one of the things I've found really cool.

The data supports PLD as being a catalyst for teachers to shift away from traditional teacher-centred practice to practices which instead validate and rely upon students' own knowledge. Through participant reflections on their teaching practices prior to involvement in the PLD programme compared with their current practices, it can be seen how practices basing mathematical learning around student knowledge have gained prominence in participants classrooms.

5.2.7 Discussion of Findings on Practices of Care

The current study found teachers who had undergone PLD with a focus on cultural sustainability, enacted various practices of care in their mathematics teaching. Participants elaborated on their employment of practices of explicitly teaching participation skills. They spoke about their taking action to incorporate student identity and culture into mathematical learning tasks. Teachers expressed renewed efforts to build relationships with students, whānau and community members. They talked about setting challenging mathematical tasks to reflect holding high expectations for student ability and achievement. Utilisation of collaborative learning practices was discussed along with several strategies used to uplift and value knowledge bought into the classroom by students. The data identified many practices through which teachers consciously infused acts of care into their pedagogy.

The works of Earl and Giles (2011), Hunter and Anthony (2010), and McCrone (2005) speak of the rarity of teachers employing pedagogies to explicitly teach and/or assess for skills of participation. The current study found that participants reflected on giving little consideration to their students' skills of participation prior to undertaking PLD for cultural sustaining practice. However, after participating in such PLD, participants showed an understanding of the importance of teaching students participation skills. Their descriptions of classroom practices elaborated on their adoption of deliberate acts of teaching geared toward equipping students with these skills. Participants also discussed the challenges they faced in making these changes to their teaching practice and their desire for stronger guidance and reassurance, particularly early on in their

PLD programme. This suggests the need for a framework or guideline to support teachers in implementing practices of care.

In her PHD thesis, Milne (2013) spoke of the negative repercussions of the ongoing suppression of indigenous and minority identity and culture in New Zealand's mainstream education system. Hermsen and Embregts (2015) and Macgill and Blanch's (2013) study on ethics of care highlight teachers' duty to ensure students are able to express their identity and culture in the classroom environment and have it celebrated and uplifted. Brough and Calder (2014) situate mathematics learning as stemming from a foundation of students' culture and identity and emphasise the benefits of pedagogy which embraces incorporation of student identity as a fundamental 'need to have' rather than an optional 'nice to have' tenant of classroom learning. The data from the current study showed a shift in participants' practices toward use of teaching strategies which support and validate student identity and culture. Teachers attributed this shift to their participation in PLD focused on culturally sustaining practice in mathematics.

Studies by Poole (2010) and Powers (2004) found practices by teachers which sought to build relationship between school, students, whānau and community held benefits to both teachers and students. Powers found that where teachers had built strong connections between school and home, students experienced higher levels of engagement in their learning tasks. Poole concluded that good relationships with community members and whānau gave teacher access to reservoirs of knowledge which they would not have otherwise been able to share with students. The Controller and Auditor General (2017) along with the Assembly of Alaska Native Educators (1998) calls for teachers to take an active role in building relationships with both students and those outside of school with an interest in student education such as whānau and community members. The results of the current study showed that the value of relationship building for Māori and Pāsifika students was a well embedded concept in the teaching practices of participants prior to their embarkment into culturally sustaining PLD. However, participants reflected that such PLD had given them

renewed appreciation for the role of relationship building in connection to student learning and had increased and enhanced their use of relationship building actions.

The findings of the current study reported several specific practices which teachers adopted in response to holding high expectations of their students post PLD participation. Participants discussed implementing a mixed ability grouping structure for their mathematics lessons. This is supported by literature such as Shah and Crespo (2018) and Hunter et al. (2020) who proport the benefits of a shift away from ability based groupings. Shah and Crespo speak of the removal of barriers to knowledge in comparison to ability-based grouping where students are required to master lower-level strategies before being granted knowledge of advanced strategy. This is connected to another practice enacted by participants, that of deliberately breaking down and rejecting stereotypes about who can be successful in mathematics. Boaler (2013) and Shah and Crespo discuss how Māori and Pāsifika students are frequently overrepresented in lower-levelled groups regardless of actual ability and that students in lower groups are acutely aware of their positioning in terms of hierarchy. The studies of Campbell (2017) and Mazenod et al. (2019) found that teachers who group based on ability held lower perceptions of their students' capabilities. The results of this study showed participants implemented changes in practice based on their participation in culturally sustaining focussed PLD which encouraged them to hold high expectations of students' ability.

The subthemes of collaborative learning and valuing student knowledge shared similar findings in that participants responded to PLD by shifting their pedagogies away from traditional transmissive modalities of learning toward student-centred practices. These findings sit in antithesis to studies by Kaymakamoğlu (2018) and Duru (2015) which found teachers often espouse a student-centred mentality whilst continuing to utilise teacher-centric teaching methods. The participants of the current study discussed adapting their pedagogies following on from participation in culturally focussed PLD. The teachers engaged in a range of practices which aligned with their student-centred philosophy. Collaborative learning practices implemented by participants included specifically teaching skills of participation (as previously

discussed) and setting mathematical tasks which require groupwork by design. These group tasks were constructed upon utilising students' prior held knowledge as the basis for mathematical learning to stem from. Brough (2008) and Fraser and Paraha (2002) discussed students' prior knowledge as a starting point from which to build new learning. Fraser and Paraha highlight the importance of working from a base of students' own knowledge as enabling Māori students to become co-constructors of their learning. Through centring tasks on a context which students are familiar with (further discussed in section 5.3.1) and encouraging collective responsibility for students' own learning and the learning of others in their group, students are given autonomy over their own learning (Hunter & Hunter, 2017).

5.3 Context of Care

This section examines the contexts that teachers who have engaged in culturally sustaining PLD utilise to connect mathematics with the lives of their students. The context of care theme was the least spoken about concept emerging from participant responses in only 15% of answers.

Five sub-themes arose from the context of care data. These sub-themes are explored in the following sections: *Family and Whānau* (section 5.3.1), *Community* (section 5.3.2), *Place-based* (section 5.3.3), *Student interest* (section 5.3.4), and *School-based* (section 5.3.5). Finally, the findings are discussed in relation to the reviewed literature (section 5.3.6).

5.3.1   Family and Whānau

Participants described changes in levels of student engagement with mathematical concepts in response to the use of contexts connected to students' whānau and family lives. Many gave examples from their own classrooms of student responses, such as participant C who said,

> We were doing as a [sic] algebraic formula in tukutuku panels and I had one
> boy say, 'oh my gosh I didn't realise how clever my tipuna were' and for him

that was just massive because he didn't realise that was maths in the cultural practices of his tipuna.

This participant articulated,

> Building relationships with their whānau, with their aiga, that's really important too so that you're actually more aware of how those contexts for learning can in a problem can make it so that the students are really engaged and really excited about the maths that you are doing.

Participants also spoke about the inclusion of family contexts as having an impact on parent and family involvement in their students' math learning with participant C saying, "because the kids talk about it. They write about it in their Seesaw posts, and they talk about it at home. The parents know how they do maths."

The data supports PLD which focuses on developing culturally sustaining practices as resulting in the use of context connected to the family, whānau and aiga of students. The data has shown the result of this to be a positive impact on student engagement with the concepts of mathematics. The data also supports the use of familial contexts as beneficial to building relationships between the school and home lives of Māori and Pāsifika students.

5.3.2 Community

Community contexts made up 20% of the context related comments from participants. These comments encompassed building mathematical teaching around a shared community vision, validating and strengthening student identities, drawing from community knowledge, and teacher attendance of community events. Community contexts were spoken about by two participants. The participant who did not mention community context had the shortest teaching experience and was in the early stages of their PLD involvement.

An experienced teacher who was at the beginning of their PLD programme made community context focussed comments twice. The participant with both the most

extensive teaching experience and the longest involvement in PLD mentioned community contexts sixteen times.

Therefore, the data supports the concept that involvement in a culturally sustaining PLD programme has a cumulative positive impact on teachers implementing practices which utilise context to build connections between mathematical concepts and the community lives of their students.

5.3.3 Place-based

The second least spoken about contextual concept was place-based education. Participants talking about the context of their challenging tasks spoke about place 16% of the time. None of the participants gave an example of their use of place-based math context. Many of the participants comments acknowledged this was an area in which they could do better.

When asked directly about their use of place-based settings participant C said, "Oh I'm just trying to think if we've done anything around [place]. I don't think we have". In a later statement the same participant said, "I'm just thinking about land features and whether we do, but no".

In answering questions about the use of local geographical history and land features, participants often spoke about other contextual circumstances such as family or community events for example participant C who said, "We use local churches, halls, sports grounds, community gardens and community events at different locations etc (e.g., The local market) for problem contexts".

The data supports the statement that place-based contexts remain an underutilised aspect of mathematical context despite participation in PLD. It appears that teachers hold misunderstandings of what place-based context involves and the value it can bring to the mathematical classroom.

5.3.4   Student Interest

The most frequently commented on area of context was student interests. Participants described utilising context that related to students' lives on a cultural level, but which did not necessarily connect to other aspects such as family or place. For example, participant B who said,

> Our maths connection of recent is actually more to do with sport because a lot of our children are really into sport and a lot of our Māori families are into sport. So, I have written challenging tasks related to sport.

Participants spoke about positive responses from students stemming from interest-based contexts. Participant B described this as,

> One example the other day was talking about percentages in relation to fractions. When I started talking about 50% being half and then I talked about if you went into Rebel Sport, and you found a pair of sports shoes that were 50% off or what's 50 out of 100 and when they worked out it was half one of them was like [excited tone] 'can you do that? Oh my goodness, *name of teacher*! I always have to ask Dad how to do that and now I'll be able to work it out myself.' He was very excited. So, although you might not say that's a cultural context, it's very relative to what they're doing and their passions.

Participants also spoke about the use of student interest in adding relevance to the learning of math by connecting mathematical concepts to students' real world lives. This was exemplified by participant C who stated,

> I think what's happened with DMIC is that relationship is really really built on high expectations and really knowing about that student and their world so that you're trying to make the math relevant and there's problems worth solving in terms of their world.

The data supports participation in PLD as influencing the use of student interests as a context to connect students with the relevance of mathematical concepts in their every-day lives. The data suggests that challenging tasks embedded in socially and

culturally relevant contexts positively impacts students' intrinsic motivation to engage in mathematical learning.

5.3.5   School-based

School-based context were the least frequently spoken with 7% comments describing use of mathematical task context related to school. The participant with the longest involvement in PLD did not speak about school contexts whilst both participants early in their journey did. Of these participants, the newest to teaching spoke openly about their use of school focused context whilst the more experienced participant spoke about their efforts to move away from utilising school events stating, "We try really hard not to have school contexts" this participant followed up saying, "I mean sometimes they [school contexts] work if a number of kids have experienced it".

The data highlights PLD's success over time in transitioning teachers away from utilising school situated contexts into task settings more firmly connected to students lives such as family and community environments. It shows this is a concept which teachers appear to initially find challenging to move away from. Teachers with longer involvement in a PLD programme relied on school contexts significantly less than those beginning the programme. The data strengthens the argument for development of an ethics of care framework to support teachers early in their PLD journey.

5.3.6   Discussion of Findings on Context of Care

The findings of the current study uncovered the use of numerous contexts of care by teachers participating in culturally sustaining PLD. Participants discussed this culturally sustaining PLD as strengthening their use of whānau, community, place and student interest contexts whilst indicating a reduction in their use of school-based context. The results highlighted participant perception of context as both a critical aspect of ethics of care and as a practice through which care was enacted.

Findings in the data for both whānau and community contexts were similar. Results of the current study showed agreement with the review of Patara (2012) and the study conducted by Powers (2004) who found schools' relationship building with whānau and community produced increased educational engagement for their students. Participants in the current study described increases in student engagement as the result of utilising both whānau-based and community contexts. Like the findings of Poole and the Controller and Auditor General (2015), participants felt involvement of community and whānau in students' mathematical learning had strengthened relationships between community, home and school. Participants stated the impact of being involved in culturally sustaining PLD as increasing their utilisation of whānau and community contexts to teach mathematics. This is in line with the aims of culturally sustaining PLD programmes such as DMIC which extoll the value of making connections between students lived experiences and classroom learning (Brough & Calder, 2014; Hunter & Hunter, 2017). These results support and recommend ongoing PLD for cultural sustainability as a strong tool for schools to use as part of their strategy to meet curriculum and Treaty of Waitangi obligations for Māori and Pāsifika students.

The current study also found student-interest to be a common context used by participants in teaching math. Participants reported noticing increases in students' motivation and engagement in mathematics lessons. The findings of Brough and Calder (2014) noted connection to student interest as having positive impacts on engagement particularly where students were able to select or co-construct their own interest-based contexts.

The works of Jahnke (2012) and Macfarlane et al. (2019) described place-based contextual learning as under-employed in the New Zealand education system. The current study reflected this also in finding that participants were the most uncertain about and least likely to use place-based contexts. The literature from Jahnke and Macfarlane et al. accentuates place-based pedagogy as transformative and de-colonising. There are implications from the current study for future programmes of PLD to consider inclusion of a greater emphasis on place-based education as literature strongly underlines the importance of place to identity for Māori and Pāsifika cultures

(Dickie, 2005; Herrmann & Keene, 2016; Penetito, 2009; The Pacific Community, 2021).

The literature examined revealed the commonality of school-based contexts being used by teachers of mathematics. Hunter et al. (2020) discussed school-based contexts as being superficial in terms of both connection to students' lives and depth of mathematical learning achieved. In concurrence with the findings of Hunter et al. the current study showed participants as initially finding it challenging to shift their practice away from school-based contexts. Participants with longer participation in culturally sustaining PLD relied on school context significantly less than those at the beginning of their journey, but none the less still incorporated them in their current practice. The significance of this shows ongoing PLD for cultural sustainability has an impact in reducing the use of school-based contexts but that more could be done to support teachers away from use of school-based contexts particularly early on in their PLD journey.

5.4   Conclusion

This chapter has examined enaction of care through the themes of practices of care and context of care as used by mathematics teachers who have participated in ongoing PLD aimed at culturally sustaining practice.

Various practices of care were disclosed by participants as being implemented in their classrooms. Teachers undertook deliberate acts of teaching to equip students with the specific skills required for participation. Participants demonstrated a shift in their practices toward incorporation of identity and culture as a critical aspect of their teaching. The participants considered their experience with culturally sustaining PLD as having solidified their use of relationship building practices. Teachers were shown to have adopted practices such as the use of mixed ability grouping in response to their commitment to holding high expectations of all students' mathematical capabilities. In addition to this, participants reflected on their PLD as influencing them

to introduce student-centred teaching practices such as an increase in collaborative learning by design constructed on students' prior knowledge as a valued start point.

Participants discussed their implementation of teaching skills of participation to students following their participation in PLD focussed on culturally sustaining practice. This was highlighted as an area that teachers had not commonly considered prior to their PLD and as an area of challenge early on in their PLD journeys. Participants spoke about their increased use of practices supporting and incorporating students' identities and cultures as a fundamental part of classroom operation. Teachers reported that relationship building was a well-established component of their practice prior to participation in PLD. However, they considered PLD as having positively enhanced these practices. Involvement in PLD for culturally sustaining practice was found to be influential in participants shift to a mixed ability grouping structure as an enaction of holding high expectations for all students to achieve well in mathematics. This was reflective of a move away from traditional transmissive modalities of teaching through increased use of collaborative learning embedded in student-centred teaching practices.

Usage of five separate contexts of care were identified by participants in their classroom pedagogies. Teachers were shown to have increased their usage of whānau, community and student interest contexts. In addition to this, participants reduced their reliance on school-based contexts over time. Participants spoke about the challenge to move their practices away from school-based contexts and it was clear that longer participation in culturally focussed PLD held negative correlation with use of such contexts. Place-based mathematics was the least used and most misunderstood context discussed by participants.

Participants spoke about their increased use of whānau, community and student interest-based contexts as a result of undertaking PLD. Teachers reported seeing higher motivation and engagement from their students which they attributed to the contexts building connection between students' lived experiences and their learning of mathematics. Teachers discussed their continued, but reduced use of school-based

contexts and the difficulties associated with shifting their practice away from such contexts. The study identified place-based education as holding the biggest ongoing challenge in contexts. Participants showed misunderstanding of what place-based contexts entailed and reflected this was an area in which they felt there were improvements to be made.

The findings on the themes of practices of care and context of care recommend such culturally focussed PLD as a successful tool in increasing teachers' use of both practices and context to enact of care. This has positive implications for schools in assisting them to meet their goals for Māori and Pāsifika students in mathematics and meeting their obligations to both the New Zealand Curriculum and the Treaty of Waitangi. Other considerations are for future PLD programmes to include an emphasis on place-based context and to better support teachers at the beginning and throughout PLD with a guiding framework for implementing practices of care.

6.0   Conclusion and Implications

6.1   Introduction

Through analysis of semi-structured interview transcripts, the preceding chapters of this study have identified the ethics of care considerations and the classroom practices of care used by teachers involved in long term PLD programmes for mathematics teaching.

Section 5.2 discusses these findings in relation to the implications of this research in terms of teacher mindset toward ethics of care. In section 5.3 the implications for classroom practices of care are explored. Section 5.4 outlines the limitations of the current study. The arising potential future research opportunities are considered in section 5.5. An overall summation and final thoughts are given in section 5.6.

6.2   Supporting Teacher Mindset Towards Ethics of Care

Prior research and literature outlined in chapter 2.0 established how the way in which teachers think about and value ethics of care has a direct impact on their implementing of practices of care in the mathematics classroom. Throughout this study the changes and shifts in teacher's views on care during their involvement in PLD have been explored. Multiple themes emerged describing the shifts in teacher mindset toward ethics of care attributed to their participation in PLD such as the DMIC programme.

The study of Rubie-Davies and Peterson (2016) showed how teachers' expectations of student ability correlates to student achievement in mathematics. In her doctoral thesis Hunter (2007) showed how a focus on expectations within ethics of care positively impacted teachers' belief in their students' capacity for mathematical attainment. In the same vein, this study showed a shift in teachers' perspectives on their students' mathematical abilities in response to participation in PLD. Prior to undertaking professional learning teacher participants viewed students' capacity in

mathematics as fixed and held constructs of students as being divided into those that could achieve well in math and those who could not. The results showed a shift in this mindset toward genuinely held beliefs that all students have the capacity to achieve well in mathematics.

The effect of PLD in raising the capacity of teachers to understand and articulate the meaning of ethics of care and its important role in teaching mathematics was illuminated within the current study. Teachers who had been involved with a PLD programme for greater lengths of time were more easily able to articulate their views on care and its role in their planning and teaching practices. Many teachers made comparisons and reflected on their current perspectives of care in relation to their perspectives before participating in PLD. These reflections showed a significant change toward actively considering care in actions of mathematical teaching.

This current research contributes toward the current body of literature by investigating the specific impacts of involvement in PLD on teachers' mindsets toward ethics of care in mathematics. It shows the transitions and challenges teachers experience during their journey of participation in culturally sustaining PLD and the ultimate shift toward greater understanding and active consideration of ethics of care in mathematics teaching. The practical flow on effects of these shifts in mindset are explored in section 5.3 which examines the application of care practices in mathematics.

6.3   Outlining Practices of Care in Mathematics

The findings of this study highlighted practices of care identified by participants as fundamental to their mathematics teaching. In semi-structured interviews, participants described using practices of care stemming from their ethics of care mindsets outlined in section 5.2. Teachers used these practices as acts of care aimed at building culturally sustaining mathematical learning environments.

Participants described transitioning their classroom practices in response to their participation in ongoing mathematics PLD. These practices included considerations of care at the planning stage of mathematics lessons such as ensuring lessons were constructed around valuing students' identities and culture, basing lessons on students' prior held knowledge, and incorporating high expectations of student achievement. They also included teacher actions such as offering student explicit guidance on participation skills, positioning themselves as a facilitator rather than a leader during lessons. Other changes in practices were based on classroom and lesson organisation with shifts to a strong focus on building relationships and a collaborative structure for learning activities.

Also seen by interview participants as important to the practices of care were the contexts through which mathematics teaching and learning took place. Contexts of care which participants described as frequently used in their mathematics teaching were whānau, community and student interest. Contexts of care related strongly to themes emerging in the literature review from works such as Biddulph et al. (2003) and Cunningham et al. (2005) who champion connection between whānau and schools as critical for the academic success of Māori and Pāsifika students. The use of school-based contexts was primarily referred to in relation to being minimised and with examples of attempts to move away from school-based tasks. This was also in line with the literature review discussion of discouragement of school-based contexts in favour of building genuine connection to student's lives outside of school (Hunter & Hunter, 2017). Place-based contexts were the least frequently mentioned by participants. This was consistent with the literature review which indicated place-based contexts as under-implemented in New Zealand schools (Jahnke, 2012). Comments by one participant suggested that this is an area of growth which teachers who have embraced practices of care are open to incorporating.

6.4   Study Limitations

Despite being qualitative in nature, sample size could be considered a limitation of this study as the number of participants interviewed was small enough that

generalisability may be impacted (Noble & Smith, 2015). The small sample sized resulted in a homogenous group for both ethnicity and gender. Although this is not a-typical of the New Zealand teaching workforce, it would be prudent to ensure the results of this study were comparable in a more diverse population (Ministry of Education, 2020). It is acknowledged that the findings do not represent all teachers who have undergone professional learning such as that of the DMIC programme (Absolon & Willett, 2005; Morss, 1996). The benefits of increasing the diversity of the sample group are further discussed in section 5.5.

Subjectivity is another limitation presented by this study. As the video observations sessions were unable to take place, the findings of this research are drawn solely from participants judgements of their own teaching. Therefore, some issues of validity or reliability are likely to be present. Had this study been able to employ multiple data collection methods, mutual findings would have enhanced these aspects through triangulation (Noble & Smith, 2015).

Owing to the complex nature of both ethics of care and classroom practices themselves as well as the inexperienced nature of the researcher, the scope of discussion could be called into question. The researcher has minimised this through extensive familiarisation with a wide range of prior existing data sources and thorough consolation with participants regarding findings (Noble & Smith, 2015). However, there remains the possibility of differing interpretations of the data and the researcher acknowledges that this study represents only one such interpretation.

6.5   Future Directions

Whilst this study interviewed teachers with a wide range of experience levels in both length of time teaching and length of time in a programme of PLD, the sample size was small. Further investigations with a larger sample size would provide confidence in the generalisability of results.

Similarly, because of the small number of participants there was little diversity in terms of ethnicity and gender. A more extensive study with a wider diversity of participants would ensure opportunity for exploration of alternative viewpoints which may not have been produced in this study.

This study pinpointed several practices of care currently being used by DMIC experienced teachers to teach mathematics. These were broadly examined in the findings of this investigation. However, a more in-depth study solely focussing on how these practices of care contribute to the success of ongoing PLD programmes in raising the achievement of Māori and Pāsifika students could support the development of a framework or guideline for care practices in New Zealand's mathematics classrooms. The findings of this study indicate that a guideline for care practices would be welcomed by teachers beginning their PLD journey.

6.6   Concluding Remarks

This study's purpose was to investigate the influence of participation in ongoing programmes of PLD on mathematics teachers' conceptions of ethics of care and to identify the specific practices of care used by these teachers in the mathematics classroom. Semi-structured interviews with teachers involved in the professional learning within DMIC were used to gain insights into the perceptions of mathematics teachers on ethics of care and how these perceptions influenced their pedagogical practices. The findings of this study suggest ongoing programmes of mathematical PLD have numerous and complex implications for ethics of care.

Through engaging in ongoing programmes of PLD such as DMIC, teachers were shown to experience significant shifts in their understandings and mindsets towards ethics of care. These shifts in perception were considered by participants as instrumental in influencing changes to their teaching practices in mathematics.   Teachers   who have ongoing participation in programmes of PLD described care as an important driver in their lesson planning, group structuring and acts of teaching within the mathematics classroom.

In analysing the semi-structured interviews specific practices and contexts of care used by mathematics teachers were identified. Through active teaching of skills for participation, valuing of student identities and cultures, seeking to build relationships, holding high expectations for student achievement, introducing collaborative learning opportunities and valuing student knowledge as fundamental to mathematical learning, teachers were able to build student self-image and confidence as mathematicians and create culturally sustaining learning environments.

These conclusions reiterate the complexities of ethics of care and contribute to the growing literature on ethics of care in mathematics and the New Zealand educational context. They also add to the body of literature on such culturally sustaining PLD for teachers. This research can aid teachers new to ongoing mathematics PLD in their understanding of the ethics of care mindset and the importance of ethics of care in mathematics. It can also inform of them of successful approaches to implementing care practices in their mathematics classrooms.

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Appendices

Appendix A: Interview Guide Sheet

Interview Questions:

Teacher understanding of ethics of care

- What is your understanding of the term ethics of care in relation to teaching mathematics?

- How do you seek responses to care/confirmation of care from students in the mathematics classroom?

Teacher practice of ethics of care specific to Mari and Pasifika students

- What do you believe are key ethical concerns when it comes to care practices for Māori and/or Pāsifika students in a mathematics context?

- What practices would you say are important for ethics of care when teaching students of a different ethnicity than your own?

- What strategies and practices do you use in your teaching to connect math to the lives of Māori students?

- What strategies and practices do you use in your teaching to connect math to the lives of Pāsifika students?

DMIC impact on ethics of care

- In relation to care, what impact do you think DMIC PD has had on your decision making when planning for teaching math?
  - How does this compare to your thinking processes when planning for mathematics in the past?

- What specific teaching actions stemming from DMIC PD do you use in mathematics teaching to bring care into the classroom?

- How has DMIC mathematics PD impacted your relationship building with your students?

- How has the DMIC PD programme had an impact on your awareness of student needs in relation to mathematics teaching?

- What impact have you seen on the learning culture in your classroom since undergoing DMIC PD?

Advice on ethics of care for those new to DMIC

- What advice would you give a teacher who is new to DMIC about how to bring care practices into their math classroom?

Other

- Is there anything further you would like to add?

Demographic information (collected at end of interview):

Age: 18-24   25-34   35-44   45-54   55-64   65+

Prefer not to disclose

Gender: Male   Female   other/non-binary   Prefer not to disclose

Ethnicity: Māori   Pākehā   Pāsifika   Asian

other _____   Prefer not to disclose

Number of years teaching: less than 2   2-4   5-9   10-14

15-19   20-24   25-29   30-34   35-40   40+

Prefer not to disclose

Number of years using DMIC based teaching strategies:

less than 1   1-2   3-5   5+ years   Prefer not to disclose

Appendix B: Diary of Research Analysis

Date	Thoughts/actions
14/07/2021	Read through transcribed data from interviews 1 and 2 for familiarisation.
16/07/2021	Re-read data.
17/07/2021	Made notes on stand out themes from the raw data (teacher perceptions, teacher practice, transference to other curriculum areas, student response to care). Began making notes alongside interview responses to assist code development.
19/07/2021	Completed making notes on interview responses.
22/07/2021	Developed coding methodology guideline with themes and subthemes.
09/08/2021	Read through transcribed data from interview 3 for familiarisation.
11/08/2021	Re-read data.
13/08/2021	Updated coding - removed classroom practices and other practices categories and replaced with contexts of care and practices of care theme categories. Refined coding methodology to reflect this.
16/08/2021	Wrote macros for data coding.
20/08/2021	Began assigning codes to data chunks.
23/08/2021	Further updates and additions to coding methodology made. Clearer categorisation of content for each theme.
02/09/2021	Continued coding
13/09/2021	Added theme of teacher mindset which incorporates teacher perceptions.
14/09/2021	Continued coding data.
15/09/2021	Continued coding data.
17/09/2021	Final tweaks to coding framework. Read over codes to check for accuracy.
20/09/2021	Read over codes to check for accuracy.
21/09/2021	Extracted code data into spreadsheet for use in writing up analysis.
22/09/2021	Performed numerical analysis on percentage of responses in each theme/subtheme.
23/09/2021	Began writing up findings.

Coding Methodology

Theme: Teacher mindset (TP)	
Participant speaks about their own personal understanding and outlook in relation to elements of care, the ethical components behind their decision making in the application of care practices, and the impact or changes that the DMIC professional development programme has had on these viewpoints.	
Sub-theme:	**Criteria:**
Teacher understanding of ethics of care (U)	Participant talks about their own understanding of the elements of care and the ethical considerations of applying them.
Changes in perception of care (CP)	Participant talks about transformation and change of their personal understanding and viewpoint of care in mathematical teaching through the DMIC professional development process.
Changes in perception of students (PS)	Participant comments on changes in how they view their students or student's abilities in mathematics stemming from the DMIC professional development programme.
Changes in perspective of teaching math (M)	Participant speaks about changes to their understanding and viewpoint of math teaching and math teaching practices.
Collaborative teaching (CT)	Participant talks about seeking help from others for aspects of their math teaching or ethics of care practices.

Theme: Practices of care (PC)	
Participant speaks about the practices which they use to implement care in their teaching of mathematics.	
Sub-theme:	**Criteria:**
Teaching skills of participation (SP)	Participant comments on teaching practices which aim to teach the skills of participation and how to learn in the math classroom environment.
Valuing identity and culture (VC)	Participant refers to teaching practices which place value on students' identities and cultures.
Relationship building (RB)	Participant comments on practices which aim to build relationships and understanding between students and teacher.
High expectations (HE)	Participant speaks about holding high expectations for their students' achievement and ability in math.

Theme: Practices of care (PC)	
Collaborative learning (CL)	Participant talks about utilising practices of students working together in mathematics learning.
Student knowledge (SK)	Participant speaks about utilising and or valuing students' previously held knowledge to enhance mathematical learning.

Theme: Perceived student response to care (SR)	
Participant comments on their perceptions of student response to utilised practices of care. This includes how participant seeks and notices responses to care practices.	
Sub-theme:	Criteria:
Positive response (PR)	Participant comments on students' expression of positive emotions or reactions to care practices.
Negative response (NR)	Participant comments on students' expression of negative emotions or reactions to care practices.
Student needs (SN)	Participant comments on teacher awareness of the needs (learning or otherwise) of their students.
Changes in response (CR)	Participant comments on perceived changes over time in students' response to care practices.
Cross subject (CS)	Participant speaks about classroom practices of care influenced by DMIC professional development which students have transferred to curriculum areas outside of mathematics.

Theme: Contexts of Care (CC)	
Participant speaks about the practices which they utilise to implement care practices in their teaching of mathematics.	
Sub-theme:	Criteria:
Family and whanau connection (FW)	Participant refers to care practices undertaken which involve connections with students' whanau.
Community connection (C)	Participant refers to care practices undertaken which involve connections with students' wider community.

Theme: Contexts of Care (CC)	
Place-based education (P)	Participant refers to care practices undertaken which involve connections with the area, land and geographical features of students' and/or the school's location.
Student interests (SI)	Participant refers to practices which utilise student interests to teach math.
School context (S)	Participant speaks about practices which utilised students' school-based experiences to teach math.

Appendix C: Teacher Information Sheet

Ethics of Care in Developing Mathematics Inquiry Communities: Best practice for non-indigenous teachers working with Māori, Pāsifika and other diverse learners

INFORMATION SHEET

Researcher(s) Introduction

This research is conducted by the researcher Melanie Stone in pursuit of a Master of Education (Māori education) qualification. Melanie is a current master's student at Massey University under the guidance and supervision of Professors Roberta Hunter and Jodie Hunter.

Project Description and Invitation

This research will investigate the relationship between use of the Developing Mathematic Inquiry Classroom [DMIC] teacher professional development model and the implementation of ethics of care in classroom mathematic teaching practices, with the intention of developing a guide to ethics of care for non-indigenous teachers working with Māori and Pāsifika students in DMIC environments.

Research questions this study seeks to answer:

- What do teachers in mid-upper primary school (years five and six) classrooms who have undertaken DMIC professional development perceive as critical to ethics of care and which practices do they use to enact ethics of care with Māori and Pāsifika students?

- What best practices can non-indigenous teachers of Māori and Pāsifika students enact to implement ethics of care withing mathematics classrooms in New Zealand?

Care and ethics of care

For this study, the process of care has been defined in terms of Tronto's 1993 key elements of care.

1. Attentiveness: A teacher recognizing a need of a student.
2. Responsibility: The teacher accepting responsibility for meeting the identified need.
3. Competence: The teacher carries out an act/s of care to meet the student's need.
4. Responsiveness: The student responds to the act of care.
5. Trust: Trust is built between the student and the teacher.

103

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Ethics of care is the decision-making process behind acts of care in classroom teaching.

Participation in this research will involve a one-on-one sound recorded interview (you are welcome to bring a support person along with you) and a video and sound recorded observation of a math lesson in your classroom.

You are invited to participate in this research based on the following criteria:

Participant Identification and Recruitment

- Teacher participants have been selected based on their employment at schools using the DMIC teacher professional development model.

- Participation is open to teachers of all ethnicities, ages and experience levels who have undertaken DMIC professional development and who teach years 5 and 6 students.

- Teachers of year 5 and 6 have been selected to ensure students are an appropriate age to give informed consent.

- Schools undertaking DMIC professional development have been identified from the work of Professor Bobbie Hunter.

- This research is aiming to interview between two to three teachers in order to fit the feasible size for a master's research study.

- There is no control group involved in this research.

- Interview Participants are not expected to incur any expense as the result of participating in this research. Interview participants will be provided with a small voucher for a local café as koha to acknowledge contribution of their time.

- Identified risks to participants include the potential for un-comfortability or embarrassment in having their teaching practices examined.

Project Procedures

- Teacher participants will be involved in a 1-hour (audio recorded) interview regarding their teaching practices and decision-making processes focused on DMIC and ethics of care as well as a video recording of a typical mathematic teaching sessions in their classroom. Recordings will be minimally invasive and observational only.

- Involvement with video recording of mathematics lessons will not require additional time commitments from participants. Involvement in interviewing will take 1 hour per participant.

- There are no financial interests of outside parties in connection to this research. The researcher is not aware of any conflicts of interest pertaining to this research.

- The researcher does not foresee any adverse physical or psychological outcomes for participants as the result of participation in this research. However, participants are encouraged to approach the researcher and/or supervisors should any concerns arise.

Data Management

- All data collected for this study, including but not limited to; interview recordings, interview transcripts, video recordings, and video transcripts, will be used for the sole purpose of informing the student researcher's master's thesis.

- Following the interview recordings, data will be transcribed into text and presented back to participants to confirm accuracy. After this, individuals will be assigned randomly generated pseudonyms and data will no longer be identifiable/traceable to specific individuals. Once pseudonyms have been assigned all data will be thematically analysed for common themes.

- Video recordings will also be transcribed into text and presented back to individual participants to confirm accuracy before being assigned pseudonyms and thematically analysed for common themes.

- After completion of the researcher's master's thesis, all collected data will be destroyed.

- All data, in both raw and analysed formats, including interview recordings, interview transcripts, video recordings, video transcripts, personal and demographic data, and final reports, will be stored on an encrypted hard drive accessible to only the researcher and research supervisors.

- Findings will be presented back to participants both individually and at a meeting located at the school following the initial analysis and prior to final publishing. The published research will be formally presented to the participants and wider school community upon completion of the researcher's master's thesis. If a participant is unable to attend one of these meetings and wishes to receive a copy of the findings, this can be arranged by contacting the researcher in person or through one of the below listed contact methods. Findings will be communicated both verbally and in text formats.

- In all cases where findings are presented, pseudonyms will be used to preserve confidentiality and prevent individual identification.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question.
- withdraw from the study at any time.
- ask any questions about the study at any time during participation.
- provide information on the understanding that your name will not be used unless you give permission to the researcher.
- be given access to a summary of the project findings when it is concluded.
- ask for the audio recording device/video camera to be turned off at any time during the interview/lesson.

Project Contacts

Student researcher: Melanie Stone
Phone: ████████████
Email: ████████████████████

First supervisor: Dr Bobbie Hunter PhD (Professor of Pasifika Education Studies)
Phone: 09 213 6530
Email: r.hunter@massey.ac.nz

Second supervisor: Jodie Hunter PhD (Associate Professor Institute of Education)
Phone: 09 213 6518
Email: j.hunter1@massey.ac.nz

You are invited to contact the researcher(s) and/or supervisor(s) at any stage before during or after the research if you have any questions about the project.

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

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Prof Craig Johnson, Director, Research Ethics, telephone 06 356 9099 ext. 85271, email humanethics@massey.ac.nz".

Appendix D: Teacher Consent Form – Interview

Ethics of Care in Developing Mathematics Inquiry Communities: Best practice for non-indigenous teachers working with Māori, Pāsifika and other diverse learners

PARTICIPANT CONSENT FORM INTERVIEW - INDIVIDUAL

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

1. I agree/do not agree to the interview being sound recorded.
2. I wish/do not wish to have my recordings returned to me.
3. I agree to participate in this study under the conditions set out in the Information Sheet.

Declaration by Participant:

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

Signature: _____   Date: _____

Appendix E: Teacher Consent Form – Video Observation

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Ethics of Care in Developing Mathematics Inquiry Communities: Best practice for non-indigenous teachers working with Māori, Pāsifika and other diverse learners

PARTICIPANT CONSENT FORM VIDEO OBSERVATION - INDIVIDUAL

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

1. I agree/do not agree to the lesson being sound recorded.
2. I agree/do not agree to the lesson being image recorded.
3. I wish/do not wish to have my recordings returned to me.
4. 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.
5. 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.

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 group. There are risks in taking part in group research and taking part assumes that you are willing to assume those risks.*

6. I agree to participate in this study under the conditions set out in the Information Sheet.

Declaration by Participant:

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

Signature: _____   Date: _____

Appendix F: Parent and Student Consent Form – Video Observation

Ethics of Care in Developing Mathematics Inquiry Communities: Best practice for non-indigenous teachers working with Māori, Pāsifika and other diverse learners

PARTICIPANT CONSENT FORM - INDIVIDUAL

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

1. I agree/do not agree to the lesson being sound recorded.

2. I agree/do not agree to the lesson being image recorded.

3. I wish/do not wish to have my child's recordings returned to me.

4. I understand that my child has 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.

5. I understand that all the information I or my child provides 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.

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 group. There are risks in taking part in group research and taking part assumes that you are willing to assume those risks.

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6. I agree to my child's participation in this study under the conditions set out in the Information Sheet.

Declaration by Parent/guardian:

I _____ [print full name] _____ [relationship to child] hereby give

consent on behalf of _____ [print child's full name] to take part in this study.

Signature: Date:

Appendix G: Parent and Student Information Sheet

Ethics of Care in Developing Mathematics Inquiry Communities: Best practice for non-indigenous teachers working with Māori, Pāsifika and other diverse learners

INFORMATION SHEET

Researcher(s) Introduction

This research is conducted by the researcher Melanie Stone in pursuit of a Master of Education (Māori education) qualification. Melanie is a current master's student at Massey University under the guidance and supervision of Professors Roberta Hunter and Jodie Hunter.

Project Description and Invitation

This research will investigate the relationship between teacher involvement in the Developing Mathematic Inquiry Classroom [DMIC] professional development model and teacher practice of ethics of care in the classroom. The goal of this research is to develop a guide to ethics of care for non-indigenous math teachers working with Māori and Pāsifika students.

Research questions this study seeks to answer:

- What do teachers in mid-upper primary school (years five and six) classrooms who have undertaken DMIC professional development perceive as critical to ethics of care and which practices do they use to enact ethics of care with Māori and Pāsifika students?

- What best practices can non-indigenous teachers of Māori and Pāsifika students enact to implement ethics of care withing mathematics classrooms in New Zealand?

Participation in this research will involve your child/ren being video and sound recorded during one of their regular math lessons. The research is observational only and involves no changes to teaching methods or content. Your child/ren will have the same learning experience/opportunities whether they participate or do not participate in the research study. No individuals or locations will be identifiable in the published research.

Your child/ren are invited to participate in this research based on the following criteria:

Participant Identification and Recruitment

- Participation is open to students of all ethnicities aged eight or older who are currently enrolled as year 5 or year 6 in the classroom of a participant teacher.

- Schools using DMIC professional development for their teachers have been identified from the work of Professor Bobbie Hunter.

- There is no control group involved in this research.

- Risks to participants include the potential for un-comfortability or embarrassment in being video and sound recorded

Project Procedures

- Student participants will be involved in a video recording of a single mathematic lesson in their classroom. Recordings will be minimally invasive and observational only.

- Involvement with video recording of mathematics lessons will not require additional time commitments from participants.

- There are no financial interests of outside parties in connection to this research. The researcher is not aware of any conflicts of interest pertaining to this research.

- The researcher does not foresee any adverse physical or psychological outcomes for participants as the result of participation in this research. However, participants are encouraged to approach the researcher and/or supervisors should any concerns arise.

Data Management

- All data collected for this study, including but not limited to; video recordings, and video transcripts, will be used for the sole purpose of informing the student researcher's master's thesis.

- Video recordings will be transcribed into text and presented back to individual participants to confirm accuracy before being assigned pseudonyms and thematically analysed for common themes.

- After completion of the researcher's master's thesis, all collected data will be destroyed.

- All data, in both raw and analysed formats, including; video recordings, video transcripts, personal and demographic data, and final reports, will be stored on an encrypted hard drive accessible to only the researcher and research supervisors.

- The published research will be formally presented to the participants and wider school community upon completion of the researcher's master's thesis. If a participant is unable to attend one of these meetings and wishes to receive a copy of the findings, this can be arranged by contacting the researcher in person or through one of the below listed contact methods. Findings will be communicated both verbally and in text formats.

- In all cases where findings are presented, pseudonyms will be used to preserve confidentiality and prevent individual identification.

Participant's Rights

You are under no obligation to accept this invitation.   If you decide to participate, you have the right to:
- decline to answer any particular question.
- withdraw from the study at any time.
- ask any questions about the study at any time during participation.
- provide information on the understanding that your name will not be used unless you give permission to the researcher.
- be given access to a summary of the project findings when it is concluded.
- ask for the audio recording device/video camera to be turned off at any time during the interview/lesson.

115

Project Contacts

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You are invited to contact the researcher(s) and/or supervisor(s) at any stage before during or after the research if you have any questions about the project.

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

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Prof Craig Johnson, Director, Research Ethics, telephone 06 356 9099 ext. 85271, email humanethics@massey.ac.nz".