

TĀTAI KŌRERO I NGARO, TĀTAI KŌRERO E RANGONA
LEGITIMATION AND THE LEARNING OF CURRICULUM
MATHEMATICS IN AN INDIGENOUS MĀORI SCHOOL

BY

BRIAN TWEED

A thesis

submitted to

Te Whare Wānanga o te Ūpoko o te Ika a Māui

The Victoria University of Wellington

in fulfilment of the requirements for the degree of

Doctor of Philosophy

Victoria University of Wellington

Te Whare Wānanga o te Ūpoko o te Ika a Māui

2016

To Mum and Dad, and my brothers and sisters

Jan and Gord, Liz and Jim, Gerry and Jane,

Eve and Brian, Dot and John, and Phil and Elaine.

Acknowledgements

Firstly, to my family and friends who have tolerated me during the many trials and tribulations of this doctorate journey I send my love, gratitude and heartfelt apologies.

To my supervisors, Associate Professor Joanna Higgins and Associate Professor Joanna Kidman, I give my warmest personal thanks for your hard work, support and all those really hard questions. I hope that being my supervisor also contributed positively to your lives. Doctor James Graham is also acknowledged for his supervision in the early stages of the thesis.

Special acknowledgement must be made of all the teachers, students and whānau of the kura Māori who participated in this project. You have so graciously and patiently allowed a glimpse into your lives and the kaupapa of your kura. It is my sincerest hope that this thesis contributes to the kaupapa.

Victoria University generously considered the research worthy of a doctoral scholarship and a doctoral submission scholarship. I would like to express my gratitude to the University for this vital financial support.

Without the unstinting support of my partner and colleague, Pania, this thesis would have been impossible. Heoi anō tāku, he tautoko kē i a koe, hani.

Nō reira, ka tukua nei āku mihi nūnui ki a koutou katoa.

Contents

Acknowledgements	i
Contents	iii
List of Figures	vi
List of Tables.....	viii
Abstract	1
Chapter 1 - Introduction.....	3
Research Questions	4
The Background of Pāngarau Education	5
A Brief History of Pāngarau	6
The Research Paradigm of the Thesis	9
The Researcher - A Personal Account of Arrival at Research	11
Relations to Existing Research Literature	12
The Contribution of the Thesis to Knowledge	20
Chapter 2 - Theoretical Framework	23
The Intransitive and Transitive Dimensions of Reality	24
Fallibilism.....	27
Indeterminacy, Dialectical Relations and Social Life	29
Stratified Ontology and Laminated Structures	34
Emergence, Agency and Social Structures.....	35
Critiques of Critical Realism	41
Social Fields.....	42
Recontextualisation, Diffraction and Refraction	45
Evaluation and Legitimation.....	48
Dialectical Learning	50
Causality	53

Hegemony and TINA Formations.....	57
Absence, Presence and Being-in-Becoming.....	58
Causal Mechanisms.....	60
Conclusion.....	62
Chapter 3 - Realist Methodology.....	65
The Overall Methodological Strategy.....	67
Data Collection Methods.....	81
Recognition Rules: Evaluation.....	92
Realisation Rules: The Interpretive Framework.....	98
Using the Analytical and Interpretive Frameworks.....	120
Chapter 4 - Case Examples.....	141
Whaea L.....	142
Whaea M (Dominant Regime).....	156
Whaea M (Emergent Regime).....	169
Whaea D (Year 7/8).....	180
Whaea D (Year 11).....	200
Matua J.....	212
The Kura Ethos.....	227
Chapter 5 - Discussion and Conclusions.....	243
Inter-specialisation Tensions.....	243
Intra-specialisation Tensions.....	250
The Knower/Knowledge Dialectic.....	252
Dialectics Revisited.....	254
Summary.....	255
A Causal Mechanism for Struggle for Pāngarau (with promissory notes).....	257
The Description of the Mechanism.....	261
Potentials.....	266

Future Research	269
Conclusion	269
References.....	274
Appendix A - Māori Words used in the Thesis.....	308
Appendix B - Participant Information Sheets and Consent Forms	310
Appendix C - Interview Question Guide	314

List of Figures

Figure 2.1. The theoretical framework.	23
Figure 2.2. Relations between a stratified intransitive reality and stratified transitive knowledge.	26
Figure 2.3. Dialectical relations underpinning aspects of social life.	33
Figure 2.4. Legitimation and evaluation as maintaining components of social fields in relation to social reality and intransitive reality	49
Figure 2.5. The theoretical framework (repeated for convenience).	62
Figure 3.1. Real, actual and empirical domains related to stratified ontology and knowledge.	66
Figure 3.2. Overall relationships of ontology and methodological components	67
Figure 3.3. Contextualised methodological components.	80
Figure 3.4. Conceptualisation of interpretation as realisation rules of the external language of description.	99
Figure 3.5. Social ontologies, explanatory frameworks and substantive research studies in the context of the thesis.	104
Figure 3.6. The 4-K model of epistemic and social relations.	106
Figure 3.7. The specialisation framework/tree.....	110
Figure 3.8. The translation of contextualised features to specialisation code.....	112
Figure 3.9. Example of a simple specialisation tree.	113
Figure 3.10. Example of a multi-specialised specialisation tree.	114
Figure 3.11. Representing specialisations on a topological plane.....	116
Figure 3.12. Analysis and interpretation strategy used in each case example.	121
Figure 3.13. Provisional specialisation tree and topological specialisation plane for Whaea L.	138

Figure 4.1. Whaea L's regime - specialisations of the epistemic relation and social relation.	149
Figure 4.2. Whaea M's dominant regime- specialisations of the epistemic relation and social relation.	164
Figure 4.3. Whaea M's emergent regime - specialisations of the epistemic and social relation	174
Figure 4.4. Whaea D's Year 7/8 regime - specialisations of the epistemic relation and social relation	195
Figure 4.5. Area problem - find the area of the unused section.	201
Figure 4.6. Whaea D's Year 11 regime- specialisations of the epistemic relation and social relation.	207
Figure 4.7. Shift of specialisations between Whaea D's Year 7/8 and Year 11 regimes	210
Figure 4.8. Matua J's regime - specialisations of the epistemic relation and social relation.	221
Figure 4.9. The Kura ethos - specialisations of the epistemic and social relation.	239
Figure 5.1. Topological representation of all pāngarau specialisations and the Kura ethos specialisation	244
Figure 5.2. Regimes as refractions/diffractions of the knower/knowledge dialectic.	254
Figure 5.3. Causal mechanism for struggle with pāngarau.	260

List of Tables

Table 3.1. Data collection methods.	91
Table 3.2. Evaluations concepts.	97
Table 3.3. Generic descriptions for specialisation concepts.	111
Table 3.4. Realising contextualised statements as abstract specialisation concepts.	135
Table 4.1. Whaea L's pāngarau regime related to specialisation concepts.	147
Table 4.2. Whaea M's dominant regime related to specialisation concepts.	163
Table 4.3. Whaea M's emergent regime related to specialisation concepts	173
Table 4.4. Comparison of specialisations in Whaea M's dominant and emergent regimes. .	177
Table 4.5. Whaea D's year 7/8 regime related to specialisation concepts.....	193
Table 4.6. Whaea D's year 11 regime related to specialisation concepts.....	206
Table 4.7. Matua J's regime related to specialisation concepts.	220
Table 4.8. The Kura ethos related to specialisation concepts	238
Table 5.1. Summary of all specialisations of epistemic relations in terms of strength, type, insight, lens, and strength.....	248
Table 5.2. Summary of all specialisations of social relations in terms of strength, type, gaze and lens, and strength.....	248

Abstract

In this thesis, the learning of conventional curriculum mathematics in indigenous Māori schools is conceptualised as a site of struggle within the wider context of a national New Zealand education system. For example, the research literature documents the effects of inadequate mathematics education resources, detrimental impacts on the nature of traditional Māori language and cultural practices, and concerns about under-achievement of Māori students in mathematics and access to powerful societal knowledge. The thesis aims to uncover a causal mechanism for the struggle with mathematics education in one Māori school.

Empirical data about mathematics learning activities are examined using a theoretical perspective strongly influenced by Dialectical Critical Realism. The methodological frameworks are based on Basil Bernstein's sociology of education, Systemic Functional Linguistics and Legitimation Code Theory. Using these theoretical and methodological tools, empirical data are related to deeper-level ontological determinations which underpin practices in the Māori school.

The major conclusion of the thesis is that struggle derives from two conflicting ontological determinations about the nature of a person. Mathematics education tends to construe people, and create subjectivities, in terms of their knowledge. The ethos of the Māori school considered in this thesis tends to construe people, and create subjectivities, in terms of their genealogically-embedded, unique, material and spiritual natures.

Based on this conclusion, the thesis indicates some potential consequences and future developments of mathematics education in Māori schools. These developments may be thought of in general terms as a disengagement from current relations with mathematics education, an establishment of autonomy, and a re-engagement with mathematics on different terms.

Chapter 1 - Introduction

Over the last 30 years, an indigenous education system has been established in New Zealand in which Māori families and schools provide an education for their children immersed in the Māori language and based on Māori philosophy. Pāngarau has emerged as a version of conventional, curriculum mathematics education for these schools. Pāngarau is considered in this thesis to be a site of struggle because it is an interface between two knowledge domains - mathematics and mātauranga Māori (Māori knowledge). It is also embedded within a nation-wide emancipatory project which seeks to secure the achievement of Māori aspirations in a variety of fields. Amongst these aspirations are the revitalisation of Māori language and culture, increased self-determination, and the reclaiming of the means to create an autonomous future indigenous Māori society (Durie, 2003, 2011; Sissons, 2005). Most importantly, in the context of this thesis, Māori children must be reclaimed in order to create this future Māori society (Sissons, 2005, p. 140).

The political aspects of this nation-wide emancipatory project, which is also part of a global indigenous movement (Sissons, 2005), are circumscribed by the Treaty of Waitangi. The Treaty, signed in 1840, was an agreement between the British Crown, now the New Zealand Government, and most, but not all, Māori tribal groups (Iwi). It guaranteed control by Māori over all of their cultural and material resources. The Treaty is still instituted and embedded throughout current New Zealand legislature. It has provided the basis on which settlements have been negotiated to partially compensate Iwi for historical and continuing injustices. It has also provided political leverage for Māori to establish revitalisation projects such as the establishment of Māori schools (Durie, 2012; G. H. Smith, 2000, 2003).

(Henceforward the Māori phrase *kura Māori* will be used for Māori school or schools. The phrase *kura Māori* can refer to a single school or many schools; context must be taken into account to decide which. See appendix A for a list of all Māori words used in this thesis and the approximate English meaning.)

The New Zealand Government is, generally speaking, well-disposed towards Māori interests. There are a significant number of Māori members of parliament, a Māori political party, and support is provided for Māori initiatives in education. For example, *kura Māori* are fully supported financially with new *kura* currently being established. Professional learning initiatives organised by the New Zealand Ministry of Education, such as The New

Zealand Numeracy Development Project, have been recontextualised for kura Māori with an explicit aim of language re-vitalisation along-side aims of developing teacher competencies in conventional, curriculum mathematics education.

The struggle with pāngarau can be related in general terms to frictions generated by the need to prepare students in kura Māori to participate in New Zealand general society whilst attempting simultaneously to establish them as indigenous Māori people (Macfarlane, Glynn, Grace, Penetito, & Bateman, 2008; Penetito, 2010). This thesis does not address the more general political and ideological struggles associated with the larger Māori emancipatory struggle. It examines instead dilemmas presented on a daily basis in actual pāngarau learning activities with the understanding that analysis of such small-scale struggles can reveal how dilemmatic choices characterise and perpetuate larger societal beliefs. These dilemmas ultimately relate to differing social ontologies (Billig, 1991; Billig, Condor, Edwards, Gane, & Middleton, 1988). With this in mind, the thesis takes a close look at empirical data about pāngarau learning activities enacted in a kura Māori and relates findings to some fundamental ontological determinations which underpin practices.

The whakataukī (proverb) “Tātai kōrero i ngaro, tātai kōrero e rangona” (Mead & Groves, 2004, p. 362), is used as the title for the thesis because it is interpreted here as conveying the notion that current pāngarau practices are held in place by certain schemes of legitimation, *tātai kōrero e rangona* (some schemes will be heard), with other, potentially viable schemes being made absent, *tātai kōrero i ngaro* (some schemes are lost). This also simultaneously implies that other schemes may be made present in the future and the current ones made absent; there is potential for new forms of pāngarau education to emerge.

Research Questions

The thesis examines detailed empirical data from one kura Māori (henceforward referred to as *the Kura*) and attempts to illuminate the ways in which struggle is expressed in actual classroom pāngarau activities. It then attempts to relate these expressions to sociological and philosophical concerns which are woven into the fabric of attempting to mediate simultaneous participation in general society and Māori society.

The thesis aims therefore to answer, in part at least, the following three questions.

1. How is struggle with pāngarau expressed in the Kura?
2. What causes these expressions of struggle with pāngarau?
3. What are some potential consequences and developments for the Kura?

The Background of Pāngarau Education

Pāngarau has emerged in the broader context of the establishment of a Māori educational system in New Zealand. This Māori education system was a response to the perceived inability of New Zealand's general (English-medium) education system to provide equitable education for Māori students. It also has a major objective of the re-vitalisation of Māori language and culture (Bishop, 1996). It began with a clear transformative and emancipatory purpose; it sought to transform the educational experience of Māori students (G. H. Smith, 1990). It also challenged English-medium schooling, in which all Māori students were previously enrolled, at the ideological and structural levels in order to break cycles of social and cultural reproduction (Jones, Marshall, Matthews, Smith, & Smith, 1995, pp. 188-191).

Beginning with the establishment of the first Māori language pre-schools, called *kohanga reo* (*language nests*), in 1982, the Māori education system has grown to include primary schools, secondary schools, and universities. In this system, indigenous values, knowledge, language and practices are normalised as far as possible. Māori involved in this system have developed their own interpretations and methods of how to improve Māori student achievement and to achieve social justice through education (Penetito, 2010).

The Māori education system has achieved a degree of success and become part of the educational landscape in New Zealand. New Zealand Government education policy or Ministry of Education initiatives cannot ignore this Māori education system. In addition, there has been significant exchange of ideas between the two systems. Kura Māori have developed distinctive philosophies which have become a source of inspiration for English-medium schools which must adapt to increasing numbers of Māori students. These have been partially appropriated and, in some cases distorted, for the purposes of English-medium education (Berryman, 2013; Lee, 2006; Marshall, Coxon, Jenkins, & Jones, 2000). At the same time, various, government-sponsored initiatives, such as the New Zealand Numeracy

Development Project and New Zealand National Standards for primary schools, have been recontextualised and established in some kura Māori.

New Zealand Government concerns about apparent Māori under-achievement in the education system have become a major focus of policy and resource provision (New Zealand Ministry of Education, 2009, 2013). This is currently a controversial and politically-charged area in which kura Māori are critiqued for under-achieving in powerful knowledge areas such as science and mathematics (Rata, 2011, 2012; Young, 2013; Young, Lambert, Roberts, & Roberts, 2014, p. 78) but are nevertheless able to show improved overall achievement compared to Māori students in English-medium schools (Stewart, 2012; Wang, Harkess, & Parkin, 2007). This debate is important but not entered into in this thesis.

In the light of this discussion, kura Māori can be seen to be precariously placed between the demands of a contemporary Māori society and New Zealand general society. Kura Māori are operating as mediating structures which must negotiate within existing educational structures whilst simultaneously attempting to contribute to the transformation of Māori society (Penetito, 2010, pp. 222-236). In this context, pāngarau has emerged as a parallel development in the Māori language of conventional, curriculum mathematics education.

A Brief History of Pāngarau

The development of pāngarau is punctuated by issues of mediation. In the early years of kura Māori, in the nineteen-eighties and early nineteen-nineties, pāngarau education was piecemeal; English-medium resources were used directly or translated laboriously by individual teachers. The very few publications from this time appear as direct translations in both language, structure and content of English-medium resources (Barton, 1989; Elvin, 1988). Individual teachers, often working in isolation, developed ad-hoc resources, pedagogy and words to teach their students conventional curriculum mathematics content resulting in some significant variations between kura Māori in different regions.

During the nineteen-eighties, kura Māori students were progressing through the primary years of schooling (years 1 to 8/ages 5 to 13) so that issues of variation in mathematics terminology, resources and pedagogy were less pressing than other issues to do

with language re-vitalisation. By the early nineteen-nineties these students were making the transition to secondary schooling and interacting with national qualification systems. Concerns in kura Māori at this time centred on the need to develop quality mathematics teaching and learning resources, language development in mathematics education and effects on Māori language, cultural practices and worldview (Barton & Fairhall, 1995; I. Christensen, 1996; Te Puni Kōkiri, 1993)

At this time, the New Zealand Ministry of Education was developing national curricula for all learning areas in New Zealand schools. The opportunity was taken by a group of Māori curriculum developers to produce a version of the mathematics curriculum for kura Māori (Te Tāhūhū o te Mātauranga/New Zealand Ministry of Education, 1996). The process of producing this curriculum was an exercise in empowerment but not emancipation; the developers were allowed to translate content as they wished but not change that content or structure (McMurchy-Pilkington, 2004). This curriculum represented a strategic move on the part of kura Māori. Even though the curriculum did not meet aspirations, it had many benefits in terms of establishing teams of advisers to support kura Māori, and official funding for resources and professional development. It also provided the impetus for a strengthening and quickening of the standardisation of the mathematics register, resources and pedagogy. The double-edged nature of mediation is clearly seen in this process; official status and support was given to mathematics education, now routinely known as pāngarau, but the New Zealand Ministry of Education required pāngarau to conform to English-medium curriculum structure.

The New Zealand Ministry of Education published a revised pāngarau curriculum in 2008 (Te Tāhūhū o te Mātauranga, 2008). By this time, political conditions had changed to such a degree that Māori developers of the pāngarau curriculum had much more freedom and control over content, language and structure. The only requirement was to match an eight-level hierarchy of content knowledge which runs through all learning areas in both English-medium and Māori curricula. (McMurchy-Pilkington, Trinick, & Meaney, 2013).

From 2000 to 2009, the New Zealand Numeracy Development Project (called Te Poutama Tau in kura Māori) constituted a major professional learning project for teachers in both English-medium schools and kura Māori. This project aimed to support teachers in the primary and early secondary years so that improved conceptual understanding of mathematics was achieved. It was a response to the perceived poor performance of New

Zealand students in the Third International Mathematics and Science Study of 1995 (Thomas & Tagg, 2004). After its launch in English-medium schools in 2000, it was implemented as *Te Poutama Tau* in kura Māori in 2002. This project has generated the majority of official teaching/learning resources for pāngarau including two editions of a dictionary of curriculum mathematics terms in the Māori language (I. Christensen, 2004, 2010).

After the end of the Numeracy Development Project/Te Poutama Tau, and a change of government in the 2009 election, the New Zealand Ministry of Education developed a set of National Standards for Mathematics intended to act as benchmarks for student achievement in years 1 to 8. In kura Māori, these became recontextualised as Ngā Whanaketanga Pāngarau (Te Tāhūhū o te Mātauranga, 2010) which have taken over as the major generator of official pāngarau professional learning in kura Māori.

As Penetito (2010) points out, the development of kura Māori has meant that they have always been “tied to how far and how fast English-medium education was prepared to see them develop” (p. 241). The way pāngarau has developed exemplifies this somewhat one-sided relationship; all developments for pāngarau in kura Māori are, in one way or another, recontextualisations of prior English-medium developments. These developments have produced benefits for kura Māori but have also placed constraints on what kura Māori themselves may wish to achieve.

The current situation exhibits some features of what Smith calls *domestication* (G. H. Smith, 2012). Pāngarau education has achieved a degree of success which may be defining its future potential. It has a national curriculum, Ministry of Education supported professional learning providers, and a growing range of professionally produced teaching and learning resources. Such success, however, also serves to bind pāngarau to the fortunes of English-medium mathematics education.

In the current context of potential domestication, this thesis examines how the system of conventional mathematics education permeates and is permeated by the Mātauranga-based practices of the Kura and thereby generates tensions and struggle. Informed by the results of this examination, new ways of engaging with mathematics are outlined which may negate domesticating tendencies.

The Research Paradigm of the Thesis

This thesis adopts a realist paradigm very much influenced by Roy Bhaskar's dialectical version of critical realism (Bhaskar, 1993). The theoretical framework that derives from this realist paradigm is developed in detail in chapter 2; only a brief overview is given here.

The paradigm can be summarised in broad terms as a position which accepts the relativity and situated nature of social and cultural discourses (structured activity), but contends that these discourses also involve relations to real entities which are external to those discourses. These real entities exist whether or not discourses relate to them. (Collier, 1994, pp. 6-7; Sayer, 2012, p. 47). This realist position implies a number of other basic tenets of the paradigm of the thesis.

Since discourse (social and cultural activity) is considered to be related to but distinct from real entities, a stratified ontology must be accepted. There are at least two strata: the extra-discursive stratum and the stratum of human discourses. In fact, many more strata can be identified but the point here is that reality is considered to be stratified with different kinds of entity inhabiting each stratum. These entities inhabiting each stratum can be seen to be related to each other and in this thesis they are considered to be dialectically related; components in different strata permeate each other, influence each other, and depend on each other. Furthermore, accepting a stratified ontology (also called a *depth* ontology) also accepts that empirical experience is related to strata which are not apparent in that empirical experience; actors subjectively participating in social and cultural activity may or may not be aware of all the *deeper* influences impinging upon them.

If this stratification (with hidden depths), dialectical co-relation and social/cultural relativity is accepted, then social research in this paradigm is considered to be primarily explanatory rather than descriptive or predictive. In this case, explanation of a social phenomenon is understood to be made necessary by the relativity of social/cultural lives, and the presence of hidden depth. Explanation is constituted by the identification of chains of causality running through the strata, components and dialectical relations of social reality (Manicas, 2009; Maxwell, 2008). Since people clearly do live their ever-changing lives relatively, in different social/cultural realities, with different forms of awareness/subjectivity and with different universes of meaning, social research is always necessary. Trying to

understand why certain phenomena exist in those lives entails investigating chains of causality running across strata which lead back to the connection between discursive knowledge and the extra-discursive real objects of that knowledge.

It is common to contrast and oppose realist approaches with socio-cultural, constructivist and post-modernist/post-structuralist paradigms (Sayer, 2012). Realist positions are often associated with positivism which is strongly critiqued and rejected by critical realists (Bhaskar, 1975). In this thesis, and concurring with Sayer (2012, Chapter 2), it is contended that realist research can, with care, collaborate with research conducted in these other paradigms. In chapter 2, it will become apparent that the theoretical framework draws on and re-interprets many elements from a wide range of other paradigms including post-modern or post-structural. For example, Foucauldian notions of power/knowledge may be compared and contrasted with dialectical critical realism's forms of causality, and dialectical learning may be related to the Deleuzian concept of rhizomatic development. The clarification of relations between dialectical critical realism and post-modern/post-structural theories is suggested here as an area in need of development and further theoretical investigation.

Currently there are a wide range of different theories inhabiting mathematics education research which employ different paradigms and focus on different aspects of mathematics learning activities; this plurality in itself is not problematic (Jablonka, Wagner, & Walshaw, 2013; Lerman, 2006). In general terms, these various theories and research paradigms may be thought of as forms of perspectival switching between different strata and relations (Bhaskar, 1993). This is possible if these strata are connected dialectically so that any actualised phenomenon can be seen as an instance of one or more of the co-related components.

Imagining a stratified ontology in this way is an example of a transcendental argument which lies at the heart of critical realism (Bhaskar, 1975, 1979). A transcendental argument abducts an ontological theory which accounts for the conditions of possibility of a phenomenon (Hartwig, 2007, p. 129). A stratified ontology with dialectical relations running throughout the components of strata provides possible ontological conditions for a proliferation of separate theories in mathematics education research operating profitably side-by-side, and the fusion of different elements of separate theories in a single theoretical framework (as in the practice of bricolage). Different theories and their research gazes focus

on certain strata and blur out, or completely deny, the existence of others. In relation to this notion, Lerman (2001) describes the actions of a researcher as “choosing what to focus on in research through zooming in and out in a classroom, as with a video camera, and selecting a place to stop” (p. 90). In this thesis the video camera has indeed zoomed in and out several times and finally stopped at the ontological underpinnings of pāngarau learning activities in the classrooms of one particular kura Māori.

The Researcher - A Personal Account of Arrival at Research

This section briefly describes my personal background and how I came to be doing this research.

I was born in England and grew up there. I studied mathematics gaining a Master of Science degree before training as a secondary teacher of mathematics. I worked as an English-medium secondary teacher of mathematics, science and information technology from 1984 until 1988 in the South of England. In 1988 I came to New Zealand with my young family.

I spent the next 14 years working as a secondary teacher at a variety of schools in the lower North Island of New Zealand during which I developed, from my point of view, a rapport with many of the Māori students in my classes. At one particular school, this rapport developed to a point where I was forced (by my own interest and by my students) to participate in activities such as Māori performing arts, and welcoming ceremonies.

Eventually, my competency in the Māori language improved sufficiently to allow me to be considered for a teaching position in a new Māori secondary school (a wharekura) being established in the town where I was living. From 2002 until 2004, I worked as a kaiako (teacher) in this wharekura which was the most challenging experience in my teaching career; the immense workload and conflicting tensions drained me completely within three years.

From 2004 until 2011 I worked as a kaitakawaenga (school adviser) based at a nearby university supporting kura Māori from all areas of New Zealand in their endeavours to implement curriculum mathematics and science learning programmes. In this position, I was charged with supporting teachers to implement Te Poutama Tau/New Zealand Numeracy Development Project. Three official reports provide an account of my work in this capacity

(Te Maro, Averill, & Higgins, 2007; Te Maro, Averill, Higgins, & Tweed, 2008; Te Maro & Higgins, 2009).

In 2011, I began this PhD research project.

This history of the lead up to this PhD can be interpreted as providing me with a certain set of sensitisations which generated my interest in *struggle with pāngarau*, although I have only adopted this term during the PhD. As an immigrant to New Zealand/Aotearoa, it is Māori language and culture that is unique and of special interest. As a student of disciplinary mathematics, I am interested in the differences between curriculum mathematics education and disciplinary knowledge, why this is so and what the consequences are for kura Māori. As a citizen of the United Kingdom, and an immigrant, the colonial history of New Zealand, especially in relation to Māori, is made very apparent.

It was during my work as a kaitakawaenga (adviser) that the phenomenon of struggle in the area of pāngarau/curriculum mathematics education was experienced ‘from the other side of the fence’; I had already experienced it directly as a teacher. In working with teachers who were simultaneously attempting to develop their own pāngarau competencies and teach pāngarau in a way consistent with the cultural contexts of their kura, I was doubly alerted to the complex nature of this effort. Teachers and students are simultaneously asked to balance multiple demands which are in various states of harmony/disharmony.

My personal experience of the struggles and tensions associated with pāngarau, as a teacher, and then as a kaitakawaenga/adviser, has led me to the research documented here.

Relations to Existing Research Literature

Relating this thesis to existing literature has proved to be a difficult task because it has developed from long personal experience rather than being constructed in relation to a specific body of literature. The thesis adopts a sociological and philosophical perspective which begins with a realist ontology. This locates it in a broad area of sociological and philosophical endeavour. This perspective also means that the thesis intersects in a variety of ways with many other research areas and paradigms whilst not being located in any of them. It is considered here that the thesis relates to and has potential contributions to make to the following areas of research:

- ethnomathematics,
- critical mathematics education,
- kaupapa Māori theory/ Māori education
- pāngarau education,
- mathematics curriculum enactment, and
- indigenous mathematics education.

Each of these will be briefly discussed and the relations to the thesis clarified.

Ethnomathematics.

Ethnomathematics is taken to mean the recognition and investigation of the philosophy, sociology and phenomenology of localised forms of mathematics (Barton, 1999; D'Ambrosio, 1985, 1990). These localised forms are often associated with distinct cultural groups but may also include other groups oriented towards a profession or an activity in which it can be said that participants are operating with a commonality of identity (Francois & Van Kerkhove, 2010).

The presence of distinctly Māori practices that might be considered ethnomathematical in the above sense were not present in the data. The phenomenon of struggle in the Kura is with pāngarau education which is an instance of what Barton refers to as the near-universal conventional form of mathematics (Barton, 2009). Although this conventional mathematics can itself be considered a form of ethnomathematics (Gerdes, 2001; Wilder, 1981), its near-universal status and official mandation by the New Zealand Ministry of Education presents many challenges to the development of indigenous understandings of quantity, space and relations (Barton, 2009). The thesis comments obliquely on this challenge by identifying instances in which cultural practices are recontextualised, and essentialised, as, mathematical (in the near universal sense) despite having developed without reference to this form of mathematics. This is an important topic to be discussed and analysed elsewhere.

Because of the research aim of uncovering causes of struggle with pāngarau, the thesis is not explicitly ethnomathematical in the sense of investigating distinct Māori cultural

activities which relate to space, time, quantity or quantitative relations. It may, however, contribute to the ethnomathematical literature in the different sense of showing how a cultural group responds to and eventually adapts conventional mathematics education.

Critical mathematics education.

Critical mathematics is taken to be an examination of how conventional mathematics education conveys legitimisation messages to teachers and students about what is valuable in the world, how the world works and how people should think and be in order to participate (O. R. Christensen, Stentoft, & Valero, 2008; Pais & Valero, 2012; Skovsmose & Valero, 2005). These issues overlap with the central concerns of the thesis because these legitimisation messages directly impinge on kura Māori who are involved in a cultural revitalisation project that explicitly aims to establish a Māori way of thinking and being.

Being critical of mathematics education involves sociological and philosophical investigation because mathematics education is involved in both processes of reproducing inequities in society and promoting certain ontologies and epistemologies (Skovsmose, 2009, 2011). It also considers how mathematics may be recruited for critical work in general. Students involved in a critical mathematics education can be involved in using mathematics to support the exploration of many social problems that confront us (Frankenstein, 1983, 2009; Gutstein, 2005).

The wider mathematics education literature contains many examples of critical studies having potential connection with the thesis. Most of this literature engages with equity and social justice issues related to how students from certain cultural backgrounds succeed in school mathematics within a dominant, culturally different education system. This literature is extensive; what follows is a small indication only of its potential relevance to the thesis.

Gutiérrez (2008, 2009, 2012) is concerned with latino/a students in North American, English-medium schools; she introduces the concept of *nepantla* as an important consideration for teachers of these students. This is conceptualised as a state of being between cultural perspectives so that teachers who are embedded in one perspective (Anglo-American usually) can switch to that of their students. Gutiérrez suggests that this is a necessary ability for teachers of students from cultures different to their own. The notion of

nepantla has a potential connection with the thesis which identifies the management of perspective switching as an important ability for kura Māori in engaging with curriculum mathematics.

Again in the North American context, D. B. Martin (2007, 2009, 2012, 2013) and Stinson (2008, 2011, 2013) consider how African American students experience mathematics and are successful because of their culture. This work has potential connection because it illuminates how such students engage successfully with mathematics on their own terms. This resonates with this thesis because engaging with mathematics on Māori terms is identified as an important component of future development of pāngarau.

Mathematics education researchers in South Africa also engage with similar issues impacting on indigenous students in the particular context of post-apartheid South Africa (See, for example, Keitel, 2005). Research in South Africa is noteworthy here since sociologically oriented perspectives are strongly represented; Bernstein's sociology, in particular, underpins several studies (Ensor & Galant, 2005).

The mathematics education literature also contains critical post-modernist/post-structuralist studies which share a common interest with this thesis in asking fundamental questions about the nature, purposes, effects and necessity of mathematics education (Gutiérrez, 2013; Stinson & Bullock, 2012; Walshaw, 2013). Even though this literature adopts a theoretical paradigm that may be considered to be quite different to that of this thesis, the insights generated are of considerable interest. A challenge and an opportunity is presented to consider how the results of research addressing the same questions but based in differing theoretical paradigms may be integrated.

The critical mathematics literature, and wider mathematics education literature that is critical, offer substantial support for an investigation of struggle with pāngarau. The thesis makes a contribution to this field by providing an example of how the nature of pāngarau/conventional mathematics education still presents many critical challenges in an indigenous context despite the apparent autonomy of that context.

Kaupapa Māori theory/Māori education.

Kaupapa Māori theory requires careful consideration in relation to this thesis. Whilst there is a vigorous debate about whether non-Māori researchers can participate in kaupapa Māori research with a range of views expressed for and against the idea, this researcher does not consider this thesis to be a type of kaupapa Māori research. Kaupapa Māori research should be completely under the control of Māori researchers with the research agenda, theorising and methodology designed by Māori and with Māori research participants (Bevan-Brown, 1998). The kaupapa Māori research project is thereby owned by the community and oriented towards practical transformation in the actual contexts of peoples' lives (Tumoana Williams & Ormonde, 2010). This thesis does aim to support the aspirations, inherently transformational, of the Kura in which the research took place. The researcher is committed to being involved with kura Māori and certainly considers the thesis to be diminished if it has no other benefit than the gaining of a doctorate. It is true however that the research has not been designed by Māori, nor initiated organically from internal motivations. This renders the thesis as *Māori-centred* rather than kaupapa Māori (Cunningham, 1998).

The area of Māori education is dominated by an orientation towards improving Māori achievement in conventional curriculum terms (Penetito, 2010). The majority of Māori students are in English-medium schools and most research in this area is concerned with how such schools can transform themselves to accommodate Māori students and thereby raise their achievement levels. This research is largely based on the notion that understanding and representing Māori culture in schools and adopting culturally-responsive pedagogies will acknowledge the cultural background of Māori students and provide access for them to the learning offered by the school. This has led to significant professional learning projects in English-medium schools designed to equip teachers with cultural competencies that allow them to relate effectively with Māori students (Bishop, 2003, 2007a, 2007b; Bishop & Berryman, 2006; Macfarlane, 2004). It has also created problems of appropriation of Māori concepts and activities which have consequently been re-defined in English-medium terms (Lee, 2006, 2009). Māori concepts and activities are no longer Māori but rather caricatures of them (McKinley, Stewart, & Richards, 2004).

This research is of interest but not directly relevant to this thesis because of its orientation to achievement in English-medium contexts and its interpretation of struggle to be

about the raising of achievement in conventional terms. In contrast, no assumptions are made in this thesis about the need to improve mathematical achievement.

The most closely related research in the contexts of kura Māori examines science (pūtaiao) education. It describes many parallel concerns to those of pāngarau education outlined in the next section with respect to curriculum development (McKinley, 1995), language development and knowledge relations (Stewart, 2007, 2010). Māori knowledge, however, is being related to science in ways that are not yet seen with mathematics. The interface between science and Māori knowledge is being investigated and has been exemplified in several recent practical collaborations (Durie, 2004; Mercier et al., 2014). This work suggests that a type of feasibility study investigating how Māori knowledge and mathematics may relate is desirable. This thesis may then be thought of as contributing to this feasibility study.

Pāngarau education.

Evaluations of New Zealand Ministry of Education teacher professional learning projects constitute the largest group of publications about pāngarau (Hāwera, 2011; Hāwera & Taylor, 2013; Te Maro et al., 2007; Te Maro et al., 2008; Te Maro & Higgins, 2009; Trinick & Parangi, 2006; Trinick & Stevenson, 2005, 2006, 2007, 2008, 2009a, 2009b, 2009c). These evaluations are understandably limited in their coverage and perspectives by contractual obligations with the New Zealand Ministry of Education. They necessarily are confined to evaluating the projects within the parameters established by the professional learning projects. The relevance of this literature is empirical rather than theoretical; it provides evidence of how teachers and students in kura Māori engaged with official professional learning projects. Chapter 4 describes how the impacts of these professional learning projects are apparent in the classrooms of the Kura and thereby contribute in a direct way to the overall conclusions of the thesis.

Scattered throughout the pāngarau education literature are a number of important themes of direct relevance to the thesis. The literature in almost every case refers to conceptualisations of struggle with pāngarau in a variety of forms and contexts. These are summarised in the following paragraphs.

The struggle for Māori control of the pāngarau curriculum is examined in the pāngarau literature from a hegemony/anti-hegemony perspective (McMurchy-Pilkington, 2004, 2008; McMurchy-Pilkington et al., 2013). The conclusion is drawn that Māori control of the curriculum is now significant but still framed by English-medium constraints. Incompatibilities, such as the problems of including Māori knowledge belonging to particular Iwi (tribes) in a national curriculum intended for all, are also discussed and tensions highlighted (McMurchy-Pilkington & Trinick, 2002).

Meaney, Trinick, and Fairhall (2013) consider equity for Māori students through pāngarau education; they define equity as achieving in both Māori knowledge (mātauranga) and pāngarau knowledge. They subject their data to a Bernsteinian analysis illuminating how knowledge is distributed to teachers and students. In their study, pedagogy is identified as the carrier of Māori philosophy whilst the knowledge to be learned is defined by the pāngarau curriculum.

Meaney, Fairhall, and Trinick (2007a, 2007b) also conducted research to identify unique Māori pedagogies used to learn the pāngarau curriculum register. These studies conclude that individual practices are not unique, apart from use of unique language features, but the way they are combined as bundles of practices may constitute distinctive Māori pedagogy.

The hidden potentials of pāngarau to damage Māori language and worldview, referred to as a *trojan horse effect*, is examined from a number of perspectives in the pāngarau literature. In linguistic terms, language shift is hastened through pāngarau education by supporting words and sentence structures in which English syntax is mimicked with Māori words (Barton & Fairhall, 1995). In cultural terms, Barton, Fairhall, and Trinick (1998) consider that pāngarau carries a hidden technical-instrumental worldview which threatens traditional holistic concepts of people and nature.

The tensions involved in using traditional activities as pāngarau learning contexts is also discussed (Barton, 2004; Meaney, Fairhall, & Trinick, 2008). These authors consider that the traditional activity or the mathematics may be devalued since the traditional activities have developed without reference to formal pāngarau concepts. In broad agreement with Dowling (1998), these authors suggest that emphasising pāngarau concepts subordinates traditional concepts and vice versa.

Meaney, Trinick, and Fairhall (2011) adopt a practice theory perspective on many of the above issues; they summarise how one community responded collaboratively to the challenges of learning mathematics in a kura Māori. According to this research, this

particular kura Māori has achieved an effective balance between powerful societal knowledge acquisition (pāngarau) and centralising Māori knowledge.

In the conclusion of the thesis, in chapter 5, the themes in the pāngarau literature are re-interpreted in the light of the findings and conclusions of the thesis.

Mathematics curriculum enactment.

The professional learning initiatives in New Zealand over the past 15 years mirror an international movement towards the learning of mathematics with enhanced levels of conceptual understanding. This has generated a large body of curriculum materials aimed at developing conceptual understanding in students which is of a very different nature to previously available materials. Researchers have therefore become interested in the relations between curriculum materials and the enactment of learning activities in classrooms (Stein, Remillard, & Smith, 2007).

This interest has generated a body of literature in which classroom activity is theorised to be the result of processes involving actors operating within structures at multiple levels. For example, Remillard and Heck (2014) propose a complex model, resembling a realist conception of a stratified social reality, for curriculum enactment. This model includes relations between factors that influence official curriculum, curriculum as intended by teachers, and the curriculum as operationalised in classrooms. This emphasises how classroom enactment is a product of teachers and students acting in the moment but influenced by a complex process involving actors at different levels who transform curricula ideals and intents - a conceptualisation very similar to Bernstein's conceptualisation of *recontextualisation* (Bernstein, 2000). Classroom learning activities are thus portrayed as existing in a milieu of surrounding structures and actors which involve varying degrees of responsivity to international, national, regional and local contexts.

This literature shares an interest with this thesis in how the nature of curriculum materials plays its part in actualised classroom activities. In this thesis, the nature of pāngarau resources is considered to be a possible factor in struggle with pāngarau.

Indigenous mathematics education.

Literature in this area investigates how the achievement levels or formal qualifications in conventional mathematics curricula of indigenous students from a range of indigenous peoples around the world may be improved (Jorgensen & Wagner, 2013; Meaney, McMurchy-Pilkington, & Trinick, 2008, 2012). Generally, this involves some form of integration between indigenous knowledge and contexts, and curriculum mathematics concepts. Four kinds of integration are identified: the use of indigenous contexts to illustrate mathematical concepts (see, for example, Lipka, Wong, & Andrew-Ihrke, 2013), the use of indigenous or alternative pedagogy to learn conventional content (see, for example, Sullivan, Jorgensen, Boaler, & Lerman, 2013); inter-cultural negotiation between indigenous knowledge and mathematical knowledge; and reconstruction of mathematics education based on indigenous ontology and epistemology. Only the first two approaches are commonly represented in the literature (Nutti, 2013).

This literature is of interest in this thesis because it highlights the delicate nature of relations between curriculum mathematics knowledge and indigenous knowledge. There is a need for careful analysis of the compatibilities between these knowledge forms in any attempted integration or interaction between the two. The thesis makes a contribution to this literature by offering an example of research in the under-represented categories of inter-cultural negotiation and/or reconstruction.

The Contribution of the Thesis to Knowledge

The main purpose of the thesis is to gain an understanding in realist terms, and with a robust philosophical and sociological perspective, of causes for struggle which surround pāngarau education in one kura Māori. As indicated in the previous section, the thesis makes contributions to a range of existing research areas, but, in the first instance, will be related to the body of research about Māori education. Penetito (2010) observes that a major weakness of research in Māori education is that it puts philosophical and sociological concerns to one side, preferring to focus on issues of curriculum, pedagogy, achievement and evaluation (p. 14). This thesis therefore will contribute to this body of research by adopting a strong

philosophical/sociological perspective, which, the researcher contends, offers new insights and indicates new possibilities for pāngarau.

The contribution is not intended to be merely to the research literature. There is also an intention to support kura Māori to understand and ameliorate their struggle with pāngarau and counter domesticating tendencies. The knowledge generated in the thesis illuminates some deep level causes of struggle; this knowledge is used to indicate possibilities for the transformation of pāngarau education. Suggestions arising from the thesis have already been discussed by the Kura and by several other kura Māori who have shown interest. In this way, it is hoped that the thesis meets the challenge of conducting doctorate research as an academic exercise and contributes practically to the transformation of actual, pāngarau classrooms.

Chapter 2 - Theoretical Framework

This chapter develops the theoretical framework of the thesis which brings together dialectical critical realist ontological concepts with sociological concepts drawn from the sociologies of knowledge and education. In this way, the framework is both a theorisation of ontology and a framework for making sense of empirical data. Figure 2.1 shows the complete framework diagrammatically. The diagram shows a nested arrangement in which localised social activity operates in a social reality held in place by elements such as practices, resources, knowledge, and legitimation code. The social reality constitutes the *transitive* dimension of human existence - that which is partially and imperfectly held in the minds of people as they participate in social life. Social activity is considered to operate within social structures (social fields, institutions or ad-hoc groups) with all of human activity embedded within an *intransitive* dimension of unknown or potentially unknowable real entities which form the objects of fallible knowledge generation. The detailed relations between elements of the framework will be discussed as the chapter progresses.

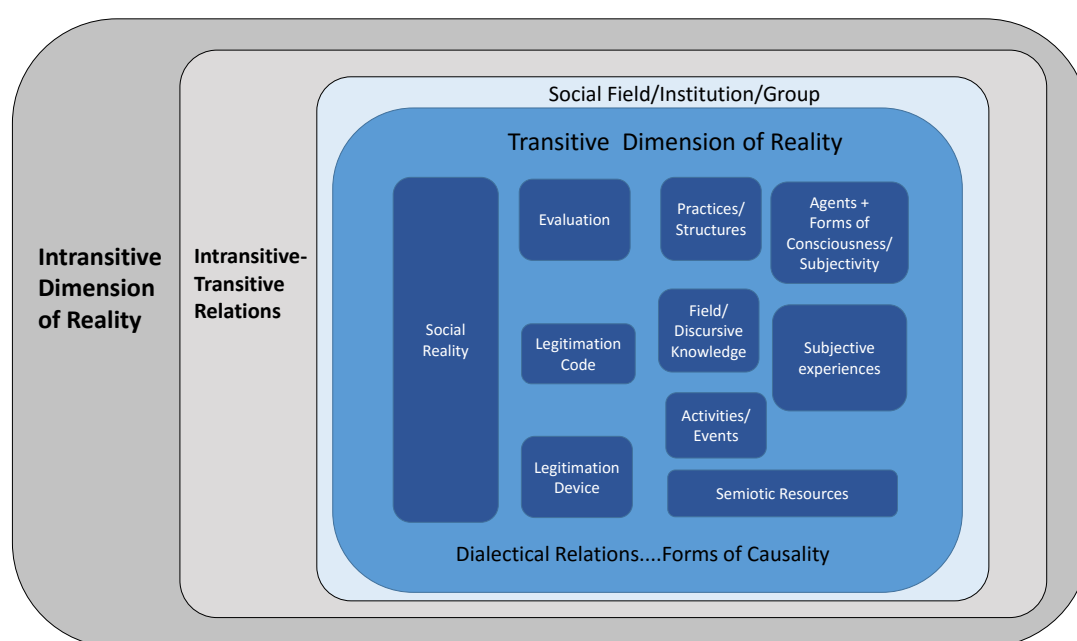


Figure 2.1. The theoretical framework.

For the purposes of explaining the theoretical framework, this chapter begins with intransitive reality and progresses towards the fine detail of classroom activity ending with a theorisation of how students learn in such a dialectical, realist ontology/sociology. In chapter 4 (Case Examples) the reverse process is followed; empirical data capturing details of learning activities are analysed in order to theorise causal mechanisms which relate back to ontological determinations of intransitive entities.

The Intransitive and Transitive Dimensions of Reality

All forms of realism subscribe in one way or another to the idea that reality includes entities that are independent of human consciousness (Schwandt, 1998). Critical realism conceptualises reality as having a transitive dimension and an intransitive dimension. In general terms, these correspond to human knowledge (discourses, structured activity) and the objects of human knowledge respectively. The terms transitive and intransitive will be used in the development of the theoretical framework to denote those parts of reality that are located in the human mind and those that are independent of it. It is to be emphasised that critical realism considers everything to be real. The transitive dimension is as real as the intransitive; the distinction is a recognition that consciously-held knowledge must always be “won out of an original unconsciousness, passivity, error and dependence” (Collier, 1998, p. 279). The things people are unconscious of, in error about, and dependent on, constitute the intransitive dimension. In relation to the analysis of data, this understanding places the thesis and its findings in the transitive dimension offering a fallible explanation in its own terms of why empirical features are present. An important understanding here is that the terms of the thesis, its internal language, are not the terms of the research setting, the Kura. People located in the Kura will provide their own explanations in their own terms. This is an illustration of *transitivity*; different explanations and languages of explanation about the same empirical data are possible.

Philosophical debates about the intransitive-transitive relation are long-standing and have produced many variants of realism or relativism based on a different definitions of the intransitive-transitive relation. These definitions range between extreme anti-realist/relativist positions, which consider the intransitive dimension to be a figment of the human mind, and extreme realist positions which suppose that human knowledge directly corresponds with the

intransitive objects of study (Alston, 2002). The extreme anti-realist position has difficulties in explaining, amongst other things, why human minds produce the ills that are present in their own social lives (Bunge, 2014). The extreme realist position has difficulties because human knowledge is reduced to an exact correspondence with the objects and properties of intransitive entities and has no possibility for creativity in its own right (Putnam, 1999).

Theories of human perception as an intermediary between intransitive and transitive dimensions are also intertwined with realism/anti-realism debates. Again, a range of positions are taken; perception is portrayed variously as a direct, accurate transmitter of the rich details of reality to the brain, or as a system that completely fabricates an illusory world stimulated by intransitive objects (Putnam, 1999). Recent developments in neuro-science suggest that perception systems do indeed create an illusory version of an external reality which nevertheless still allows people to function effectively in a distinct social and material real milieu (Dehaene, 2014). This introduces a perceiver/perceived dialectic which recognises that intransitive objects do impinge on human perceptions and thereby have a direct impact but, at the same time, people respond to that direct impact in their own socially conditioned and embodied ways.

These understandings support an intermediate realist position; reality has both an intransitive dimension and a transitive dimension related through ontological conditions of possibility, imperfect perception systems and conscious ways of developing knowledge (epistemologies). Transitive knowledge, mediated by perception systems and epistemologies, despite its fallibility, retains sufficient consistency with ontological conditions of possibility to allow the formation of human practices which sustain life. The intransitive/transitive relation is considered here to be dialectical; transitive knowledge uses epistemologies and perception systems to construe the intransitive dimension which provides the ontological conditions of possibility for transitive knowledge (figure 2.2).

Critical realism theorises stratified intransitive and transitive dimensions suggesting that different types of transitive knowledge attend to different strata (figure 2.2). In relation to the natural sciences, a stratified philosophical ontology suggests that nature (non-human entities) is constituted by strata such as a physical stratum and a biological stratum. The scientific disciplines are associated with study of different ontological strata. For example, physics and chemistry study nature at the stratum of material particles such as masses (macro-objects), molecules, atoms, and sub-atomic particles. These disciplines can explain

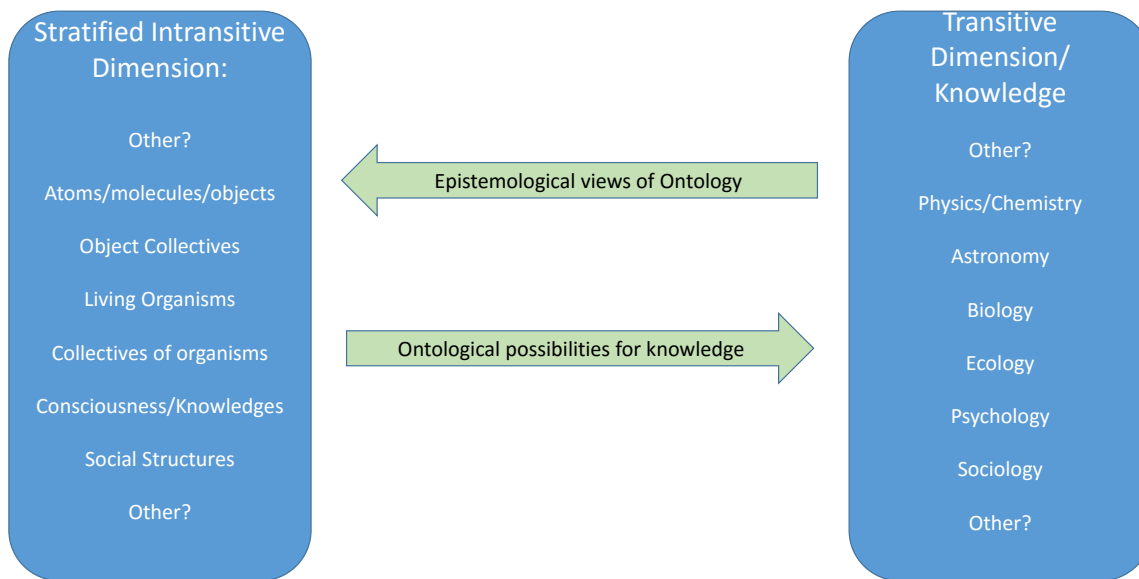


Figure 2.2. Relations between a stratified intransitive reality and stratified transitive knowledge.

events, such as a lightning strike or why water rusts iron, in terms of their own transitive theories (physics and chemistry concepts). Physics and chemistry, however, cannot explain why a certain organ in an animal's body is as it is, or how species come to exist. These issues belong to the stratum studied by the biological sciences; biology theorises nature within a different stratum which is emergent from and dependent on the physical stratum but not reducible to it (Bhaskar, 1975; Collier, 1998).

People are not exempt from such a stratified reality since people, their knowledges and their social organisations also depend on the physical and biological strata and are considered to be part of reality. Ideas, concepts, and knowledge in general are real and have dialectical and causal relations with other transitive and intransitive real entities (Bhaskar, 1997). Societies, cultures, social fields/institutions, and people are thus theorised to exist in strata emergent from a physical/biological stratified reality. In such an ontology, human social life is interpreted to exist in additional emergent strata: the strata of consciousness, social structure and society (Bhaskar, 1979). Furthermore, the possibility of other strata existing above and below currently recognised ones, or sub-strata within them, is not excluded.

A dialectical critical realist ontology is adopted because it is an intermediate realist position; it accepts the existence of the intransitive dimension, and provides an ontological theory, but also acknowledges the variable, fallible and situated nature of transitive knowledge about it (Sayer, 2012). In this way, Dialectical Critical Realism appears as a viable ontological theory which can theorise relations between the subjective natures of personal experiences on the one hand and the existence and involvement of intransitive real entities on the other. This renders Dialectical Critical Realism suited to the purpose of this thesis in its quest for causes of struggle with pāngarau. At the same time, as part of the researcher's own fallible knowledge, this position is tentative and subject to change as the researcher's future experience unfolds.

Fallibilism

Fallibilism is understood here to be more than just accepting that knowledge can be in error. Although fallibilism asserts that, as far as we can tell, knowledge only approximates to varying degrees an intransitive dimension of reality, it cannot claim that absolute knowledge of intransitive reality is impossible. Furthermore, fallibilism is a property of epistemology, but intransitive ontology, as the real means of production of an intransitive event, must be considered as infallible since the event is produced independently of our knowledge of it; the event simply is (Bhaskar, 2010, p. 131).

With this in mind, mathematical knowledge cannot claim to be absolute knowledge of an intrinsically mathematical intransitive reality. It is, rather, a system of ideas with imperfect relations to empirical and embodied existence (intransitive reality) and circumscribed by the limits of human ability to know such a reality (fallibility) (Ernest, 1991, 2014; Lakatos, 1980; Lakoff & Núñez, 2000). Recognising that mathematics is transitive, that is, socially/culturally produced, and relative in the sense of having different interpretations in different individuals or groups of people, is not inconsistent with a realist/fallibilist philosophical position. This position would suggest that mathematics is the transitive body of knowledge that attends to aspects of intransitive material and social reality but is not the same as those aspects. Assertions about the universality/absolute certainty of mathematics and its inherence in nature as a fundamental characteristic are considered here to be an

example of an *epistemic fallacy* (Bhaskar, 1975); the transitive discourse of mathematics is conflated with the intransitive object of study of mathematics; claiming that intransitive reality is inherently mathematical contradicts its intransitive nature. It is worth noting in passing that there is an extensive literature about mathematical modelling which explicitly recognises this situation. The mathematical model and the object of the model are not the same and so careful consideration must be given to how models and the reality they model are to be understood (see, for example, Morrison, 2015).

For a realist fallibilist, the intransitive object of study of mathematics is different from the discourse of mathematics which is inextricably embedded in how people perceive and conceptualise the world. Such obvious and concretely real operations as counting objects can be seen as dependent on socially/culturally induced assumptions that the objects we perceive and count are discrete, can be grouped with others of the same kind and are interchangeable with them (Ernest, 2014). This is also a source of difficulties for students when learning the discourse of school mathematics which relies on assumptions about objects being identical when actual objects cannot be. For example, the problem of sharing 20 apples equally between 5 people expects the conventional answer of 4 apples each. This is possible only if all apples are identical and all people are identical. Students are completely justified in stating that such problems cannot actually be solved without knowing the 20 apples and 5 people concerned (Verschaffel, Greer, Van Dooren, & Mukhopadhyay, 2009). It also follows from this perspective that if social/cultural practices are different (for example, there is no money or accounting of property) then ontological assumptions about reality and associated practices related to quantity and space will also be different. In this perspective, conventional, near-universal mathematics loses its privileged status and is recognised as another part of the transitive dimension. This perspective is important because a more balanced perspective about mathematics and mathematics education supports creative responses to it by kura Māori and suggests the possibility of developing new ways of engaging with mathematics.

Accepting mathematics as transitive can also be regarded as an advance in knowledge; it recognises more fully the relations of mathematical knowledge to other transitive and intransitive entities. Understanding more clearly the nature of mathematical knowledge affords future growth both of mathematical knowledge itself and of relations of such knowledge to other knowledges (Kitcher, 1985; Kline, 1980). This perspective suggests

that understanding the nature of mathematics knowledge and its relations with mātauranga (Māori knowledge) in particular is important for kura Māori.

Indeterminacy, Dialectical Relations and Social Life

Intransitive real entities are considered in this theoretical framework to be in a state of indeterminacy; they are known only fallibly and are different to that fallible knowledge. They can be attributed simultaneously with different, possibly contradictory, meanings. This is theorised to be intrinsic to the generalised intransitive/transitive dialectic relation which is composed of innumerable dialectical relations between particular intransitive entities and the transitive knowledge (meanings) ascribed to them by different groups of people.

The sense of dialectic used in this thesis is closely related to Marx's theorising of dialectics, such as the use/value dialectic; multiple identities of intransitive entities are created depending on the perspective of the person or group of people relating to them (Ollman, 2003). Each person or group must come to a decision about what something is in order to bind it into the social reality that constitutes the subjective background of their life. In this binding, dialectical relations are spontaneously generated. Social life requires sufficiently tight and stable definitions of intransitive entities to support practices that create a social reality and establish a viable and practically adequate lifestyle. Bernstein (1981) expressed this in the following way:

Every culture specializes principles for the creation of a specific reality through its distinctive classificatory principles and, in so doing, necessarily constructs a set of procedures, practices, and relations from a range of such sets. As a consequence, each [cultural] modality can be regarded as an arbitrary angling of a potential reality. (p. 339)

The indeterminacy of intransitive entities provides scope for different lifestyles to be based on different definitions. In anthropological terms, this can be seen as involved in the generation of distinct social or cultural groups and their subjective realities or worldviews (Kearney, 1984). In cultural-psychological terms, culture provides the psychological resources which establish a common theory of reality; different cultural/social groups operate on different theories (Cole, 1998).

In the absence of absolute knowledge of intransitive entities, definitions of intransitive entities must be arrived at in relation to already established meanings. Creating a meaning for an unknown entity in relation to a known one automatically creates a dialectical relation. The unknown entity becomes defined in terms of its relation to the known, and henceforward the known entity can be defined in terms of its newly-minted relation. For example, a social/cultural group may define a plant by its scientific name which relates it dialectically to already established definitions. Another group may consider the plant to be something else entirely because they include it in a class which includes insects and birds with a different logic relating elements in the class. (This group of people may not have the terms *plant*, *insect* and *bird*.)

The meanings to be attached to an entity can only be known through the context in which the meanings are used. Context is understood to be a relational web of other signifiers/meanings that allows the location of the meaning. Rather than considering meaning as a relation between signifier and signified, that is, between the words and symbols used and the meaning construed by them, it can be conceptualised in realist terms as a relation between signifier, signified and real referent (Sayer, 2012, pp. 36-37). Contexts, as webs of signifiers, are used relationally to create a meaning for a referent but the referent itself is still independent of that meaning (it is intransitive). The real referent is indeterminate but the meaning to be given to it, its significance in a particular context, can be decided and is stable (Nellhaus, 1998; Sayer, 2012). Furthermore, context, as well as immersing or surrounding the particular referent, is also distributed throughout practices, structures, resources and agents within a wider social or cultural field (Geertz, 1973). The meanings decidable through context, which constitute transitive knowledge, are therefore inextricably related to the nexus of practices, resources and agents in which those meanings are employed (Schatzki, 2002).

These considerations imply that mathematics knowledge is based on sets of determinations about intransitive objects for the purposes of creating stable foundations for a mathematised form of life. In socio/cultural constructivist terms, mathematical knowledge is recognised as socially and culturally constructed and not a fundamental property of reality. The addition that realism makes is that this social construction of mathematics is still about something that is real and intransitive but transformed or refracted differently, via different dialectical determinations in relation to existing practices and webs of meaning in different social/cultural groups.

The most difficult aspects of mathematics to reconcile with this view are with respect to mathematical proof and the strong warrants this produces for the certainty of mathematical knowledge. Mathematics, in fact, may provide a case in point which clarifies the understanding of intransitive-transitive relations adopted in this thesis. Mathematical proof provides a type of discursive certainty based on mathematical logic; if the dialectical determinations of mathematics about intransitive objects are accepted, then mathematical theorems are logically certain through the practice of mathematical proof. This, however, does not imply that such knowledge can claim to be absolute knowledge of those intransitive objects. No assumptions should be made that the intransitive dimension is intrinsically mathematical; it is only that transitive mathematical knowledge supports viable and practical social practices that interact with intransitive entities.

Ernest (2014) distinguishes between logical certainty as just outlined and objectivity as socially developed collective belief in the certainty of mathematics. This is helpful because belief in the absolute certainty of mathematics can be understood to be a historically and culturally produced social reality/worldview. Logical certainty is derived using an epistemology of mathematical proof from a specific set of ontological statements/axioms about the world. The epistemological, proof-based certainty of mathematics has limitations derived from the separation between intransitive objects and the transitive mathematical determination of them (Lakatos, 1980). The formation of these determinations creates a mathematical worldview in which, to quote examples from the conventional mathematics curriculum, objects are considered identical so they may be counted, and shapes are considered to have regular outlines and impossible dimensions (lines have no width, flat shapes have no height) so they may be measured. Accepting these impossibilities, however, allows the construction of proofs of such familiar statements as $2+2=4$, the sum of two odd numbers is an even number, and the theorem of Pythagoras.

The theoretical picture being formed here is one in which intransitive, indeterminate entities are related to meanings (the discursive knowledge of the social field) which are related to nexae of social/cultural practices, agents and resources. Relations are characterised as dialectical in the sense of mutually-influencing or mutually-constituting. The intransitive entity has its own intransitive character which relates dialectically and variably to meanings, practices and resources; these meanings define what intransitive entities are for the purposes of the social practices interacting with them. Practices supply a context for the decidability of meanings but those meanings supply the basis for the construction and enactment of

practices. A conception of dialectical relations in this way is necessary for the changeable practices of social/cultural life to have a kind of tethering to intransitive reality. Dialectical relations between intransitive entities, meanings and practices are conceived as a bi-directional network of relations through which social life may establish viability and practicality; the social field constitutes meanings which relate fallibly to intransitive entities whilst intransitive entities also rebound on life in social fields when practices are enacted. Ultimately, practices, singly and/or collectively must have practical adequacy; they must provide a viable and sustainable way of life in negotiation with the impingements of the intransitive dimension. This perspective suggests that pāngarau classroom regimes represented in empirical data may be thought of as a coherent nexus of practices which construe dialectical relations with intransitive entities; in other words, these classroom regimes may be thought of as partially independent social worlds formed, bubble-like, within the Kura.

A further consideration, taken up in more detail later in the chapter, is a theorisation of the causes of empirical phenomena as distributed through the dialectical relations of social life. This perspective seems plausible if we accept that contexts and the meanings they define are distributed through webs of signifiers, practices, agents and resources. Since social life is theorised to be constituted by these things and to operate through dialectical relations, causes are not singular but are distributed through, and made operational by, configurations of meanings, practices, structures, resources, knowledge/beliefs and agents.

Resources are theorised in this scheme as intrinsically semiotic; they always stand as a signifier of some kind in the contextual web of significance that is transitive knowledge. They are intrinsic to the nexae of practices and the implicit social world in which they are used. Resources are embedded in dialectical relations with knowledge, practices and social reality; a resource is not a resource if it is not so embedded (Wertsch, 1998). At the same time, the nature of the resource has causal effects on knowledge and practices.

Dialectical relations are considered to be fundamental in human social life. Any entity can be considered from different points in the webs of significance which define the meaning it is allocated in a social/cultural reality. This is clear when the meaning of an entity is sought. The definition for the entity is always in terms of relations to other things. For example, the meaning of an object signified by the word *tree* might be given crudely as a type of plant composed of wood and leaves which grows together with other trees in groups called

forests. *Tree* can be known through the web of meanings relating tree to wood, leaves and forests. Several dialectical options are offered: the tree is partially defined as a producer of leaves and wood, but leaves and wood are defined as products of the tree; forests are groups of trees but trees are components of forests. Which component partner of the dialectical relation is focussed on becomes an important consideration as a basis for social practices. For example, if trees are thought of as components of forests, harvesting practices of trees may tend to promote the health of the forest. If forests are collections (sources) of trees, harvesting practices may perhaps result in increased tendency for destruction of forests. Successful harvesting of trees and maintenance of forests would appear to rely on perspectival switches between two dialectical perspectives of what a tree is.

Indeterminacy becomes very apparent when meanings are considered for the same real entity in different languages. The Māori word *rākau*, which dictionaries offer as the Māori word for tree, is associated with a range of meanings in Māori webs of significance that create *rākau* as a different thing to the English tree. Although the real entity signified by tree and *rākau* is intransitively itself, independent of either English or Māori, no absolute meaning can be given to it; the Māori *rākau* and the English tree are simultaneous, and somewhat contradictory, transitive theories of the same intransitive tree/*rākau*.

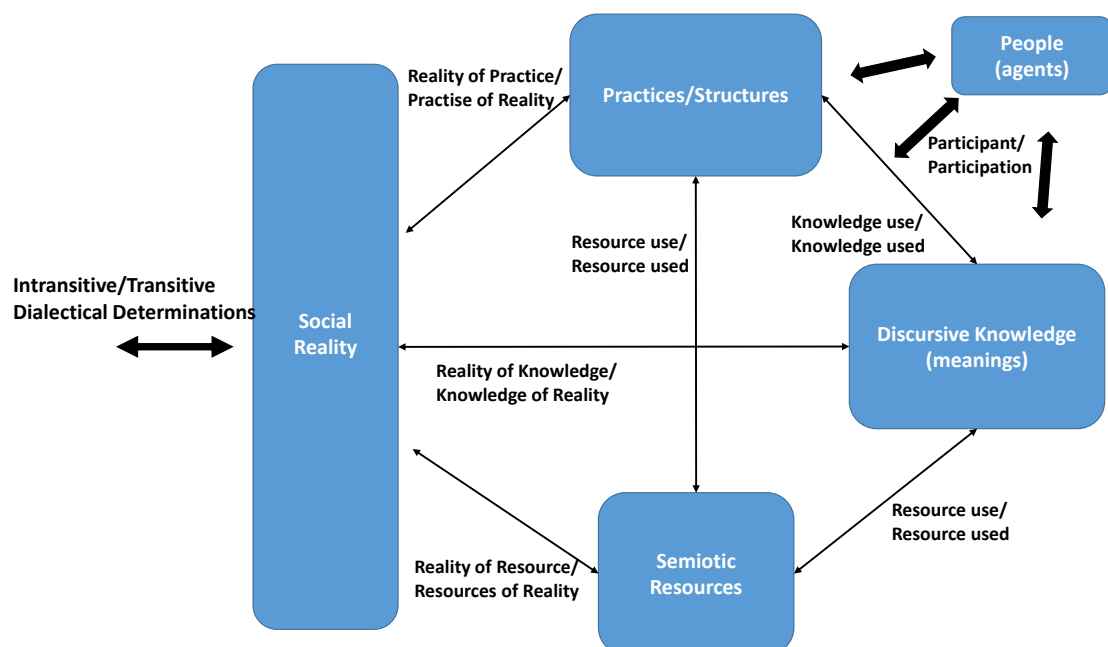


Figure 2.3. Dialectical relations underpinning aspects of social life.

Various dialectical relations at this mid-level of analysis can be identified between theoretical entities as shown in figure 2.3. Participant/participation relations describe how agents participate in practices/knowledge/social reality/resource use but are simultaneously defined by that participation. Practices are part of social reality and must be justified in social reality (the reality of practices) but are causal in defining social reality (the practise of reality). Resource/resource use dialectics refer to the relation between the nature of resources and possibilities for their use; the structure and nature of a resource is implicated in how it may be used but how it is used must be accommodated in its design/nature. Similarly, knowledge/knowledge use dialectics refer to how the nature of knowledge is implicated in how it may be used, and how the use of that knowledge is capable of re-defining it.

These mid-level relations are themselves composed of innumerable relations between particular entities; for example, the knowledge of how to use a measuring device (a ruler or a weighing device perhaps) is dialectically related to the nature of the device. Knowledge of this kind of measurement creates measured social environments which establish knowledge of measurement as a *fact of social reality*. Measuring is also a way in which people interact dialectically with intransitive entities; gathering data of various kinds about such entities forms a fallible basis for practices which interact with them.

Stratified Ontology and Laminated Structures

As discussed earlier, critical realism theorises a stratified or depth ontology. This locates the causes of empirical phenomena across several strata and involving multiple entities in each stratum. In addition, it implies that entities themselves may exist across multiple strata; real entities are *laminated structures* (Collier, 1989).

Consciousness locates people in strata of consciousness, knowledge system and social structure. At the same time, they possess a living, material body which itself is located in biological and physical strata. People are laminated structures and so other entities such as social fields, social structures and systems of ideas are also laminated. Consciousness is necessary for the development of social structures, indeed, any social activity at all. Dialectically it is to be understood that consciousness allows participation in structures which, through that participation itself, shapes consciousness. Social and conceptual structures add another lamination to people and vice versa.

A social field, for example, has presence in the minds of the people who participate in it; it has presence in the stratum of consciousness. The field also exists beyond this stratum of reality as a collective of organisms, organs within organisms, and different collectives of atoms and molecules. It therefore can exist in various causal conjunctions to produce events via a number of strata. This can be seen very clearly when human population density is high; not only are there social/structural events within the population, there are environmental events attributable to the sheer presence of so many peoples' bodies and their atoms and molecules. People consume resources, create wastes and displace other organisms not just by conscious planned action but also through sheer biological and physical presence.

Emergence, Agency and Social Structures

The development of the framework has brought the focus on to the notion of emergence. Emergence has been mentioned or implied at several points in relation to the emergence of strata of reality from earlier strata. Understanding social structures and systems of ideas as intransitive, causal entities also requires a theory of emergence.

Firstly, the discussion of emergence of social structures and systems of ideas will assume that groups of people operate collaboratively. If this were not the case, social structures would not exist or at least not be a solitary creature's object of study. A full treatment of how people are able to collaborate is beyond the scope of this thesis. A basic position, however, can be sketched out.

It is understood that people create transitive knowledge about other entities. What is usually thought of as learning can be re-interpreted as the development of a person's own transitive theories about the world, who/what they are and their place in it. Subjectivities, as a person's collection of such transitive theories, are produced dialectically through participation in social activity. The processes of child-rearing and formal schooling can be conceptualised as an individual child's continuing process of transitive theory development in relation to causal engagements/events with the people of the family, the education system and the changing nature of the child's own self. These transitive theories constitute a *habitus* (Bourdieu, 2000), also referred to by van Dijk as a set of context-models (Van Dijk, 2009), which guide them in their participation in practices in a wide variety of social domains. Such *habitaes*/context-models represent fallible transitive theories about the nature of other people,

the material world, and how they themselves, as a laminated person, can interact in social practices, material resources and with non-human organisms (Van Dijk, 2008, 2009). In particular, how people conceive of themselves in relation to possibilities for participation in practices is a real causal entity in their future trajectory in their social field (Willis, 1977).

Context-models are individualised; they are the sole possession of each person formed during their life-history of engagement with others. Context-models are not known absolutely by any other person; they are transitive for the holder of them but intransitive for anyone else. Each person's knowledge of another person is contained in context-models which theorise that other person. It is the dialectical creation of mutually consistent context-models that is proposed here as the basis of collaborative social life. This process is dialectical in the sense that different peoples' context-models co-create each other through social interaction/events. Because people interact with each other so closely and intensely over long periods of time, each person develops context-models of all other known people, and vice-versa, so that collaborative social life is made possible on the basis of sufficiently consistent individualised context-models (Van Dijk, 2009). This perspective is broadly aligned with Vygotskian theorising which considers that internal understandings are developed through social interactions so that those internal understandings or context-models (intra-subjectivities) are derived from the already existing social/cultural milieu in which a person is embedded (inter-subjectivities). Context-models are dialectical; they are simultaneously the intra-subjectivity of an individual and the permeation of the individual by the social-cultural world in which they live. It is a dialectical perspective switch which allows the seeing of the person in society, or the society in the person. Collaboration in a broad sense is possible because of this dialectic.

Returning to the concept of emergence, social structures are configurations of people acting collaboratively and relationally so as to constitute a laminated structure which has unique properties not attributable to any of the people involved and with causal properties in multiple strata (Elder-Vass, 2011, pp. 48-53). This is also a recognition that the social structure as a set of relations between social positions is independent of the particular people who occupy those positions despite the actions of those people in forming and maintaining the structure (Groff, 2004, pp. 96-101).

On a small scale, emergence of structures can be seen and experienced subjectively even in the context of small groups of people operating collaboratively. For example,

consider a small group of people who decide to collaborate to build a shed. At first perhaps, the collaboration is disorganised and inefficient. If they persevere, a set of routines and a division of labour is likely to be decided upon. This constitutes an embryonic form of social structure because the people involved start to relate to each other in terms of their role within the structure and routines of work (as, say, *nail-gun operator*, *circular-saw operator*, or *timber preparer*). Practices as inter-linked sequences of actions are formed so that, for example, the timber preparer smoothly provides timber to the circular-saw operator who provides the nail-gun operator with precisely those lengths of timber that he/she needs. A new person joining this project is presented with an already existing structure which they must learn about as an intransitive object. It may be that the new person suggests an adjustment to the structure that improves the efficiency of building the shed; they have exercised personal agency within an existing structure that results in a new structure. Over time, this small group of people may tackle larger projects, incorporate more people and develop more extensive and sophisticated divisions of labour/social structures. Small groups of people operating collaboratively can be seen to develop structural organisations analogous to larger scale social and societal structures formed in essentially similar ways. For larger groups of people who have learned to collaborate on a large scale over long periods of time, complex social structures and sub-structures may emerge which render individual agents incapable of knowing the whole structure into which they are born.

Social and conceptual structures can be regarded as intransitive because they do not reside in their entirety in any person's context-models. Partial, fallible theories about structures are formed through engagement with other people (both face-to-face and virtually through books for example) who have their own pre-existing context-models. Another way to put this is to say that already emerged social structures and systems of ideas pre-exist the people who are living with them; these people must learn about them as intransitive objects of their own transitive knowledge (Sayer, 2012, pp. 32-35). For example, a person's understanding of mathematics is a transitive and fallible theory about the totality of mathematics gained by engagement with other people's pre-existing transitive theories of it. The system of ideas referred to as mathematics exists independently of any person or group of people. Mathematics is not known in its entirety by any one person; it is the entity which is emergent from the total collection of components contained within the context-models of mathematicians (and others). Mathematics, as emergent from its components but possessive of its own unique causal powers, is conceptualised as a laminated structure.

Practices as regular, institutionalised routines within the structure (for example, the routines followed by the circular-saw operator) can be seen to be formed in relation to position in the structure (how and why the circular-saw operator must supply wood to the nail-gun operator and receive it from the timber preparer) and the resources available to agents in that position (what the circular-saw operator has available to accomplish necessary practices). Practices themselves, are organised sequences of actions that form a consistent whole, that is, the actions together are sufficient to achieve a recognised and valued goal. They have a permanency which characterises them as intermediate between event and structure (Chouliaraki & Fairclough, 1999, p. 22); they can be thought of as emerged in their own right and with causal efficacy in a social field. To this end they have rules and are based on common understandings about how to implement rules in practice and what enacting them means in relation to other general relational understandings of importance in the social field, (Schatzki, 2002, p 80). This offers an interpretation of practices as social structures distributed over time (Schatzki, 2012), or as structures of agency (Nash, 2005). Practices require the acceptance of a discursively constructed role within a time-sequenced pattern of actions and which relate to positions in larger social structures. Practices can therefore be thought of as laminated, time-based structures with their own causal properties.

The above discussion highlights that the emergence of social structures is intimately enmeshed in the on-going collaborative lives of people operating with their individual context-models and interacting with pre-existing social structures, practices and material conditions. Emergence of changed or completely new structures and people may occur over time through this interaction of human agency with structural conditions (Archer, 1995; Bhaskar, 1979).

The structure-agency debate is one of the most long-standing debates in sociology and critical realist explanations of social phenomena are always couched in forms of structure-agency relations (Scott, 2010). Durkheimian positions regard agency as an epiphenomenon of structures, Weberian positions regard structures as epiphenomena of agency, and dialectical or conflationary positions attempt to theorise some compromise combination of the two such as those of Berger and Luckmann, and Giddens (Berger & Luckmann, 1967; Giddens, 1984). These compromise combinations have been strengthened through various critiques (Archer, 1988; Sewell, 1992; Stones, 2005) which have supported the development of a critical realist theoretical solution to the structure-agency problem. Models have been suggested which separate structure and agency both temporally and across different strata of

reality (Archer, 1995; Bhaskar, 1979). These models suggest that agencies are always exerted in real-time in actualised events in relation to structures with laminations in other strata which pre-exist the agency. This offers an ability to both separate agencies and structures and theorise relations between them in ways which shed light on how new structures may emerge and existing ones be maintained. Dialectical Critical Realism suggests that rather than a structure/agency debate it is rather the investigation of *structures and agencies* in order to explain events.

It is perhaps difficult to grasp how systems of ideas (or knowledge systems) which are intellectual creations can also be intransitive real objects of study. Even though people spend their lives in social fields, no one has yet grasped what a social field is in an absolute sense. People may develop sophisticated theories of life in social fields but these do not constitute absolute knowledge of them. In a similar way, systems of ideas, such as mathematics for example, cannot be said to be known in their entirety in absolute terms. Even the most prominent of mathematicians does not have a conscious grasp of the totality of mathematics. In one sense, this can be seen to be due to the distributed nature of knowledge and structure throughout the people involved so that no one person can grasp the entire system/structure or know the complete set of causal effects of that system. In another sense, structures and systems of ideas, though constituted by people, are more than the collection of those people; individual people have fallible understandings of the systems of ideas in which they participate and are continuously developing their understandings of them (Dowling, 2013). The emergent properties of the system may in fact *require* people to have incomplete understandings of it; full consciousness of a complete system (absolute knowledge of it) in any one person would bring the system into the realm of an individual's intentional agency thereby reducing the system to a property of one of its components (Bhaskar, 1982). This perspective places people in a perpetual state of theorisation about intransitive entities which include their own selves, their own social lives, and the structures and systems of knowledge in which they are embedded.

Although structures are not reducible to their components neither are they isolated from them. If this were so, no exertion of agency by individuals or groups would ever change structures. Irreducibility means that the structure is ontologically distinct from their agents. However, in certain circumstances, agents clearly do influence structures as well as structures influencing agents. This amounts to the transitive knowledge of agents penetrating the intransitive structure of which they are a part - a transitive to intransitive shift (Scott,

2010, pp. 94-108). The transitive knowledge of the agent has become represented in the relational terms of the structure so as to constitute a redesigned intransitive entity for other people in the structure. The reverse shift is more familiar; structures constrain and afford actions of agents which provide the basis for their transitive knowledge formation.

Mathematics provides a case example of a transitive-intransitive-transitive re-circulation, referred to by Skovsmose (1994) as the formatting power of mathematics (chapter 3). In this perspective, mathematics as a system of ideas is seen to provide the means by which concrete situations are built and re-built using mathematics concepts so that environments and practices become concrete abstractions of mathematical relations. The mathematised built and social contexts of people become internalised (an intransitive to transitive shift) so that the transitive to intransitive agencies of people support the reality of their mathematised world. In other words, mathematics becomes a hegemonic system which is causal in re-designing peoples' concrete and social realities to confirm its own ontological status. (Skovsmose, 1994, pp. 50-53).

The irreducibility of an emerged entity also implies that it is available as an object of study for others who may or may not be members of the social/cultural group who generated it. This renders some knowledge systems, such as mathematics for example, as *trans-cultural* in the sense of being directly accessible and usable by anyone regardless of culture (Gellner, 1992, pp. 75-80). This does not mean, however, that such knowledge systems are *a-cultural*; in this thesis, all knowledge systems and the practices associated with them are cultural in the sense of being based on ontological determinations which could have been chosen differently. Mathematics may be the best example of a trans-cultural knowledge system but, as this section has already discussed, it is based on a particular set of dialectical determinations which provide the conditions of possibility for mathematical proof, certainty and the development of mathematical theory. Mathematical proof is thus conceptualised as a human social and cultural practice based on these ontological determinations and part of the total culture of mathematics.

Dialectical critical realist theorising deepens thinking about structure and agency by theorising social life as being fundamentally based on dialectical relations with a variety of ways in which real entities are involved with one another (Bhaskar, 1993, p. 54). The concepts discussed so far, and the ones to follow, are steps along the way to a dialectical perspective of structure and agency, an instantiation of which constitutes the theoretical

framework of the thesis. A more complete expression of this will be arrived at towards the end of this chapter.

Critiques of Critical Realism

Before continuing with the theoretical development some critiques of critical realism will be considered because the perspectives described here are not without challenge and controversy. As transitive knowledge, critical realism, like other bodies of knowledge, does not claim to be perfect. It is a work in progress and critique is essential for progress to be made.

Critical realism, in its original non-dialectical formulation at least, is challenged because it promotes its stratified, ontological theory as being an accurate representation of reality whilst also theorising knowledge of it as fallible. This appears to commit an ontological fallacy which fails to recognise that critical realist ontology is also a theory and therefore fallible (Cruickshank, 2004). The theorisation of social structures/systems of knowledge as part of the intransitive dimension is controversial and challenged on the grounds that only people have agency and structures are essentially inert, if they exist at all, without people (Harre, 2009; Wahlberg, 2014). Kivinen and Piironen (2006) maintain that the division between transitive and intransitive dimensions creates a false duality (a dualism) between the human subject and that which is observed/experienced by them. Dowling (2009) does not deny the existence of an intransitive dimension and the material consequences of actions but contends that since knowledge is only possible within discourses, contemplation of an extra-discursive reality is non-productive in terms of social research. In a related critique, Fairclough, Jessop, and Sayer (2004) suggest that critical realism does not take account of intra-discursive causation tending to explain causation in structural terms. According to these two authors, the causal powers of concepts formed entirely within discourses are neglected in critical realist research.

Critiques of critical realism and realist philosophy in general are extensive and on-going; a full consideration of them is beyond the scope of the thesis. However, there are strong counter-critiques which continue to support critical realist perspectives (Elder-Vass, 2005, 2014; Martins, 2011; Roberts, 2014). If critical realist ontology is accepted as a theory

which renders it fallible, the charge of committing an ontological fallacy is weakened. The necessity for an ontological theory is not diminished however. Epistemologies are contained within ontology (Norrie, 2010, pp. 10-11); therefore, a theory of ontology is required for epistemologies to be tethered to reality like any other practice. Failure to do this, consigns epistemologies to being ad-hoc methods or having unexamined, implicit ontologies without consensus (Bhaskar, 2010). The concept of lamination goes some way to countering charges of creating false subject/object dualities; a theory of emergence counters claims that social/conceptual structures and systems of ideas (knowledge systems) cannot be intransitive and causal in mechanisms that produce events. In partial response to Dowling's claim of the impotence of extra-discursive entities in social research, it is argued in this thesis that extra-discursive entities, though not directly knowable, provide conditions for and perturb discourses; effects noticeable in discourses may not be the result of intra-discursive features alone. Finally, intra-discursive causation is acknowledged in this thesis as causal. The beliefs of teachers and students, which may be ideological in the sense of being formed discursively without any empirical verification, are nevertheless causal since teachers and students clearly act in accordance with their beliefs and produce (cause) empirically observable effects.

Social Fields

To continue with the development of a theoretical framework, this section conceptualises social fields as emerged and laminated structures with unique causal properties. Social fields are given a particular emphasis because the classrooms of the Kura that supplied empirical data are conceptualised as distinct social fields. Explaining struggle with pāngarau relies on a detailed theorisation of social fields underpinned by the ontological theory developed so far.

A social field, then, is a structure emergent from the constellation of people, sub-structures and resources that constitute it. In social fields, people go about their daily lives participating in practices, operating within the possibilities for action provided by structures, and exerting their own causal powers, or more conventionally, their agencies, in order to achieve what their context-models conceive of as the purposes of their existence. In the process, the emergent properties of the field are maintained. The theorisation of a social field alluded to here is Bourdieuan; people develop a habitus (subjectivity, context-models) as

they are inculcated into various social fields and eventually are located in some position within structures (partly self-selected) in the social field according to measures of attainment of recognised capitals. Life in social fields according to this perspective, involves agents participating in social practices according to habitus/context-model definitions of profitable participation within the field but in constant interaction with, constraint by and resistance to pre-existing structural and material conditions. Habitus and the practices, capitals, structures and interests/purposes of the field are seen to *conspire ontologically* to create a connection between the material and social world (Grenfell, 2012)

As emerged real entities, social fields possess sufficient coherence and completeness to possess recognisable boundaries within which the indeterminacy of intransitive entities can be resolved. This is necessary in order to provide actors in the field with a sufficiently stable, and unquestioned, version of reality on which to construct practices and participate in them. The potential range of possible meanings that might be attached to each intransitive entity (including people and the social field itself) must be collapsed to a smaller range of meanings or a single meaning that provides a sufficiently accurate definition for the purposes of the social field. This set of definitions provides the dialectical grounds, or, in Bourdieuan terms the cultural arbitrary/doxa, on which practices are devised and which practices must protect. Doxa refers to the misrecognition of the cultural arbitrary as reality which therefore is in no need of challenge or question (Deer, 2012). If practices are devised which de-stabilise these definitions, the coherence and continuation of emergent properties of the field are put at risk.

The social field must establish relations to an intransitive material and social reality, and to a base in transitive (discursive) reason for all people in the field. The field can justify its own existence because of the *sense* of its relations to intransitive reality (the viability of material life within it) and by recruiting rationales with sufficient power to convince agents of the reasons for continued participation (Bourdieu, 1990; Douglas, 1986). Such participation is clearly necessary for the continued existence of the field.

The field therefore, must perform a number of functions if it is to have duration such as: create and maintain a social reality appropriate to its own interest which also tethers it to intransitive reality; maintain its own internal structural/relational integrity over time; inculcate new agents into the field; regulate agents' actions and the design and creation of practices; and, interact with other entities and respond/adapt to new conditions. Theorisations

of the components and properties of social fields relevant to the above functions already exist, especially in the work of Bourdieu (1990), Bernstein (2000) and Maton (2014).

Bourdieu's theorising of social fields provides the concepts of field, cultural arbitrary, agent, habitus, capital, interest and doxa (amongst many others). Space precludes a detailed discussion of these concepts which have already been adumbrated earlier. Maton (2014) explains that whilst these concepts are vital because they define what is to be studied in social fields, Bourdieu's work does not offer systematic operationalisations of the concepts which allow detailed analyses of empirical data. The work of Bernstein and Maton go some way to providing this operationalisation which is the basis of the methodology detailed in chapter 3.

Social fields are about something, their interest. People in social fields are directed in their actions towards this interest; the field generates rules about the kinds of actions people should produce. In Bourdieuan terms, people are oriented through habitus towards accumulating capitals of various kinds which are defined as legitimate/valuable in the field. The concept of legitimation appears to be distributed through several of Bourdieu's concepts; agents recognise capitals through habitus which is formed in the agent through engagement in practices and exposure to the doxa and cultural arbitrary of the field.

Bernstein (2000) introduced the concept of the pedagogic device which performs legitimation functions in pedagogic fields. Maton (2014) has extended this concept as the legitimation device. The operational advantage of this concept is that the legitimation device can be characterised in detail so that legitimation may be examined empirically in social fields rather than being distributed and rarefied through several related concepts.

Bernstein (2000) fashioned the pedagogic device after Chomsky's language acquisition device (Chomsky, 1965). The language device is theorised to transform a meaning potential in language to actualised communication in social fields. This view is commensurate with a Systemic Functional Linguistic perspective which regards instantiation of language, or speech in actual social contexts, as a collapse of meaning potential provided by language systems (Halliday, 2004). The pedagogic device is theorised to perform a similar function with respect to what Bernstein terms pedagogic discourse; the device regulates how other discourses are changed and represented in discourse in a pedagogic social field such as a complete education system, individual school or classroom. Maton (2014) develops the concept of the legitimation device to regulate all that is legitimate in a social field. The legitimation device supplies definitions of what is to be counted as legitimate in the field. In a pedagogic field, the legitimation device subsumes Bernstein's

pedagogic device. The legitimation device provides the rules, the legitimation code, on which legitimate participation in practices can be based.

The legitimation device provides a theoretical concept which can be used to investigate how social fields create definitions of intransitive entities to create their own internal social realities. The legitimation device is involved in creating dialectical determinations of intransitive entities, that is, the process of deciding what an indeterminate entity is from a meaning potential. The device collapses this meaning potential so that a manageable, relatively enduring, transitive definition is created that is sufficient for the purposes of practice construction and maintenance in relation to the interest of the field. The legitimation code of social reality is supplied by the legitimation device. The device is therefore considered in the theoretical framework to be fundamentally involved in the creation of dialectical relations in social fields.

Recontextualisation, Diffraction and Refraction

Bernstein uses the concept of *recontextualisation* to denote intentional processes through which a pedagogic social field appropriates the discourses of other social fields and in so doing changes those discourses to align with the pedagogic interest of the field. This is a familiar phenomenon for teachers and students in schools where school versions of knowledge are routinely experienced as being quite different to the original versions. This is because the pedagogic field must recontextualise the knowledge of other fields for its own interest which fundamentally involves issues such as assessment and certification, the professional position of teachers, and the political and ideological influences of government and business (Apple, 2006, pp. 83-90; Bernstein, 2000, pp. 56-61).

In the terms being developed here, recontextualisation is seen as an inherent process of all social fields since, as for any entity, other social fields must be defined (recontextualised, re-designed, re-purposed) in order to be part of the social reality of the field. Recontextualisation then is a dialectical determination of what the external field means in the terms of the *home* field. Pedagogic fields have specific purposes of bringing students to some kind of understanding of the knowledge of other fields and so are distinctive, but recontextualisation is not specific to pedagogic fields. Pedagogic purposes mean that the knowledge discourses of other fields must be re-designed for legitimate use the pedagogic field. Recontextualisation is therefore also subject to the legitimation code of the field.

With this generalised view of recontextualisation, a question may be asked about how the internal and external relations of recontextualised external structures manifest in the practices of the home field. This is understood here to involve both intentional, explicit processes and unintentional implicit processes. Intentional processes refer to how structures may be deliberately represented such as, for example, when authors write textbooks for use by students. Implicit processes refer to how structures represented differently in re-contextualisations may still retain relational characteristics of the original structure which re-surface in an altered form. In Dialectical Critical Realism, the concepts of *diffraction*, to which Roberts (2014) adds the concept of *refraction*, are used to indicate how a structure, or more generally, any *totality*, may be broken into its components, and reconfigured as a diffracted/refracted version of the original (Norrie, 2010, p. 50; Rieder, 2012). The term totality is used to refer to any collection of elements which relate to each other in such a way as to create themselves as a coherent unity (Hartwig, 2007, p. 334). Diffraction indicates that a fragment of the originally totality may be represented; refraction indicates that the whole of original totality may be represented. The legitimisation device is then theorised to control the recontextualisation, diffraction and refraction of other structures in its work of supplying the legitimisation code for social reality within a social field. Recontextualisation produces a version of an external structure which is intended to be legitimate within the home social field. Through implicit processes of diffraction and refraction, however, this version may still carry within it something of the original structure. As a recontextualisation of curriculum mathematics education in kura Māori, it is to be expected that pāngarau will retain aspects of internal relations similar to English-medium mathematics education and thereby have causal influences that derive from general society. Despite having different components (language and contexts), pāngarau retains the same relations between those components as English-medium mathematics education. The fact of the phenomenon of struggle with pāngarau suggests that this recontextualisation has not achieved legitimacy in some kura Māori. One further consideration in this regard, is how structures derived from Māori society are recontextualised. The versions of these structures existing along-side pāngarau can be identified theoretically as a potential source of struggle.

Of relevance here are Bernstein's conceptualisations of official and pedagogic recontextualising fields (Bernstein, 2000) and knowledge structure (Bernstein, 1999). For pedagogic social fields, recontextualisation is an explicit and substantial component; many agents are involved in recontextualising the discourses of other social fields for pedagogic purposes so that recontextualisation itself has created an emergent field or sub-field.

Bernstein distinguishes between two distinct types of recontextualising field: an official recontextualising field and a pedagogic recontextualising field. The official field is constituted by agents of the state and consequently carries the official stamp of approval of government as well as having official ideologies inscribed in it. The pedagogic field is constituted by independent agents working in schools, universities and other institutions with a degree of autonomy and developing pedagogic resources according to their own theorising and ideologies. With respect to pāngarau education, the official recontextualising field is very strong so that almost all pāngarau learning resources are produced by a small number of agents in this field. The pedagogic recontextualising field for pāngarau is fragmented consisting perhaps of individual teachers operating in isolation. In empirical data in this project, the influence of official recontextualisation can often be clearly seen; in some cases, the official resources and the messages contained are given directly to students without any critical filtering.

Bernstein also provides concepts of horizontal and vertical discourses. Vertical discourses are based on hierarchical knowledge structures in which higher level, more abstract concepts subsume lower level, less abstract ones. Horizontal discourses are based on segmental knowledge structures in which new bodies of knowledge are added to existing ones without abstract concepts over-arching separate bodies of knowledge. The relevance of this distinction in the pāngarau/mathematics education field is that mathematics knowledge discourse is always presented as strongly hierarchical; the pāngarau curriculum consists of eight levels with higher levels only accessible (officially) after successful learning of lower levels. In this regard it mirrors the English-medium mathematics curriculum. This strong hierarchy however does not match with the knowledge structure of disciplinary mathematics described as networks of inter-related concepts (Burton, 2004; Dowling, 2013; Hadamard, 2007) or as a towered knowledge structure with both vertical and horizontal characteristics (O'Halloran, 2007). Official recontextualisation processes alter mathematics knowledge structure for pedagogic purposes; this may be to facilitate assessment practices (Veel, 2006) or to support a problem-solving conception of mathematical activity which also misrepresents the work of practicing mathematicians (S. I. Brown, 2001; Davis, Hersh, & Marchisotto, 2011). Regarding pāngarau as a totality means understanding that curriculum knowledge structure, assessment practices, discourses and the problem solving formulation of mathematical activity are configured dialectically to form an emergent, causal real entity; together they exert causal influences on other entities such as people, systems, practices and social structures.

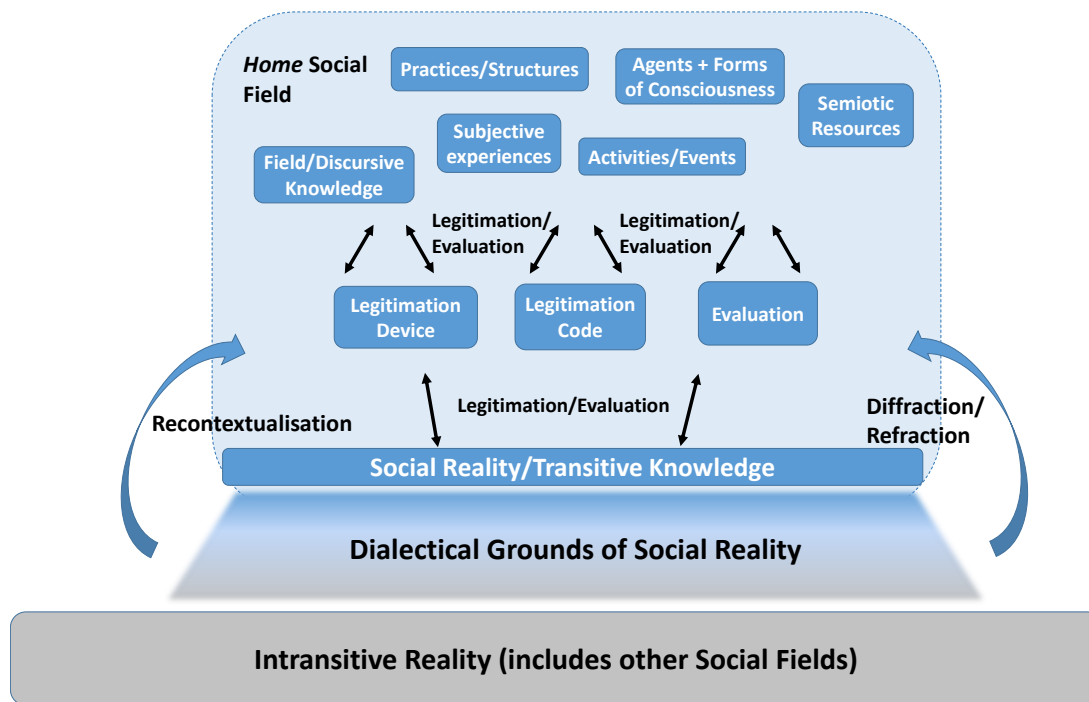
Evaluation and Legitimation

Legitimation in social fields involves defining both how external entities are defined (through recontextualisation/diffraction/refraction) and how internal components are defined and managed. The purpose of internal legitimation is interpreted as being primarily about maintaining the emerged status of the field and the emergent properties of the field.

Bernstein (2000) supplies a conceptualisation of evaluation which is consistent with this interpretation. Evaluation practices are conceptualised as a condensation of (legitimation) code (pp. 36-37). Condensation means that evaluation practices are intimately related to code and more directly carry legitimate meanings; evaluation practices regulate and manage other practices with respect to code and so must convey aspects of code directly, in condensed moments, in their regulatory effects.

Evaluation practices can also be theorised to be essential in the maintenance of the social reality defined by the legitimation code. Evaluation of other practices maintains the dialectical relation between practice and the social reality of the field. Evaluation therefore must tend the definitions themselves and the ways in which practices are constructed and enacted in relation to them. A clear equivalence exists between these aspects of evaluation as upholding a transitive social reality and the alignment of practices with it, and Bernstein's concepts of *classification* and *framing* (Bernstein, 1971). Bernstein uses these concepts to analyse knowledge relations; evaluation practices maintain relations to knowledge through protecting the definitions and the boundaries of knowledge domains (classification) and regulating the enactment of practices so that they align with those definitions (framing).

Evaluation is a powerful analytical concept dissolved throughout all practices in social activity. Bernstein (2000) considers pedagogic discourse as consisting of a regulative discourse and an instructional discourse with the latter always embedded in the former. Evaluation practices (regulatory discourse in Bernstein's terms) continuously inflate the social/cultural environment in which all enactments of pedagogic practices (instructional discourse) take place.



Note: this diagram is a vertical, side view of the theoretical framework of figure 2.1.

Figure 2.4. Legitimation and evaluation as maintaining components of social fields in relation to social reality and intransitive reality

Figure 2.4 summarises the discussion of this section diagrammatically; it provides a vertical, side view of the theoretical framework shown in figure 2.1. It depicts social fields as a configuration of changeable elements buoyed up and maintained in place by practices of legitimation and evaluation. This produces a range of generalised legitimation/evaluation dialectical relations. Legitimation code supplies the *ruler* with which evaluation practices can detect legitimate performance and products. In doing so, evaluation practices re-establish legitimation code as the basis of social reality in the field. Social reality itself is founded upon dialectical determinations of intransitive reality which form its *dialectical grounds*. Particular instances of these relations in a pedagogic field might refer to students' work and the involvement of students in pedagogic practices. For example, the participation of a student in pedagogic practices and the subsequent production of a certain product (an essay, a solution to a mathematics problem perhaps) is simultaneously something to be compared to a legitimate performance and a re-establishment or re-instantiation of it.

Dialectical Learning

This section considers learning to be intimately involved with evaluation and legitimation. This brings the focus of the theoretical development onto interactions within learning activities which are a major part of the empirical data. These interactions are regarded as being made in a dialogic context formed dialectically in relation to the legitimation device of the pāngarau classroom regime. This relation connects the dialogic context and the process of learning to internal components of the regime and to recontextualised/diffracted/refracted forms of external totalities. Learners are subjected to close evaluation, and respond to those evaluations in order to establish themselves in a social field. In the process, they develop fallible yet workable understandings of the components of the field, its discursive knowledge, and accept its social reality.

All practices automatically establish a dialectic between the practice which guides the agent and the agent who performs the practice. This establishes a tension between the variability of enactment of the practice related in part to the agency of the people involved and the integrity of the practice in its relations in the field. This is very apparent when learners engage with practices for the first time. Learners have at best only partial understandings of what being an agent in the field entails and so make many errors. This requires more prominent evaluative exertions by teachers and other learners. Examining evaluation in learning activities should therefore provide a clearer window into legitimation code.

Learners must somehow develop a habitus without possessing a clear understanding of what that habitus will be if they are to participate competently in learning activities. This issue has been termed the learning paradox (Bereiter, 1985); learners appear somehow to be able to develop sophisticated knowledge from simple knowledge without having any prior understandings of that sophisticated knowledge.

The paradox highlights a problem with the conceptualisation of learning as knowledge construction (at least in its radical constructivist form as espoused by von Glasersfeld, 2002); construction pre-supposes the prior possession of knowledge of equal sophistication to the product of construction (Bereiter, 1985; Roth, 2009, pp. 24-32). A dialectical theory of learning has been suggested as a solution to this paradox which is consistent with the theoretical framework being developed here (Roth, 2009, 2014).

Dialectical learning offers a solution to the learning paradox by recognising that it results from the configuration of many elements operating together. This constitutes an example of *holistic causality* (discussed in the next section). In this sense learning can be said to emerge from this configuration. In this view, learning cannot be a conscious, strategic sequence of actions on the part of the learner to acquire something, which cannot be known in advance and so cannot form the object of such a sequence. Instead, arrival at the acquisition is understood to be contingent upon the social interactions with people, language, resources, structures and, most tellingly, with evaluation practices. Rather than searching for a psychological mechanism which somehow uses social interactions and produces internalised knowledge (a radical constructivist view), social interaction *is* that mechanism (Lerman, 1998, p. 300). Thus legitimisation code, evaluative practices, recontextualised views of other social fields, resources, teachers and students themselves all conspire to produce learning. This is arrived at in a somewhat blundering, yet gradually more focussed, fashion as the learner comes to terms with what is legitimate. This learning is always defined and controlled in its blunderings through evaluative practices in terms of the social reality of the field, its interest, and its legitimisation code.

From the subjective perspective of the learner, every small social (and therefore public) act they perform has an indeterminate meaning until it is evaluated in the dialogic context of learning. The evaluation communicates to the learner the degree of legitimacy of their acts and utterances in the dialogic learning context of the activity. Learning itself is characterised as a process of *abduction* which creatively imagines the larger conceptual totalities which are construed in diffracted or refracted forms in learning activities. With this view of learning, concepts of legitimisation code, evaluation and a dialectic of structure/components coalesce to provide insights into how learners progress from simple to sophisticated knowledge.

Learning activities provide representative (diffracted/refracted) fragments of larger, totalities which are, ultimately, the object of the learning. For example, mathematics education attempts to bring students to an understanding of what mathematics is all about but has to achieve this through the provision of a large number of small fragments in learning activities which can only represent (fallibly) recontextualised/diffracted/refracted moments of mathematics as a totality. As students struggle to make sense of the learning activity, evaluative practices inform them of the closeness of their public performances (utterances, actions, products) to a legitimate participation in pedagogy and to a legitimate learning

product. Processes of abduction over an extended period of time, always guided by evaluative practices, lead to more complete graspings/imaginings of sophisticated knowledge structures from these construed fragments in learning activities. Students may emerge as competent practitioners themselves and be the agents of evaluation for other learners. In this perspective, learning is understood as a process of emergence so that a person who has become a competent practitioner does so by assembling their incomplete understandings of, say, mathematics so that their competencies are unique, emerged properties of the assemblage not of any component. This perhaps provides a clue about why competence is such an elusive property for students who have not yet made such an assemblage.

Fallibility runs through all of this dialectical learning process. Learning activities may present an incoherent construal of mathematics. Students may abduct their own incoherent understandings from activities which present a highly coherent picture of mathematics. At the base of all this, of course, is the contention that the totality of mathematics is not currently known absolutely by anyone which introduces fallibility into even the best pedagogical versions.

Another important consideration is the nature of the learning context which, as a product of evaluative and legitimation practices, also contains distortions and contourings resulting from institutional and societal sources instituted through the legitimation code. These sources are theorised here as totalities or partial totalities which invoke various forms of causality to induce such distortions and contourings in the learning context. With this understanding, learners not only grapple with the knowledge concepts which are the explicit focus of learning activities, they also grapple with the relations of the knowledge to powerful (strongly causative) societal totalities and thereby how they themselves relate to them. This learning therefore includes the formation of students' own subjectivities in relation to such totalities. In the context of pāngarau this perspective implies that students come to dialectical terms with the knowledge itself, their own subjectivity (or identity) in relation to that knowledge and to the societal power relations portrayed implicitly in the activities. Students come to various positive and negative identifications of themselves with pāngarau and thereby with the power/causality of totalities which confer meaning on it.

Space precludes a full exploration of subjectivity. The theoretical development described in this chapter hints at a fragile and unstable conception of subjectivity consistent with some recent post-modernist theorising of subjectivity (Walshaw, 2004). Subjectivities

and the social fields in which they operate are considered to be in dialectical relation; subjectivities are causal elements within the partial totality of a social field which conditions those subjectivities. This implies that a person's subjectivity is in constant negotiation with other elements in the field and is shaped and re-shaped by the social arrangements operating in the classroom (T. Brown, 2008). Given that the social arrangements of a social field are held in place by evaluative and legitimisation practices, analysis of legitimisation should provide insights into the nature of subjectivities and their formations. In particular, the connections between evaluative practices and the affective states of students presents itself as an avenue of future research. Some post-structuralist perspectives, and recent neuroscience research, view affect as causal of cognition rather than a product of it; affect, which also recruits various unconsciously pre-inscribed conditions, is theorised to cause inconsistent bursts of cognition as well as various kinds of inhibitions or blocks (Damasio, 1999, 2003; Forgas, 2001; Walshaw & Brown, 2012). This position is consistent with processes of dialectical learning theorised in this section in which students are said to abduct the meanings of larger totalities from fragmentary moments of empirically experienced activities; it suggests that affect produced in response to evaluative processes is in fact vital for such abductions (or bursts of cognition) to take place.

In terms of data analysis in the thesis, subjectivity is not singled out specifically as a unit of analysis. Instead, subjectivities contribute empirical data, along with the many other elements of the field, to the overall collective of data which allows an characterisation of the legitimisation codes operating in the field.

Causality

Causality is considered to be a fundamental force that runs through the theoretical framework developed so far; various forms of causality are theorised to ebb and flow, vibrate and pulse through the webs of dialectical relations that exist between structures and agents. Causality, more accurately perhaps, may be conceived as embedded in those dialectical relations so that causality is always a shift in the perspective on dialectically coupled meanings. Causality here is to be understood as a conflagration of influences which together establish a perspective in a dialectical relation. Causality in this sense may be very close to a Foucauldian understanding of power (Al-Amoudi, 2007; Lynch, 2011).

Dialectical critical realism provides several powerful inter-connected conceptual tools for understanding causation in social life: a stratified reality (already discussed), open systems, four forms of causality and a Marx-influenced dialectical understanding of relations. It also supplies a high level generalised *absence/presence dialectic* and a conception of social life as *being-in-becoming*. (Bhaskar, 1979, 1993; Hartwig, 2007; Outhwaite, 1998).

In the realist paradigm of this thesis, real entities are theorised to exist in open systems; events are not caused by one entity operating on another in a simple, direct manner. Instead, real entities interact in extended configurations, exerting causal influences on each other, to produce actual events in a non-deterministic way. Events are experienced subjectively; the causes of the events are not necessarily observable directly in that experience. This conceptualisation of causality in open systems renders the causal effects of real entities as producing tendencies not predictable, patterned effects. Real entities may possess certain causal powers but the presence of other entities may alter, deflect or block them completely. The presence of the entity may only be known by recognising a tendency in empirical data which may also possess a range of contradictory features resulting from other causal configurations pressing upon it. Furthermore, in a dialectical perspective, empirical experience and events may also have causal effects on each other and on intransitive real entities; an agent's empirical actions, for example, may sufficiently change practices to cause changes in the emergent properties of the social field itself.

Dialectical critical realism provides, amongst its rather mind-boggling array of terms and concepts, four forms of causality which will be embroidered into the theoretical framework. These forms of causality are *transfactual*, *rhythmic*, *holistic* and *intentional*. For the purposes of the thesis, a simplified description of these forms is employed.

Transfactual causality is interpreted to be the use of a transfactual causal relation to justify practices. A transfactual causal relation makes a statement about how events cause other events without considering contexts; the relation transcends contextualised facts as a statement of what would happen in ideal conditions. Transfactual relations may operate as beliefs of agents to justify practices; they guide the agency of people in the production of new events and experiences. In pedagogic fields, transfactual causality may be particularly strong since teachers, schools and the entire education system are involved in the design of knowledge and pedagogy in such a way as to cause learning of a particular, legitimised kind. Transfactual relations such as *co-operative learning improves student achievement* adopted as

a belief or ideology then contributes to causing the institution of collaborative learning practices and may set in train other cascades of events and experiences.

Rhythmic causality is interpreted to mean how practices and events are carried on *into the future* by the following of established routines, natural cycles and patterns. Social practices in their repeated, more or less accurate enactments and re-enactments can be seen as having rhythmic causal properties. Similarly, the natural physiological cycles of the human body such as sleep patterns and ageing, and natural seasonal and tide patterns possess rhythmic causal properties. Rhythmic causality does not mean a static unchanging reproduction of an existing social structure *ad infinitum*. Re-enactments of practices, for example, are never perfect. Each re-enactment introduces a small, perhaps imperceptible change; in theory, very different regimes may emerge with only rhythmic causality operating.

Holistic causality refers to the causal properties of emerged structural entities, or totalities. Such entities are said to possess causality which both maintains internal components relationally configured within the structure/totality, and external relations in larger *constellations* with other entities. The term constellation refers to larger assemblages of related systems and totalities in which a structure may be embedded which support the structure/totality. In this understanding, social fields are totalities in which components are configured auto-poetically to possess holistic causal properties. Auto-poiesis is understood to be a property of a structure which corrects perturbations to its elements so as to re-establish its own previously established integrity. Attempting to change elements of structure, or wider constellations of structures, meets with resistance and correction because the changes introduce incoherence or inconsistencies in the established integrity. Attempting to change an assessment practice for example, introduces inconsistencies with existing assessment practices; pressure is felt to abandon the attempt to change from other people and from the practical consequences of lack of consistency with those existing practices. In Bourdieuan terms, social fields are structured structures operating as structuring structures in this holistic way (Bourdieu, 1989, 1990).

Dialectical critical realism recognises many kinds of totalities which configure material resources, practices, people, discourses and intransitive entities in a holistic constellation with such holistic causal properties. Ideologies, cultures, languages, religions and knowledge domains and, of course, mathematics classrooms, amongst many other possibilities may be conceptualised as totalities, or as partial totalities, which participate in

causal configurations (Lawson, 1998). This perspective is especially important in this thesis because it is argued that pāngarau is one such totality; empirical features are understood to result from causal chains in which pāngarau, as a partial totality of resources, discourses, knowledge items, knowledge structure, and practices, exerts its own holistic causal influences. Referring back to Bernstein's distinction between horizontal and vertical discourses and the strong hierarchy of the pāngarau curriculum, it may be theorised that the hierarchy itself has holistic causal effects in pāngarau classrooms by increasing tendencies to match students to knowledge levels. The requirement for an eight-level hierarchy, regardless of how the levels of the hierarchy are populated, may have significant holistic causal effects. Empirical evidence presented in chapter 4 supports this theorisation.

Intentional causality is interpreted to mean personal agency exerted in the enactment of practices. The nature of this causal influence relates to the form of consciousness of the agent. Three forms of consciousness are recognised theoretically as, following Freire (1985), semi-transitive, naïve-transitive and critical. An agent with semi-transitive consciousness closely adheres to reality and cannot objectify it so as to think about it in terms other than their interaction with it. Naïve transitive consciousness is aware of an agent's own circumstances but exerts agency to unite with sources of power in the social field. Critical consciousness involves understandings of the deeper underpinnings of the social and cultural situation a person finds themselves in. Reflexive praxis, an ability to combine critical awareness with transformative action as social activity unfolds, constitutes intentional causality; an agent with critical consciousness may possess causal properties sufficient to change the conditions and structures of the social field in which they dwell.

These four forms of causality are an essential piece in the puzzle of theorising a causal mechanism for struggle with pāngarau because it is through these forms of causality that entities interact with one another to generate actual events. For example, understanding why a certain practice occurs in a pāngarau activity could involve some or all of the four forms of causality. The practice may occur (be caused) because students and teachers continue an established practice (rhythmically) which has been induced holistically as part of a teaching system and justified by evidence-based transfactual causal relations. The practice may be enacted with variations introduced by personal intentional causality.

Hegemony and TINA Formations

Research in indigenous contexts often refers to concepts of hegemony in terms of false dualisms or dichotomies in which one group of people (a coloniser) establishes their worldview on others (the colonised) as if it is right and natural (Bidois, 2012; Eketone, 2008). This thesis deliberately does not adopt such a dualistic perspective because it is contended that a multi-faceted understanding of causality in social life will provide increased scope and delicacy with which to analyse struggle with pāngarau in actual classroom contexts. In addition, classrooms are complex dialogic contexts which do not lend themselves to a dualistic interpretation. Teachers and students in kura Māori interact with multiple systems and totalities in a variety of ways and are not in an obvious coloniser/colonised situation.

Critical realism offers a perspective in which forms of causality are employed by agents operating in hegemonic conditions. This contrasts with a view of hegemony as a pervasive imposition of worldview by one group or class on another. Joseph (2007) points out that rather than a global hegemony that permeates society, smaller scale hegemonic projects can be identified. These projects represent agent-generated actualisations operating in relation to underlying hegemonic structural conditions. In other words, structural conditions establish a hegemonic situation but smaller-scale intentional activity (hegemonic projects) perpetuates and/or modifies it.

Relating this to forms of causality, it may be seen that a hegemonic project may recruit any or all forms of causality to achieve its aims. In dialectical critical realist terms, the emergent hegemonic situation incorporating large and small collections of hegemonic projects, is referred to as a TINA formation (Bhaskar, 1993, pp. 107-110). The acronym, TINA, is short for *There Is No Alternative*. Bhaskar further explains that a TINA formation involves “a truth in practice combined or held in tension with a falsity in theory” (Bhaskar, 2011, p. 84). This concept captures the notion that a hegemonic situation internalises two fundamental contradictions or falsities: (i) it establishes itself as unavoidable when there are viable alternatives (a truth in practice) and, (ii) it thereby suppresses and denies the existence of separate axiological necessities (alethic truths) which nonetheless must eventually be acknowledged (a falsity in theory). Forms of causality are then recruited to provide supports for the TINA formation which is constantly in danger of being undermined by the alethic truths it suppresses.

The concept of the TINA formation is relevant to this thesis because teachers, resources and activities are actualised in structural conditions and may be engaged in small-scale hegemonic projects within larger TINA formations in both New Zealand general society and contemporary Māori society. In particular, mathematics and mathematics education appear to have a vested interest in maintaining a privileged status in New Zealand society and indeed globally. Mathematics has a powerful discourse of inevitability, universality and necessity associating it with high ability. This discourse is unchallenged outside academic circles (Lerman, 1998, p. 292) and may be construed as being part of the support system of the TINA formation of mathematics and mathematics education. Conventional mathematics education is a TINA formation because (i) it presents itself as essential and unavoidable for all students/people when in fact alternative ways of engaging with mathematics are possible, and (ii) it portrays reality and people themselves as mathematical ignoring their fundamental intransitivity.

Absence, Presence and Being-in-Becoming

Bhaskar (1993) suggests that absence surrounds presence which is a “tiny but significant ripple in a sea of negativity/absence” (p. 5). The main connection of Bhaskar’s promotion of absence to this thesis is the recognition of absence as causal in its own right. The notion of real/sheer absence allows the inclusion of absences as well as presences in causal explanations and the recognition of actions which engender absences and presences. The causal properties of absence are easy to demonstrate and are in fact experienced on a daily basis by most, if not all, people. For example, the absence of a tool from a carpenter’s toolbox will launch/cause certain actions by the carpenter; the absence of a great grandfather who was killed in the Great War has causal effects in the lives of his descendants even though they may know nothing of him. If the assertion of the last section that mathematics education is a TINA formation is accepted, mathematics education itself can be understood to make alternative ways of engaging with mathematics absent with consequent causal effects throughout schools and the education system.

In Dialectical Critical Realism, absence is coupled with presence in an absence/presence dialectic which is interpreted here to be a generalised, perhaps the most generalised, dialectical relation in social life. All other dialectics may be seen in

absence/presence terms by considering which aspect of the dialectic is brought into focus (made present/presented) and which de-focussed (made absent/absented) in a given social context. For example, any material object/resource, since it is defined through dialectical relations, can be considered as an instantiation of any of its dialectical *partners*; this unavoidably introduces processes of absenting and presenting depending on which partner is focussed and which de-focussed. For example, a river may be an ancestor (if you are Māori from a certain region of New Zealand) and a source of water for a hydro-electricity generation project. The absenting of the ancestor aspect (common in official/business fields) may increase the tendency for exploitation of the water resources of the river and degradation of river ecology; the absenting of the water-source aspect (more common in an indigenous field) increases the tendency to place constraints on electricity generation needed for economic growth.

The nature of dialectical relations gives social life a sufficiently durable form which also has a flickering, vibrating, potentially unstable nature. The shifting balances between entities suspended in webs of dialectical relations, creates phenomena in process (Ollman, 2003); phenomena present themselves variously at different times and places. Sometimes a phenomenon may be forcefully present and dominate proceedings; at other times it may be unnoticeable or partially present along with contradictory features and other phenomena. This processual nature is theorised to be intrinsic to social life; what are perceived in the perpetual *here and now* are the momentary products of causal processes, distributed through extended webs of significance which constitute a form of social life. The concrete moments of experience are snapshots of events occurring amongst a multitude of entities in continuous process which propel events into the next moment of subjective, conscious experience (Bologh, 1979; Lukacs, 1971). This perspective views empirical data as showing features that are these concrete moments of processes from which a theorisation of relations between processes, that is, a causal explanation of struggle with *pāngarau*, may be made.

Dialectical critical realism, in common with Marxist dialectical theory, regards social life as a process; events are caused continuously and experienced as solid-seeming products moment by moment. This perspective institutes subjective experience as perpetual interaction with shifting balances of dialectical relations seen as shifts of absences and presences. Bhaskar (1993) refers to the processual nature of social life as processes of “being-in-becoming” (p. 71). This notion emphasises that what is experienced in the moment as a solid-seeming completed product is a passing moment of the entities constituting the

experience which are in a constant process of change - they are always in process of becoming (presenting) something else and thereby absenting previous beings.

In the context of the theoretical framework and its intended application to pāngarau in a kura Māori, the absence/presence dialectic and the notion of being-in-becoming dynamise the analysis. It forces a recognition of the transient nature of the collected empirical data as a snapshot of being-in-becoming; the snapshot is neither what was present before nor what was present after data collection. The causal explanation that is sought, therefore, must be a theorisation of inter-related, jostling processes, moments of which are captured in data, rather than a clean depiction of discrete entities in a static causal configuration.

Causal Mechanisms

Various terms have been used so far in the discussion to denote some kind of linkage of entities which conspire to cause an empirical feature of data. For clarity, the term causal mechanism will be adopted for all of these linkages. Causal mechanisms are discussed in more detail in the next chapter; indeed, the theorisation of a causal mechanism for struggle with pāngarau is the main methodological goal of the thesis.

Firstly, a causal mechanism must relate real entities which may be intransitive and cannot be known absolutely or observed directly. In this way it works across and within multiple strata to cause events and produce subjective experiences for agents. Moreover, since intransitive entities are involved, identifying a causal mechanism is the process of developing a transitive theory about the (partly) intransitive real mechanism (Bennett, 2008; Hedstrom & Swedburg, 1998). A causal mechanism then is a theorised configuration of real entities enchainned together by dialectical relations through which forms of causality operate bi-directionally to produce events and empirical features.

Critical realist research, with some justification, has been critiqued on the grounds of producing static explanations of social phenomena (Kemp & Holmwood, 2003). Such static explanations, sometimes presented as causal mechanisms, adopt the form of linkages between agents and structures that appear to explain the phenomenon in a once and for all sense. For example, the depiction of causal explanations described by Sayer (1992) begins with structures proceeds to conditions/mechanisms and results in events (pp. 108-117). Such

explanations end, usually, by locating the cause in an understandable disposition in human agents but such explanations are themselves deficient because they do not ask why such a disposition is held by those agents (Boudon, 1998).

A dialectical view of a causal mechanism includes the ability of agents and events to influence mechanisms and intransitive entities. Bi-directional causality through dialectical relations is theorised to underpin social life as being-in-becoming. Rather than imagining entities combining in mechanisms to produce events in a somewhat procedural fashion, Dialectical Critical Realism invites a perspective of entities existing simultaneously, related dialectically and diametrically with each other. Through such relations their own processes of change continue simultaneously, caused by and causing processual changes in related partner entities. People, as causal entities themselves, are then theorised to be embedded in this milieu of simultaneously unfolding entities mutually generating the processes of their own change in a matrix of dialectical relations. Subjective experience is how people consciously experience their own process of being-in-becoming in this matrix.

With this theorisation of life in a perpetual moment of being-in-becoming, the history of the entities involved is not lost. The kind of causality just referred to might be thought of as vertical in the sense of causalities operating in a vertically stratified reality. Each entity in these vertically related strata also has a history stretching horizontally backwards in time. Although, it is true that these histories are no longer anywhere to be detected directly, they are collectively what has caused each entity to be as it is in the current moment. In this sense, each entity by virtue of its current form is said to contain their own histories enfolded or *sedimented* within them (Collier, 1998). Each entity then is constituted by horizontal relations (its history) sedimented within its structure, and vertical relations with external entities existing simultaneously in multiple strata (Norrie, 2010).

The theoretical framework (repeated for convenience as figure 2.5) is not therefore to be read left to right as if causality leads from the intransitive dimension of reality to practices and subjective experiences. Instead, all components are to be imagined side-by-side, jostling and elbowing each other as they exchange causal influences and process forward in a shared present moment with their histories still participating via their sedimented structures. Past events cannot cause current events since the past event has already evaporated and is not actualised in the current moment. Past events have causal currency only in so far as they

were part of the processual change of real entities (including real absences) which are currently causal; in this case they are sedimented in the make-up of these entities.

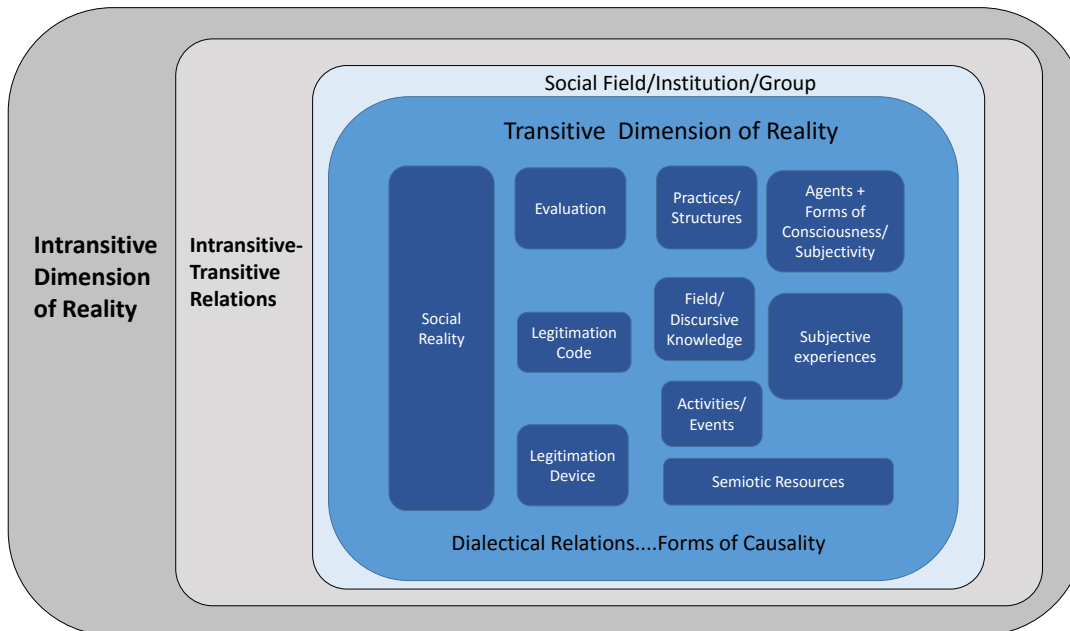


Figure 2.5. The theoretical framework (repeated for convenience).

Conclusion

The theorisation of a causal mechanism for struggle with pāngarau involves potentially drawing on all of the elements of the theoretical framework described in this chapter. The gap between transitive and intransitive dimensions of reality was termed the discursive gap by Bernstein and theorised by him as the space where the unthinkable may be thought (Bernstein, 2000, pp. 29-30). This concept is inherently realist since the concept of the discursive gap implies that the discourse of the transitive theory or model refers to an entity outside itself; the theory and the entity are not the same thing so that a discrepancy/gap exists between them. The way decisions are made in this discursive gap about the nature of intransitive entities and their subsequent geo-historical development in particular social/cultural groups is a central theoretical concern in this thesis. It is this aspect that is referred to in the whakatauki/proverb *He tātai kōrero i ngaro, he tātai kōrero i rangona*/some schemes are lost, some are heard; the indeterminacy of intransitive reality provides the

potential for new schemes to be heard, or in Bernstein's terms, to think the currently unthinkable.

The next two chapters illustrate how this theoretical framework sheds light on the causes of struggle with pāngarau by beginning with empirical data and working backwards to theorise a causal mechanism that relates empirical features of struggle with pāngarau to dialectical, still continuing, decision making in the transitive-intransitive discursive gap. The concepts of the theoretical framework provide the stepping stones in this mechanism; legitimate features identified from social activities illuminate legitimisation devices operating to create the social reality which backgrounds those activities (makes them seem real and a *good idea*). The legitimisation devices establish determinations of dialectical relations which may be seen as instantiations (refractions/diffractions) of deeper level dialectics. The different chains of dialectical determinations supporting different activities, originating from common intransitive entities, are theorised to create contradictions and tensions which constitute the phenomenon of struggle with pāngarau.

The combination of forms of causality, stratified reality, real entities and causal mechanisms is the realist solution to the structure/agency problem mentioned earlier in this chapter. The focus is shifted from an agency and/or structure debate to a sophisticated and multi-faceted understanding in which agencies or intentional causalities work alongside holistic, rhythmic and transfactual forms of causality in various weighted alliances in causal mechanisms. Instead of a structure/agency dualism, there is a question of how real entities, some of which are people, and their causal powers/agencies, articulate simultaneously to cause a phenomenon which is itself embedded in the processual change of all the entities involved. Having said this, the framework and interpreted concepts described in this chapter are only a fallible instantiation of a much fuller, deeper and more complex philosophical project. Dialectical critical realism has been extended to establish transcendental Dialectical Critical Realism (Bhaskar, 2002) and a philosophy of meta-reality (Bhaskar, 2012) which are not considered in this thesis but offer potential for further deepening the understandings of struggle with pāngarau in the future.

An area of further research and theorisation which is sign-posted here and at various points in the analysis of empirical data, is the nature of relations between forms of causality and legitimisation code in a social field. It seems likely that particular legitimisation codes will be instrumental in affording or constraining the inter-play of forms of causality operational in

the field. This is most apparent in social fields where definitions of social reality and enactment of practices are so intensely controlled as to allow only a limited form of rhythmic causality to operate (in a prison for example). The analytical delicacy provided by Maton's theorisation of the legitimation device and Dialectical Critical Realism's intensive and extensive ontological theory may combine to offer further insights that support critically conscious agents operating in sites of struggle, automatically sites of contradiction, such as kura Māori.

Chapter 3 - Realist Methodology

This chapter discusses the realist methodology behind the collection, analysis and interpretation of data. It elaborates an overall methodological strategy considered as a bricolage, then discusses each component of the research design in detail integrating them into a dialectical critical realist ontology. The chapter concludes by elaborating the fine details of the application of the methodology to a truncated case example.

The concept of bricolage involves the purposeful integration of methodological and theoretical concepts and strategies from different research domains as they are needed in the unfolding of a research project (Kincheloe & Berry, 2004). The final version of the bricolage possesses coherence; the concepts and methodological strategies employed must be carefully selected, re-interpreted and organised for the purpose of developing depth and rigour in relation to the purposes of the research and its context. This approach has been necessitated in this project because, as data collection and analysis proceeded, it became apparent that additional theoretical and methodological resources were required to understand empirical features in the data. Thus, both the theoretical framework of chapter 2 and the methodology of this chapter are products of bricolage.

Kincheloe and Berry (2004) and Berry (2006) further explain that bricolage is intimately related to ideas of complexity, criticality and socially produced ontologies and epistemologies which create different realities. This perspective is highly appropriate for a research context involving the interaction between at least two distinct ontologies/epistemologies in which critical analysis of causes is required to inform future transformative actions.

Critical realism theorises *empirical*, *actual* and *real* domains to broadly correspond to subjective experience, actualised events and their real causes respectively. Domains are not the strata of reality described in chapter 2; real, actual and empirical domains are part of a theorisation of the ontological basis of knowledge generation about a stratified reality. Transitive knowledge is generated from empirical experiences of events which are actualised by configurations (mechanisms) of real entities in a stratified ontology (Hartwig, 2007). The

transitive knowledge so generated embodies how people come to know reality which conditions the epistemological view of the intransitive dimension of reality (figure 3.1).

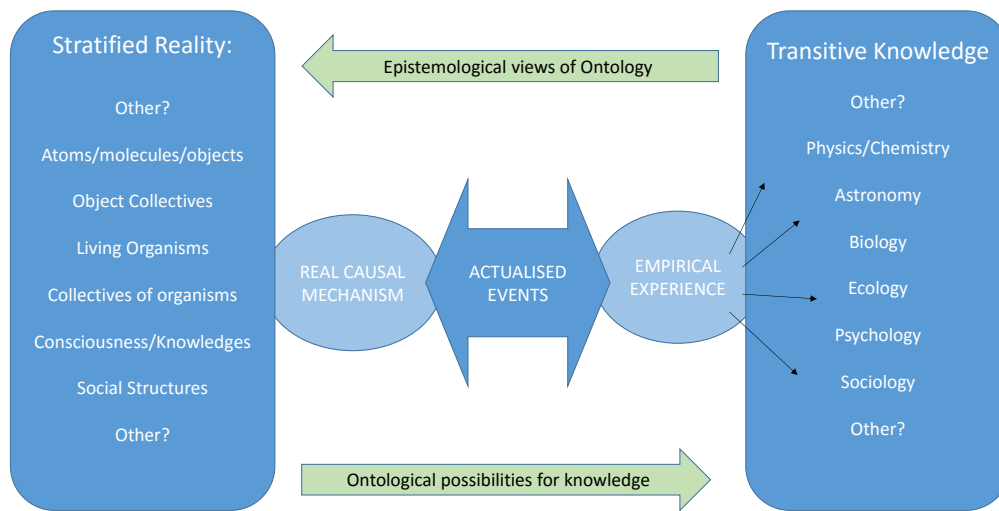


Figure 3.1. Real, actual and empirical domains related to stratified ontology and knowledge.

In alignment with Bhaskar's assertion that everything is real (Bhaskar, 1997), mechanisms that actualise events may involve the subjective dispositions of living participants, their transitive knowledges, beliefs, ideas (both true and false), reasonings and prejudices. In this regard, entities may be both part of the mechanism that actualises an event and a subjective participant in it. They are involved, at multiple strata of reality, in real mechanisms that produce events and participate simultaneously in the experiencing of those events. In a realist research perspective, one such entity is the researcher him/herself. The research project can be interpreted as the product of a causal mechanism involving, amongst other things, the personal history, ideology and capabilities of the researcher, research institutions, doctoral assessment systems and elements of the research setting. Realist research epistemology can then be understood to be the entrainment of researcher intentionality with the causal powers of other entities to actualise specifically designed research events (interviews, video recordings, observations), which are also experienced subjectively by both researcher and participants in an open system, in order to facilitate knowledge generation. This chapter details how knowledge may be generated once such events have produced raw empirical data.

The Overall Methodological Strategy

In critical realist terms, ontology over-reaches epistemology – methodology, which must work within epistemological parameters, is an intrinsic part of ontology (Bhaskar, 1975). The implementation of the research methodology will therefore unavoidably cause changes in the research setting. In addition, any component of methodology may cause changes in other components. The components of a research project and components of the research setting are considered to be entrained together as part of the collaborative production of research events moment-by-moment (Maxwell, 2012). In a dialectical perspective, both researcher and participants must be changed in some way by subjectively experiencing an actualised research event.

Figure 3.2 provides a schematic overview of the realist methodology of the thesis and aims to show how the components are related to each other and always embedded, as far as this thesis is concerned, in a dialectical critical realist ontology. Chapter 2 established the theoretical framework which characterises this ontology. This section discusses in general terms the *data collection methods*, *analytical framework*, *interpretive framework*, and *abstract theory* which are considered to be dialectically configured as a partial totality to constitute the research project.

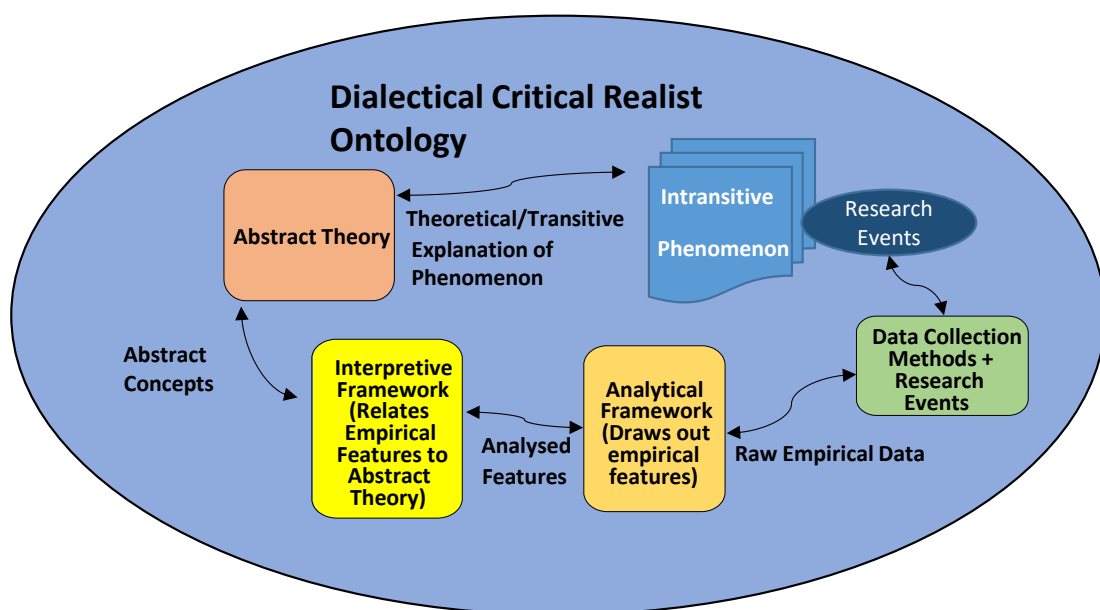


Figure 3.2. Overall relationships of ontology and methodological components

Research events and data collection methods.

The phenomenon which is the object of research is conceptualised to be intransitive as are the mechanisms that cause it. Research events, such as interviews and focus groups, are intentional events designed to generate knowledge about the intransitive phenomenon. Data collection methods record raw data about what happens in these research events. There are therefore two forms of data capture involved; the research events must contain within them genuine accounts, or actualised empirical features, of the phenomenon, and recording devices must capture what happens in the research events. The raw data produced by recording devices exist in an indeterminate state as partial and uninterpreted recordings of research events which should be inscribed with empirical features of the phenomenon. In the case of an audio recording of an interview, for example, the recording device records raw data about what happens when the interview questions are asked. Even though deliberate, pre-designed questions are asked, what happens when they are asked must still be interpreted, that is, assigned a meaning. Raw data are *raw* because they have not yet been associated (dialectically) with meanings. The indeterminacy of raw data is why ways of assigning meaning are required. This is the responsibility of the analytical and interpretive frameworks.

Analytical and interpretive frameworks.

In addressing the issue of relating abstract theory to raw, empirical data, Bernstein (2000, chapter 7) developed the concept of *internal* and *external languages of description*. An internal language is the language of the abstract theory, the concepts used, the terms of the theory and the relations between concepts. The theoretical framework developed in chapter 2 provides an internal language of description. An external language is a language for the research context which draws out the contextualised forms of the internal language. Bernstein puts it succinctly in this way:

Internal languages are the condition for constructing invisibles, external languages are the means of making those invisibles visible, in a non-circular way. (Bernstein, 2000, p. 133)

The *non-circular way* refers to maintaining fidelity with empirical data. Such data cannot be filtered, or otherwise manipulated or distorted to match the theoretical model. The external language must faithfully represent relations in empirical data but it is the internal language of description that sensitises the researcher to what counts as a relevant empirical feature. Non-circularity is created in the delicate process of analysis which refuses to distort empirical data to suit theory and always remains vigilant for the possibility of a lack of applicability of the theoretical model. Bernstein further explains that:

. . . the external language of description (L^2) is the means by which the internal language (L^1) is activated as a reading device [of empirical data] or vice versa. A language of description from this point of view, consists of rules for the unambiguous recognition of what is to count as a relevant empirical relation, and rules (realisation rules) for reading the manifest contingent enactments of those empirical relations. (Bernstein, 2000, p. 134)

Bernstein conceptualises the external language as a *reading device* consisting of *recognition rules* and *realisation rules* which are trained on empirical data. However, training the device on data and finding it illegible is always possible. In this case, revision of internal and external languages is made necessary, that is, the theoretical model must be changed.

Abstract theory conceptualises causal mechanisms that are not represented in empirical data (the *invisibles*). As figure 3.2 illustrates, the first component of an external language of description is an analytical framework that is capable of drawing out relevant empirical features from raw data. The theoretical framework of chapter 2 suggests that those empirical features identified by evaluative practices are relevant empirical features in the context of this thesis. An analytical framework which elaborates ways of identifying evaluation practices thus provides the recognition rules of the external language of description.

The interpretive framework operationalises the relation of recognised empirical features to abstract concepts. The interpretation utilises abductive and retroductive thought processes in which an empirical feature is realised within a theoretical model of abstract concepts. For example, a particular gesture of a teacher may be a positive evaluation of a feature; the feature is *recognised*. Abductive/retroductive thought processes identify this recognised feature as an aspect of the legitimation device; it is *realised*. The interpretive framework provides the realisation rules of the external language; it is based on the

Legitimation Code Theory concept of *specialisation* (Maton, 2014) discussed in detail later in this chapter. Once the interpretation (realisation) of empirical features in terms of abstract concepts is complete, the abstract theory may be used to think about the empirical data and the causes of the contextualised phenomenon under study (Bernstein, 2000).

Abstract Theory.

The causal mechanism being sought is understood to run through the strata of a dialectical critical realist ontology which in turn is theorised to provide the conditions of possibility for the social reality which generated empirical data. Causal mechanisms are not usually observable in their entirety in empirical data which makes abstract theory an essential component of realist methodology (Danermark, Ekstrom, Jakobsen, Karlsson, & Bhaskar, 2002).

Generalised descriptions or correlations of empirical features alone cannot illuminate causal mechanisms since they neglect the real non-empirical parts of mechanisms that produce the correlations. For example, in the context of mathematics education, quantitative analysis may reveal a significant correlation between gender and type of assessment preferred: boys strongly prefer a single end-of-year examination perhaps. The correlation identifies the connection but offers no insight into why the correlation exists nor how it may change or be completely absent in different circumstances. (Sayer 1992).

These considerations establish abstract theory as the main investigative tool in realist research aiming to uncover causal mechanisms existing in unobservable strata of reality. Since they are unobservable, they cannot be accessed by analysis which creates categories of empirical features and establishes relations between them (a generalised theory). Abstract theory is abstract because it is tested through empirical research but is not tied to, or a generalised description of, the features of empirical data. Abstract theory may have no analogous, metaphorical or other kind of resemblance to the features of empirical data. This requires abstract concepts to be created not by logical deductive or inductive reasoning but by abductive and retroductive thinking processes (Danermark et al., 2002)

Deduction and induction thinking processes produce concepts/statements that are of the same type as those being processed. For example, an analysis of empirical data which

establishes themes and collects participants' interview responses in categories, may build a generalised structure relating the themes and categories. The themes and the structure may be deduced (one theme logically follows from another) and/or induced (a certain statement is like others in a category, or one theme is recognised as a subtheme of another) from data. These kinds of analyses make significant contributions to knowledge but, from a realist perspective, they provide only part of the story because they remain in the empirical domain as sophisticated generalised models; they are the product of recognition rules.

Abduction and retroduction, however, constitute the kinds of thinking processes that connect statements/concepts of substantively different types; they connect an empirical/contextualised discourse with an abstract discourse. Empirical features can be thought of as the evidence left behind by real causal mechanisms which have since moved on after the period of data collection. They are no longer anywhere to be seen in that data; the data resemble a crime scene after the perpetrator of the crime has departed. Abductive and retroductive thinking processes must utilise the evidence to theorise what happened, who the perpetrator may have been, and why they did it. Retroduction re-creates possible sequences of actualised events that could have produced the evidence (what the perpetrator of the crime could have done physically to commit it). Abduction creatively imagines relations between intransitive entities involved in actualising those events (what physical, physiological, emotional, psychological, social and societal abstract concepts, motivated/caused the perpetrator to do it in that way). These entities are abstract because they exist in other strata of reality not directly accessible in empirical data; to grasp them a conceptualisation of them must be created in imagination.

Abstract theory is pivotal in another sense. Well-constructed abstract theory should allow the translation of empirical features from many different, but related, contexts such as, for example, the contexts of different classrooms in a school. (Danermark et al., 2002). In this study, this entails articulating abstract conceptualisations of the legitimisation devices operating in the Kura as part of a causal mechanism. This mechanism is understood to run through the strata of a dialectical critical realist ontology which in turn is theorised to provide the conditions of possibility for the social reality which generated empirical data.

This use of abstract concepts to think about the causes of the phenomenon of struggle with pāngarau completes a *methodological circuit* and allows data and theory to communicate in a cyclical fashion. Realist research conducted in this way can be conceived

as a methodological ebb and flow between the dialectically related positions of abstract theory and empirical data (Morais, 2002); data informs theory; theory interprets data. The causal mechanism produced through this research can then be understood dialectically as a simultaneous creation of both theory and data. Empirical data and abstract theory can be *seen in* the causal mechanism but the mechanism is not contained entirely within either data or theory; it is a unique entity which will produce its own causal effects (firstly in the readers of this thesis).

Dowling (2009, 2013) considers that a theoretical causal mechanism for an empirical phenomenon is a recontextualisation in the internal language of the theory; as such, it cannot be *pushed* into the research setting as an explanation of the phenomenon. Instead a re-contextualisation of the mechanism in the *internal language of the research setting* is required - only the people located in the setting, having formed their own version, can decide on the usefulness and explanatory power of the mechanism. It is possible that abstract theory has a *surplus element* which suggests new empirical possibilities (Moore & Muller, 2002). In this case, and following Dowling, any new possibility suggested by abstract theory must first be re-contextualised in the internal language of the research setting before it may manifest in actual practices. The suggestions made in chapter 5 for new potential directions for pāngarau await this re-contextualisation in the internal languages of kura Māori.

To summarise, raw data recorded in research events are recognised and recognised features are realised in the internal language of abstract theory. Abstract theory provides an ontology and a causal mechanism that theorise the conditions of possibility for, and the causation of, the intransitive phenomenon which is partially inscribed in raw data. A similar circulation must exist relating empirical data and the internal languages of a setting in order to initialise changes in that setting. This cyclical situation constitutes the integration of the methodology since data collection methods, analytical and interpretive frameworks, and abstract theory are formed in relation to each other and data about the intransitive phenomenon they are focussed upon. No single component can be settled upon without reference to all other components. This poses a *boot-strapping* problem since it would appear that prior knowledge of the design of components is required so that they may be designed

Solving the boot-strapping problem of research design.

In general terms, a boot-strapping problem (or paradox) is a situation in which the acquisition of a new resource appears to presuppose the prior acquisition of the desired resource or equivalent ones. The learning paradox discussed in chapter 2 is an example of a boot-strapping problem because the learning of higher-order concepts appears to require the prior acquisition of concepts at the same conceptual level. Research design may also be thought of as a boot-strapping problem because information about the implementation of a research plan appears to be required to be able to form the plan and then implement it.

The design of an integrated totality of methodological components is the result of a dialectical learning process that required the researcher to search for meanings for what were initially indeterminate terms, constructs and theories. Each step, once integrated into the always-developing dialogic context of the project, allowed new and sometimes unexpected meanings to be recognised in data and already established meanings to be revised or discarded completely. Incidentally, the researcher's own subjectivity as a researcher also developed as an integral part of the process.

The final design was not produced linearly; components were in mutual simultaneous development. After many false starts, the final design emerged. The external language of description developed in amongst the simultaneously occurring interactions between interrogations of data, investigations of theories and attempts to make sense of data. Each component is an organically developed part of methodology that grew along with other components to produce a co-ordinated system aligned with the goal of explaining causes of struggle with pāngarau.

This goal of explaining causes for struggle with pāngarau itself only became clear during this process of dialogic/dialectical development. Initially, the project was framed in terms of investigating teacher engagement with mathematics curriculum resources. As research proceeded, and understandings developed, it was realised that resources could not be understood without considering the totalities of which they are a part. Similarly, it was eventually grasped that the engagement of teachers with such resources must be understood in relation to the totalities in which they operate. This eventually led to the final realisation that engagement with resources is part of a larger issue of struggle resulting from dialectical contradictions between the totalities englobing differing knowledge domains.

The development of the methodology of the thesis can be seen as the testing of a tentative initial plan through its use in the empirical context of research. As Becker (2008) points out, this testing is iterative with each step of collection of new data or theory examination illuminating and critiquing previous steps. Maxwell (2005, 2012) considers the design plan itself to be a real causal entity in research. This view of research design recognises both the necessity of having some kind of plan which orients the researcher prior to research and that, in the reality of doing research, the plan is one of many causal entities that influence how the research is actualised. As this thesis exemplifies, the final research product incorporates the initial plan but may include many other elements which imbue it with a meaning that could not have been conceived at the beginning of research.

Causal mechanisms.

The methodology stands or falls on the concept of causal mechanism. The central aim of the thesis is to say something substantive about why the phenomenon of struggle with pāngarau came to be and continues to exist.

In an open social world, multiple causal mechanisms operate simultaneously with some actualised (with visible effects in empirical data), some blocked or masked by others, and others not actualised at all. This portrayal makes it difficult to see how causal mechanisms may be identified at all because the blocked and non-actualised mechanisms have no empirical footprint but are nonetheless present and may be causal in other contexts. Manicas (2009) offers insight into this issue by clarifying that causal mechanisms are abstracted from complex empirical situations in order to “provide accounts of action in terms of the meanings and beliefs of actors and an explanation of why the outcomes are as they are” (p. 40). Thus a causal mechanism cannot be and is not intended to be an explanation of what is experienced subjectively by actors nor is it intended to be exhaustive. Rather an identification of a causal mechanism abstracts certain features of actors and structures involved in the concrete situation in order to provide a logic for why outcomes tend to occur as they do. This causal mechanism will involve theoretical relations between abstracted entities (actors and structures) composed of certain selected (abstracted) features (Hernes, 1998).

In the context of this thesis, a candidate for a causal mechanism will involve abstractions of teachers, students, structures and systems which are configured together to illuminate the logic of why struggle with pāngarau exists. Thus teachers may be thought of as agents of legitimation organising semiotic resources that construe a legitimate view of pāngarau for students. All the teachers are more than this, of course, but the teacher role is considered to be how the agency of teachers is involved. In the same way, students, though they may be many other things, are abstracted as receivers/seekers of legitimate views.

Whilst objections to this process may be made on the grounds that significant information may be lost, the point of the exercise is to explain and illuminate a causal mechanism and not to explain exhaustively all possible mechanisms now and forever. In any explanation of causality there will be loss of details from concrete situations. This does not invalidate the causal mechanism.

Hernes (1998) further explains that the definitions of actions, structures and their inter-relations need to be explicit in order to clarify the logic of the social mechanism. This involves stating precisely in what ways actors, structures and relations have been abstracted. Due to the complexity of social ontology, and the fallibility of research, *promissory notes* may also be needed which indicate a linkage in the mechanism which, for the time being, leaves the mechanism partially unexplained. Promissory notes indicate where further research is needed (Manicas, 2006, p. 88).

The representation of participants.

A particularly important consideration in this thesis is the representation of participants. A kaupapa Māori research paradigm insists that Māori control research process, purposes and research output (Pihama, Cram, & Walker, 2002). As Māori centred research, this thesis may not be so controlled but centralises the purposes of the Māori participants in the research (Cunningham, 1998). There is a fundamental concern with the production of insights that will be of interest firstly to the kura Māori in the study, secondly to other kura Māori and thirdly to the wider research community. With this Māori-centred orientation, participants are not only highly respected and valued, and treated in ethically and morally sound ways, they are also the primary consumers of the findings of the research.

Empirical data in this study were collected with an ethnographic methodology which attempted to accurately depict actual events in the Kura. Ethnography has suffered from much critique in terms of the representation of cultural groups by predominantly western scholars. Critical ethnography has therefore come to the fore as the power position, cultural background and personal biography of the researcher have become implicated in the representation of participants in the research findings of ethnographic studies (Sherif, 2001). This view considers that the ethnographer's own biography, class, ethnicity, gender and personality affects the whole research process (Coffey, 1999). These controversies focus on the extent to which a researcher can claim to understand and represent faithfully the contextualised meanings inherent in the social and cultural lives of people being studied. In the case of a Māori community which will undoubtedly have knowledge of unfavourable, intrusive and unethical past research experiences *on* Māori, conducting ethnographic research may present especial challenges. (L. T. Smith, 1999, 2005). This is especially so when the researcher is not Māori and potentially associated with colonising agencies. In this case, there are multiple concerns centring on the ability of any researcher to authentically represent another's culture, and on a European researcher's involvement in a Māori context. Jones (2012), however, advocates that the researcher "eschews certainty, solutions, and judgment, and embraces uncertainty, contingency, reflexivity and engagement." (p 109). According to her, European and Māori researchers and participants may co-operate on the basis of awareness of the problems and imperfections but also the potential for growth and positivity that mutual challenge generates.

Roberts and Sanders (2005) point out that much of the critical controversy over ethnography and the representation of participants stems from the adoption of dualistic positions – the tension that arises between an emic and an etic perspective, the requirement to be both an insider and an outsider. Such dualisms create difficulties because a decision has to be made about where authenticity lies. Post-modernist and constructivist perspectives would locate authenticity in the contextualised meanings and situated lived experiences of the participants (Bhaskar, 2002; LeCompte & Goetz, 1982). According to Maton (2009), such an emphasis on situatedness reduces the ability to cumulatively build knowledge. Instead, an ever-growing collection of situated, segmental descriptions is generated.

May (2004) observes that in a realist research paradigm, researchers must consider themselves as part of the reality of the research process. Rather than dismissing the research as being determined by the researcher or reducing social research to relaying participants'

situated accounts, the social conditions of research and knowledge production must be integrated with knowledge of the social context under study. This accepts that the research act is not an investigation into the lived contexts of participants nor a reflection of the researcher's gaze, but a unique real event involving both and producing something that has never existed before. Therefore, the research event must be understood in terms of its own causal mechanisms which are embedded in academic disciplines, university politics, funding organisations as well as in the social lives of the researcher and the participants.

The methodology of the thesis is expressed as a translation between abstract theory and empirical data. Participants are vitally important because they have allowed empirical data to be collected about their views and practices but they are not part of the analysis or interpretation of data. The abstract theory used is the researcher's responsibility as are the interpretations made and the conclusions drawn about causal mechanisms. Such causal mechanisms are not themselves directly observable in empirical data and participants are not necessarily aware of them. The participants are considered, as all people are, to be in various states of conscientisation about the social conditions in which they live. Some will exist in a state which does not question conditions but aims to function well in them. Others will be in a more critical state and have greater awareness of unobservable causal influences. In this respect, a dialectical and critical consciousness is considered necessary for the researcher in order to establish a praxis of critical analysis of social relations whilst simultaneously engaging with them (Freire, 1972, 1985; G. H. Smith, 2008). The researcher then may be in a very different conscious state to those of the participants.

With this in mind, the results of analysis and conclusions may bear little or no resemblance to what participants themselves would say they were doing in the data (Hammersley, 2006). As Bernstein (2000) points out, without care by the researcher there is a danger that participants' voices are silenced in the case where the external language of description is not "permeable to the potential enactments of those being described" (p. 135). The analysis of empirical data must identify features evaluated from the participants' own subjective perspectives - in this thesis only participants can indicate how they value something. Having recognised that a feature is evaluated in a particular way by participants, however, it is made available for reading by the interpretative framework which realises it in abstract theory. Thus, conceptualising the external language of description as recognition rules (analytical framework) and realisation rules (interpretive framework) provides the bridge between empirical data and abstract theory in such a way that the voices of

participants are not silenced but are carried into the internal language of description as a force to inform that theory and, potentially, to enforce changes in it (Bernstein, 2000). Knowledge is fallible; all abstract theories are fallible and require this carrying of participants' voice into them. The abstract theories themselves cannot be claimed to be true or to *be* the structures or causal mechanisms they claim knowledge of. Abstract theories are accumulations of understandings gathered over time through many interrogations in empirical studies in which participants' voices and abstract theory interrogate each other (Danermark et al., 2002). It is important to remember that a similar interrogation happens between participants' subjective experiences and their contextualised internal languages (Dowling, 2009, 2013).

The problem of contamination of data through the presence of the researcher in the field in which data are being collected must also be considered. If the researcher communicates to participants detailed information of what they are looking for, participants may attempt to produce it or suppress it. The abstract theory that the researcher may already have in mind as data is recorded, will certainly influence participants if the researcher has informed them of it. Sayer (2012) points out that although the research will undoubtedly influence participants during and after its implementation, data can be collected about participants' actions prior to such influences (p. 34). In this research, participants may well have become acquainted with Bernstein's sociology of education for example. Their practices may have subsequently changed because of it. However, data recorded their practices before they knew of Basil Bernstein. In the case where a teacher already knows of this sociology with practices influenced by it, data are still valid because that knowledge would already be an authentic part that teacher's subjective position. The important point is that the researcher has not informed them and thereby sensitised them to *perform* and produce just what the researcher can easily analyse and interpret.

Roberts and Sanders (2005) discuss the issue of realist research and ethnography. Their perspective supports the notion that a critical realist social ontology involving empirical, actual and real domains enhances ethnographic approaches. They argue that the location of the subjective experiences of participants in the empirical domain both necessarily requires the inclusion of participants' voices and allows it to carry into theorising of causal mechanisms. Moreover, the authentic inclusion of the subjective voices of participants is essential precisely because of critical realism's recognition of empirical, actual and real domains. The subjective experiences and reasonings of participants are deemed to be caused by, and causally involved in, causal mechanisms which may entrain many structures and

objects in the actual and real strata. In a dialectical ontology, subjective reasons and experiences may react back into other strata and influence structures. In this ontology, it is clear that without inclusion of authentic participant voice, illumination of causal mechanisms is impossible.

Summary.

So far, this chapter has explained the methodological background to the collection, analysis and interpretation of empirical data. Ontology is understood to over-reach all methodological actions so that the presence and products of the research project are always melded with ontology and will inevitably influence the social fields which are its object of study. Ontology conceptualises social reality as being in flux with the research project as part of the flux. Realist considerations of the dialectical relations of abstract theory, languages of description, and empirical data coupled with a dialectical understanding of how the bootstrapping problem of research design is solved, elaborate how the research endeavour is inextricably embedded in social ontology.

A developed moral and ethical philosophy (also part of ontology) is required to ultimately guide research. To follow other considerations renders the research and the researcher as an agent of control (not power) in processes of causality which may propagate injustice and inequity. Research therefore is inherently about reflexive praxis/intentionality which seeks to use ethical and moral guides in its inevitable, real transformation of the conditions of social life (Bhaskar, 2002). In this regard, realist qualitative research must include authentic participant voice not only because of ethical and moral considerations but also because a realist analysis cannot stand without it.

The remaining sections in this chapter elaborate each component of the methodology. Figure 3.2 is shown below in contextualised form as figure 3.3. This diagram summarises the methodological discussion in this chapter.

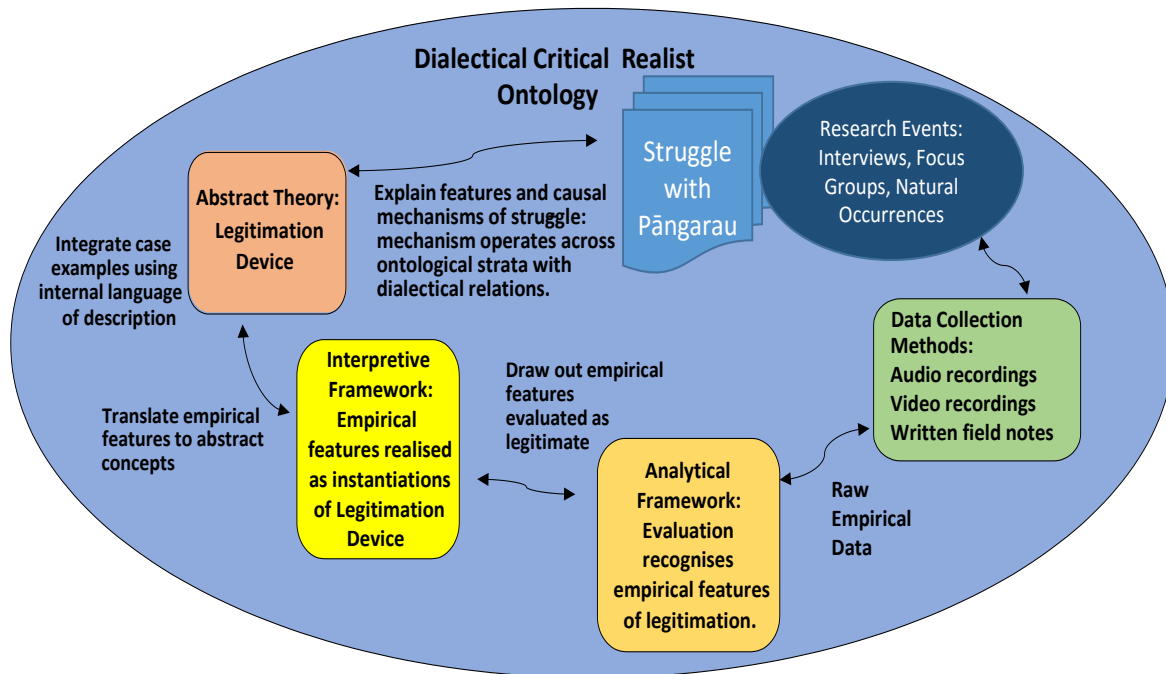


Figure 3.3. Contextualised methodological components.

Data Collection Methods

Data must be collected that represents authentically the subjective experiences of participants; the data must be as close as possible to a naturally occurring state, capturing events expressed in participants own words and deeds. The researcher must also therefore be able to enter into the social contexts of participants in such a way as to enable the collection of such data.

The mode of engagement with the research context involves an intensive, ethnographic, case study approach. The phenomenon of struggle with pāngarau is considered as a distinct phenomenon manifesting in the particular case of the Kura. Each classroom regime is thought of as a case example in which struggle with pāngarau is expressed uniquely.

The data collection methods used were fourfold: field notes, semi-structured interviews, focus groups and lesson video. Before discussing these methods and the issues of managing participant involvement in the research, the integration of them in terms of the three concepts of an intensive approach, an ethnographic approach and a case study approach will be discussed.

The intensive approach.

Intensive research, according to Sayer (2012), refers to a study that aims to understand the causes of a phenomenon by intensive *deconstruction* of a single or a small number of cases. An intensive approach starts with individuals (not necessarily individual people), traces the main causal (including discursive) relationships into which they enter, and studies their qualitative nature as well as their number. It might not be possible to define these causal groups at the outset of the research, indeed discovering them and studying how they operate may be a key component or objective of the research (Sayer, 2012, p. 20).

Sayer (2012) contrasts intensive approaches with extensive approaches which aim to discover “how extensive certain phenomena and patterns are in a population” (p. 20). Extensive research does not supply causal explanations, only descriptions of regularities. Since the causal mechanisms unearthed in an intensive study of even a single case may

illuminate the causal mechanisms generating the same or similar phenomena in other cases, intensive studies may have greater generalisability than an extensive study that produces a description of where in a population certain characteristics exist (Sayer, 2012). Merriam (1995) explains further that extensive research must show that procedures have been followed faithfully because contextual detail is sparse; intensive research bases robustness on attention to detail, portrayal of process, and inclusion of the participants' subjective experiences.

The concept of generalisability has different forms. Merriam (1998) identifies *user generalisability* to indicate a form of generalisability where a researcher may recognise that the conclusions from one qualitative study apply also to theirs. This notion refers to generalisability as transferability of conclusions and findings between research contexts (Lincoln & Guba, 1985). This may be possible in some cases by a systematic comparison of the characteristics of two contexts which may then support the transfer of findings from one to the other. There is also the possibility (as in user-generalisability) that findings from a study though expressly denying any generalisability may still, unexpectedly, be transferable. Eisenhart (2008) clarifies that whilst qualitative research cannot usually claim statistical/probabilistic or nomological (true for all times and contexts) forms of generalisability, other forms are certainly possible and important. Of most relevance to this thesis is the concept of *theoretical generalisability*. Eisenhart explains theoretical generalisability as an understanding of a generic process which may exhibit different values in new contexts. The use of understandings about the generic process developed in one context may then be tested and refined in another. Over time, a robust theorisation of the process may be achieved. This view of generalisability is most applicable in this thesis where the concept of *causal mechanism* may be likened to the concept of *generic process*; developing a refined understanding of the process is equivalent to the idea of the testing of abstract theory through empirical research. The causal mechanisms of struggle with pāngarau may not apply in another context, but they may be used as a theoretical starting point to be tested, refined or completely rejected.

Intensivity is linked with the concept of theoretical generalisability. Through an intensive investigation of a single case, a generic process/causal mechanism may be (at least partially) illuminated. This position is realist since it rests on the acceptance that there is a process/mechanism that is external (existing in non-empirical strata) to the consciousnesses of the participants which may also apply to the participants in another context. For theoretical generalisability to be entertained, a realist and stratified social ontology is

necessary. The alternative consigns research to the investigation of phenomenological description of completely contextualised and independent empirical events.

The ethnographic approach.

A Kura Māori is a distinct socio-cultural space with its own practices, language and purposes. An ethnographic approach is important because it increases the likelihood that the researcher will understand the universe of meaning of participants, that is, how participants themselves understand and conceptualise their own actions and use of resources (Merriam, 2002, p. 35). Thus there is a significant onus placed on the researcher to be able to establish the kinds of relationships with participants that will allow this. In this study, the researcher was able to form such relationships because he is fluent in Māori and has significant prior relationships with the Kura – he was already well-known with the participants before the research began.

In a kura Māori, the researcher must be fluent in Māori. If not, only staged data may be collected - data translated or conducted in another language, or data collected indirectly through another person. Direct observation and interpretation in real time of naturally occurring data are not possible. More importantly perhaps is the fact that without fluency in Māori, the researcher is less likely to form the necessary relationships with participants.

Most data were collected in Māori but appears in English translation in the thesis. Readers must rely on the researchers' translations into English. To mitigate the potential for introducing the researchers own skewing of meaning in the translation process, English translations of each participants' Māori utterances were checked with participants themselves. Participants were presented with the researcher's translation and the Māori transcripts so that participants could check the equivalence of meaning of the two (and check that the Māori transcript was accurate). By this method, the English translations presented in this thesis have the endorsement of participants.

An ethnographic approach is considered to be essential in gaining, as far as is possible, an understanding of how participants see things – an emic perspective. However, distortions of participants' actions and comments are inevitable since the researcher is doing something out of the ordinary by conducting interviews and video recording lessons. The

researcher's interpretations of such emic meanings are, as Geertz (1973) points out, interpretations of other peoples' interpretations. Such thinking may suggest that ethnography is limited in what a researcher can say about actual emic meanings since it amounts to an attempt at mind-reading. As Edwards and Mercer (1987) explain however, the mind-reading exercise is neither necessary nor relevant since social life only permits access to collective meanings. Collective meanings are generated (dialogically) in social interactions and, providing the researcher has necessary competencies, such meanings are accessible to the researcher in the same way as for participants. In this thesis, it is asserted that the researcher was in a position to access such collective meanings because of prior relationships and trust, a common interest in the research and its outcomes, fluency in Māori, sufficient cultural understanding and sufficient understanding of the institutional nature and purposes of the Kura.

These features of the researcher's relationship with the Kura are likely to minimise distortions in the sense that participants are less likely to perform for the researcher. The experience of the researcher in the field suggests that participants were natural in the data; they allowed recording of normal practices in classrooms and gave straightforward responses to interview questions. There were many examples of errors, blanks, back-tracking, embarrassments and failures that nevertheless formed part of the data. Even in a stage-managed performance, it is unlikely that legitimisation code will be hidden since it is this code that informs us of the goodness of an idea and therefore will inform and be accessible to analysis in the stage-managed performance also. This raises the possibility that a stage-managed performance may in fact construe legitimisation code more accurately than a naturally occurring one since it will be deliberately designed and controlled to show off what the teacher considers most legitimate (Schwartz, 2002).

Another feature of the ethnographic approach is the use of multiple forms of data. The data collection methods were a *net cast wide*. This strategy was adopted because it was not known in advance what sort of empirical features would be relevant. Initially data must be collected in order to refine understandings of the kind of data that should be collected. Having multiple forms of data also creates the possibility of triangulation by using one form to confirm conclusions from another. Thus field notes, video data, interviews and focus groups were all used in the data analysis to contribute to a final conclusion about the nature of the legitimisation code in a pāngarau regime.

The net cast wide approach is very likely to collect data that, in light of later developments, are not reported on. This is the case in this study; large quantities of data were collected all of which informed the development of the project but much of it does not appear in chapter 4 (Case Examples). All data informed the project and were subjected to several analytical sweeps. Only by doing this, was it known which case examples to include. Case examples not appearing in this thesis all played their part in forming the dialogic contexts that developed during the project and so influenced the final destination. The debt owed to the entire data set is substantial even though only a small number of the case examples are presented in detail.

It is possible that once some data are collected and examined (though perhaps not analysed because an appropriate analytical framework is as yet unknown), the resulting information may suggest the need to change or refine data collection methods. This decision can only be made in relation to all other components of the research which are themselves evolving in a similar fashion. In this study, adaptations to data collection methods were made and new methods brought into play in order to collect different types of data or to replace methods that proved ineffective. For example, focus groups with students produced very limited data so individual student interviews were also conducted.

The case study approach.

The phenomenon of struggle with pāngarau is real; it has been experienced by teachers, students and families from many kura Māori and reported on in several ways in this thesis. Chapter 1 details this. The phenomenon of struggle with pāngarau presents itself naturally as a case in need of study.

Yin (2009) describes the case study approach in two parts as an empirical enquiry that:

- investigates a contemporary phenomenon in-depth and within its real-life context, especially when
- the boundaries between phenomenon and context are not clearly evident (p. 17)

In other words, the phenomenon must be studied in its real-life context since it is unclear how contextual factors are implicated in the phenomenon. Secondly, Yin explains that data collection and data analysis strategies become important because the enquiry:

- must cope with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
- relies on multiple sources of evidence with data needing to converge in a triangulating fashion, and as another result
- benefits from the prior development of theoretical propositions to guide data collection and analysis. (p. 18)

Yin's definitions match neatly with the approach taken in this thesis. In order to realise the case study as part of methodology, the phenomenon of struggle with pāngarau that constitutes the case must be recognised which requires some prior theoretical development. Classroom regimes, especially in video data, provide evidence of multiple issues some of which are under-determined in the data and requiring of further research projects (hence the use of promissory notes). This situation emphasises again the importance of external languages of description capable of recognising relevant empirical features, and those which are not relevant. Recognising *variables of interest* which are under-determined is part of this language of description. Multiple data sources are also incorporated. As discussed in detail in the next section, four types of data are collected from classroom regimes throughout the Kura and from whole Kura activities.

To summarise, an intensive, ethnographic, case study rationale organises data collection methods because causal mechanisms are sought (intensive, theoretically generalisable), the subjective *universe of meaning* is sought (ethnographic), and a single, contextualised, real phenomenon (struggle with pāngarau) is the object of study (case study).

Data collection methods.

Individual. semi-structured interviews were chosen as the data collection method to inquire into teachers' ideas about pāngarau. Within a semi-structured interview situation, a predetermined question guide is followed but there is also scope for following important lines of enquiry as they arise (Merriam, 2002). This is appropriate in this study because of the

interest both in pursuing causal mechanisms (asking common sets of questions about why something is the way it is) and providing space to explicate unique features of each case example. These two modes of questioning may also be broadly interpreted as being monologic (pre-determined) and dialogic (impromptu). Pre-determined questions are driven by the monologic intentions of the researcher to inquire about specific issues; impromptu questions venture into unknown territory for both researcher and participant so that each new question and response illuminate the territory as the statements are made. In practice, the distinction between these two modes is not easy to make since even when a pre-prepared question is asked, the response to it cannot be known in advance and may cause a switch to a dialogic mode where a unique feature is investigated. In practice, the two modes are intertwined and inter-related.

Student focus groups were chosen both for practical reasons (large numbers of students involved) and for the additional possibilities that group interaction between participants offer (Kreuger, 1987; Morgan, 1996). Students in interaction with each other trigger comments that would not otherwise emerge. Focus groups consisted of students who engaged in the learning activities in the video data and, where feasible, these students also watched video of themselves in the activity.

Video recordings of lessons, audio recordings of meetings and field notes, form a vital core of the data set. Naturally occurring evidence assumed greater importance and centrality in the research because it became apparent that it represented the natural conditions in which legitimisation happened. As legitimisation and, more generally, an orientation towards deeper level causes emerged as the research purpose, naturally occurring data became central by showing how such causes were actualised in context. This recognises the phenomenon of the difference between espoused and enacted theories (Argyris & Schon, 1974). Argyris and Schön suggest that the difference between espoused and enacted theory is due to the fact that there are two distinct theories operating. The espoused theory draws on underpinning rules about how to explicitly communicate with others. Enacted theory draws on tacit and unconscious components as well as conscious theory. This renders the interview generated and naturally occurring data not only different in form but also about different things. Data collected from interviews and focus groups are mostly, but not exclusively, about an overall vision of pāngarau – what it is and how it relates to other entities in the universe(s) of meaning of teachers and students. Naturally occurring evidence is about how legitimisation code co-ordinates the completion of activities in actualised contexts which is influenced in

part by ideas communicated in interview data but also by tacit and unconscious systems. The two sets of data provide empirical evidence about complementary aspects of legitimisation code. This casts the concept of triangulation of data in this study as relating to different aspects of a phenomenon rather than gaining confirmation of the same aspect from multiple sources (Denzin, 2009).

When participants talk about how pāngarau is related to other objects in the world, they also construe those objects as well as pāngarau. Although this is a difficult aspect to analyse in the data and beyond the scope of the thesis in general terms, the way the Kura ethos itself is construed in pāngarau regimes is important because the ethos provides the general institutional legitimisation code to which all other practices in the Kura relate. The Kura ethos theoretically unites all people in the Kura in a common legitimisation scheme to achieve the collective purposes of the Kura. With this consideration in mind, a distinct case example included in the data is the Kura ethos itself. This is construed indirectly in various ways in classroom regimes, but is construed directly in the collective practices of the Kura. In this regard, an ethnographic approach is essential if data about the Kura ethos are to be collected.

Four different kura Māori supplied empirical data. In each kura, all teachers were invited to be part of the research but in two of the kura only one teacher engaged for the full eleven-month period of data collection. In the other two kura, all teachers participated. A total of twenty teachers supplied complete sets of data consisting of at least three complete learning activities captured on video, at least two personal interviews and at least two focus group interviews with students. Several teachers and students provided additional material because of their unique contexts which provided contradictory or insightful perspectives.

During the ten months of data collection, two days a week were spent in the two fully engaged kura, and two half days with each of the teachers in the remaining kura. Often this time was not spent in active data collection but served the purpose of normalising the presence of the researcher in classrooms and around the kura generally, and in observing naturally occurring events recorded in field notes.

Engaging participants, ethics and data security.

As explained in chapter 1, the researcher has had long experience working as a teacher and adviser with a large number of kura Māori. The kura who supplied data had already engaged with the researcher in these capacities. Trustful relationships had already been established which made engagement by these kura a straightforward matter. The four kura were chosen because of the length and depth of prior relationships with them. This situation increases the confidence that data supplied are authentic and naturally occurring.

Approaching these kura was a continuation of an already existing set of relationships. Initial discussions with the principals of each kura were followed by presentations and invitations to participate being made at teachers' meetings, board of trustee meetings, parent evenings and with each class of students. Obtaining signed consent forms from all participants proved easier than might be expected with such a large number of participants (approximately three hundred people altogether); the teachers themselves and kura office administration staff were particularly helpful in collecting most of the consent forms from students and their parents. (See appendix B for examples of teacher participant information sheets and consent forms.)

Ethics approval for the research project was approved by the University to cover the data collection methods and teacher, student and parent involvement. Students over the age of 7 years were included in this approval with informed consent of student and parents/caregivers. Ethical research from the perspective of the University must be understood to be different to the ethical concerns required when researching within a Māori context such as a kura Māori (Taiwhati, Toia, Te Maro, McRae, & McKenzie, 2010). Extra responsibilities are placed on the researcher to not only respect but to support contextualised aspirations through research.

The safety and confidentiality of data and the anonymity of the kura and individual participants were a highly important consideration in the ethical management of the project. The securing of data from accidental damage/loss or distribution, or theft was achieved by direct recording of interviews and lessons onto external hard drives; no data were stored on the researcher's own laptop computer because security could not be guaranteed. No data were stored on internet-based, cloud systems.

Recording of lessons and interviews was always done on two devices simultaneously to safeguard against equipment failure. Data recorded on video cameras and audio recorders were transferred immediately to an external hard drive which was always carried with the researcher. Data were also copied to a second hard drive kept in a secure locked filing cabinet at another site before deleting data from recording devices. At all times, at least two local copies of the data were in existence. Some paper resources were collected as data; these were treated in the same way - two photocopies were made and one stored in the locked filing cabinet offsite and the other carried with the researcher. All data will be completely destroyed five years after the end of the data collection period.

Preserving the anonymity of participants and the kura was similarly highly important. Firstly, it was carefully explained to participants that the data were to be used only for the PhD project the findings of which would not be published but submitted to the University for the purpose of examination. Separate permission would be negotiated with participants for any other purpose. Secondly, only the researcher and the participants in the data could access that data and no recordings could be used in any presentations of findings. Thirdly, in any writing about the data, no real names nor the names of the kura could be used. In the relatively small community of kura Māori, it is difficult to preserve anonymity; each kura Māori is well-known to most other kura as are individual teachers and the researcher himself. Simply knowing the researcher had done research in some kura Māori, would allow some people to make a good guess about which kura Māori, and possibly which teachers, had been involved. This situation cannot be prevented; all that can be said is that all steps were taken to meet the ethical requirements of conducting the research.

Summary.

To conclude this section, the main points of discussion are displayed in table 3.1 in which each data collection method along with its data type and purpose in the terms of this study are given.

This section has detailed the exact data collection methods used in the study and the types of data they collected. It also described how this supported and integrated with the other components of the research design. The collected data set formed the raw materials to which the analytic and interpretive frameworks were applied in order to relate to and encapsulate the contextualised features of the data in terms of abstract concepts. These abstract concepts are necessary in order to provide a common language in which to talk about all of the different contexts which supplied data. With this common language, the causes of struggle may be talked about.

Collection Method	Participants/Contexts	Data Collected	Research Purpose
Semi-structured Individual Interview (Audio recording)	Teachers Students Researcher	Responses to structured questions Responses to impromptu questions Real time natural speech.	Describes overall vision of pāngarau. Relations to other objects. Kura ethos construed indirectly.
Naturally Occurring Video Recording	Pāngarau activities Teachers Students	Multi-modal real time interactions, dialogic contexts.	Recognition of evaluation processes and features specialised.
Naturally Occurring Audio Recordings	Collective Staff and Whānau Meetings. Teachers, Whānau members.	Real time natural speech. Collective discussions (Naturally occurring focus group)	Construal of Kura ethos. Construal of pāngarau in relation to Kura ethos.
Focus Groups (Audio Recording)	Students	Real time natural speech Collective discussions	Student perceptions of relations of pāngarau to other objects in the world.
Naturally Occurring Field Notes	Observational contexts: Whole Kura events, interactions, practices, routines. Teachers, Students, Others	Real time interactions. Written descriptions.	Construal of Kura ethos, pāngarau. Various relations within and between.

Table 3.1. Data collection methods.

Recognition Rules: Evaluation

This section discusses the first step of data analysis and interpretation which generates a contextualised summarising statement about the elements of legitimisation in pāngarau classroom regimes and the Kura ethos. The details of how raw data were analysed to recognise relevant empirical features are described and explained.

Legitimation is understood to be recognisable in data by attending to both explicit and tacit evaluative strategies. As discussed in the previous chapter, the components of social life in a social field are theorised to be buoyed up and held in place by combined practices of evaluation and legitimisation: evaluation practices provide the visible empirical evidence of hidden legitimisation codes. Analytical concepts which facilitate the recognition of evaluation in empirical data are described in this section.

The term *analysis* is used in a restricted sense to constitute what Bernstein has referred to as recognition rules in an external language of description (Bernstein, 2000, p. 135); these are the ways in which empirical data are processed to offer up features of interest to the theoretical models of the thesis. This involves learning to notice evaluative strategies employed throughout the different forms of data and synthesising the feature being evaluated. Evaluation is multi-modal, involving actions or attributes of actions that constitute evaluation. These include, but are not limited to, explicit language, patterns and structures, intonation, sounds, gestures, use of body, relative positionings of people and objects, material resources, the taking/relinquishing of power, authority and control, and the manipulation of time.

The analytical framework.

The analysis of data employs an evaluation framework based on Systemic Functional Linguistics (J. R. Martin & White, 2007). The framework, summarised in table 3.2, describes evaluative concepts which focus attention on evidence of legitimate and illegitimate actions in the data. This framework has been chosen because it has a sharp focus on evaluation,

providing a range of analytical concepts applicable to both linguistic and non-linguistic semiotic resource use.

The data involves participants speaking in the Māori language. Most of the Systemic Functional Linguistics literature is based on an analysis of English; no Systemic Functional Linguistics analyses of Māori are available. There are studies of other languages such as Chinese (Eden, 2007) which indicate that a Systemic Functional Linguistics approach can be profitably used across languages.

In this regard, the Systemic Functional Linguistics focus on meta-function is important. Meta-functions are considered to be common to all languages which have their own ways of enacting them; three meta-functions are identified: ideational, inter-personal and textual (Matthiessen, Teruya, & Lam, 2010, p. 138). The ideational meta-function involves ways in which meanings are established, the inter-personal meta-function deals with establishing social relations between people, and the textual meta-function deals with how language is organised to facilitate ideational and inter-personal meta-functions. Evaluation is part of the inter-personal meta-function (J. R. Martin & White, 2007) and therefore transferable across languages. While English instantiations of evaluation are of little use, the social function of evaluation is certainly enacted in Māori and may be analysed in the data.

This consideration of meta-functions also elaborates the close relation between Systemic Functional Linguistics and Dialectical Critical Realism's stratified social ontology. The meta-functions of ideation and the inter-personal both construe (through the textual meta-function) aspects of social reality in the localised text of actualised social interaction. As theorised in chapter 2, social reality is both a tethering of social practices to entities in the intransitive dimension and a re-working of them for the interest of the social field. An analysis of the ideation and inter-personal meta-functions in a particular social field is considered here to be the linguistic equivalent of abducting/retroducting causal mechanisms operative in multiple strata of reality from empirical data.

The evaluative framework employs an extensive range of analytical concepts that may be employed to identify evaluations of ideational features in data. The basic strategy of analysis is to attend to the evaluations made in the data in order to construct a picture of what is considered a legitimate ideation of pāngarau in the classrooms of the Kura.

The four forms of data collection produced very large quantities of raw data. Video data in particular generated large quantities of transcripts and required many weeks of

concentrated analysis. After a protracted process, each case example, apart from the Kura ethos, produced a contextualised construal of pāngarau in terms of:

- an overall vision of pāngarau – what pāngarau is in general terms, where it comes from, its importance, its relations with other entities in the world; and,
- the internal components of pāngarau – what it is made up of and relations between components.

This construal is a contextualised depiction of pāngarau in the subjective terms of each classroom regime.

Evaluation may involve direct and indirect strategies. Direct statements provide the most obvious evaluations (for example, “problem solving is the main thing in pāngarau”). There are many other subtle ways in which evaluation occurs involving many different media (gestures, facial expression, intonation, voice timbre).

The speaker/designer of text is always positioned in relation to both the object of text and the audience (imagined as well as actual audience) so that all texts are seen as a form of stance-taking on the part of speaker (J. R. Martin & White, 2007, pp. 38-39). This stance-taking is embedded in the analytical concept of *engagement* considered to be either *monoglossic* or *heteroglossic*. Engagement expresses how the speaker sees themselves in relation to pāngarau (as they construe it) and in relation to the person /people they are addressing about pāngarau. In very general terms, monoglossic statements will indicate facts taken to be non-negotiable and of high value (the speaker associates with the source of authority and conveys unalterable fact to an uninformed audience). The monoglossic nature of the statement admits no possibility that things could be otherwise. Heteroglossic statements position the speaker as one possible voice among many (the speaker is somewhat distant from authority, more aligned with the audience); such statements suggest that the statement is open to change and negotiation; it may be construed to be of less value in the context of the activity. (J. R. Martin & White, 2007, pp. 99-111)

Three more evaluation concepts, themselves further subdivided into sub-concepts, are also employed. These concepts are *affect*, *attitude* and *graduation* which refer to emotional charging of statements, judgements of objects or people, and the degree of force behind a statement respectively.

Affect is the most fundamental way in which evaluation is made and involves a partially involuntary response to all experiences. The emotional charging of actions and sayings is something that almost all people are receptive to and capable of interpreting. Affect communicates all emotions such as like/dislike, happiness/unhappiness, security, satisfaction, fear, and anger. Martin and White point out further that there is a cultural interpretation of emotions which must be taken into account; whether an emotion is seen as a positive or negative evaluation requires cultural understanding (J. R. Martin & White, 2007, pp. 42-45)

Attitude is broken down into *judgements* of people and *appreciations* of objects. Both express an evaluation of an actual instance when compared with some ideal version. Thus judgements of people will comment on the nature of a person with respect to some moral or ethical code which defines an ideal type of person (a legitimate person). In terms of analysing data about a pāngarau regime, these kinds of judgements are valuable because they reveal a possibly hidden or assumed ideal pāngarau person/student to which actual students are compared. Judgements will indicate which aspects of a person match the ideal (have more value) and which ones don't (have less value). In a similar way, appreciations of objects, or behaviours or attributes of people considered as objects, reveal how actual instances of such objects match idealised versions. Noticing such appreciations reveals aspects of the ideal object that the speaker wishes to make present (J. R. Martin & White, 2007, pp. 35-38).

Graduation refers to the various ways in which *force* and *focus* are expressed in a statement. Graduation, as for other evaluation strategies, can evaluate something in a direct and indirect way. Force is revealed by simple means such as amplification (for example, shouting), the use of intensifiers (for example, as in “that is an **absolutely essential** thing to do”) and, less obviously, through the semantic level of the statement. This refers to the addition of force through increasing the generality or scope of applicability of a statement as in the phrase “pāngarau **will always be** important for success in the world” (J. R. Martin & White, 2007, pp. 135-159).

Focus refers to a degree of closeness to an idealised kind. This concept is close to the concept of attitude, but whereas attitude expresses difference between idealised objects and actualised ones and thus identifies illegitimacy, focus expresses where something is in a

range of legitimate possibilities for being such a thing and implies that efforts should be made to bring it closer still.

Although Martin and White have language use in mind when using these evaluative concepts, they are transferable to evaluations in other media and modalities. For example, a gesture such as a thumbs up expresses a positive affective reinforcement of a certain action; a thumbs down an affective negative reinforcement. If the gesture is enhanced by vigorous movement and position change (it oscillates or is raised high in the air perhaps), a whole range of types of evaluation is possible especially when combined with words or non-verbal voiced sounds.

The analytical framework attempts to cover in an extensive fashion the range of ways in which pāngarau and its relations to other objects are construed in the data and the different evaluations given to the components of this construal. The evaluation concepts of the framework can be seen to have embedded in them relations to ideal, normalised or expected types of people, behaviours and actions. These types may be inferred from contextualised forms of evaluation to exemplify aspects of legitimisation code.

In examining data for the Kura ethos, which is not specifically about pāngarau, the analytical framework is equally applicable because the concepts may still be used to identify what is considered to be fact in the Kura ethos and how valuable these facts are. The results of analysis may then be related to an abstract interpretive framework which is the subject of the next chapter. The interpretive framework provides a common platform on which the comparison of construals from different classroom regimes and the Kura ethos may be made.

Table 3.2 provides more detailed examples of each evaluation concept.

Analytical Concept	Interpretation Possibilities	Importance to Study
Engagement – Monoglossic. Authoritative statements that excludes other voices. Only one interpretation is intended and legitimised	Indicates facts about which there is considered to be no argument, they are incontrovertible. Facts may be considered as immutable features of nature or of life. ‘Pāngarau must be learned by all students’	Indicates what is considered to be extra-discursive – objects/characteristics that form the framing/basis of what is talked about. The referent objects of classroom interaction. It might also indicate the stance taken. Monoglossic statements might indicate a range of possible stances from a transmission only, low authority stance to a mathematician-like, high authority stance.
Engagement – Heteroglossic. Information about features that have uncertainty or variability or possible other interpretations	Indicates facts that are considered to be open for discussion, debatable, one view amongst many, contested. ‘I think it may be possible to change the order in which number operations are learned’	Indicates facts that are intra-discursive – products of discourse only and open for students/teachers to take up their own perspectives on.
Affect – refers to the amount of emotional charging infused into the interactions.	Emotions are used to indicate the strength and nature of a particular attitude. This will often be through loudness, tone, timbre or bodily expressions.	Indicates value: negative (undesirable) or positive (desirable) and strength of valuation (judgement or appreciation)
Attitude-Judgement Refers to how people are judged.	Assessment of difference between a person/conduct in relation to some moral or ethical ideal.	Indicates the legitimisation basis on which a person’s nature or actions is considered valuable or important.
Attitude – Appreciation Refers to how objects including discourses, and the behaviours of people (considered as objects not people) are valued.	Assessment of difference between a non-human object and an ideal of that object.	Indicates the legitimisation basis on which an object (real or discursively formed) is assessed as valuable/important.
Graduation – Force How resources are used to add force to aspects of the construal. This indicates relative value of the aspect.	The degree of impact conveyed by the use of semiotic resources: Intensifiers Semantic level Repetition	This is a major clue in indicating what is considered most/least valuable – accompanies all other statements; along with affect, indicates the importance of the need to change or act on the evaluation.
Graduation – Focus Refers to the location of an object within a semantic definitional area: the closeness to a prototype/ideal (most legitimate) version.	Practices may be tightly defined to match a certain ideal of teaching practice that the teacher values highly. Tight focus may indicate a highly valued practice. Precise control and definition of what is to be learned, perhaps in the Learning Objective, represents tight focus on an ideal and again may indicate highly valued knowledge.	Focus is a dynamic feature that changes during the course of a lesson. Tighter focus of object of study and manner of study is interpreted as indicating that more valuable knowledge is being considered.

Table 3.2. Evaluation Concepts

Realisation Rules: The Interpretive Framework

This section describes how the analysis of data from each case example may be seen as an instantiation of a dimension of the legitimisation device. This constitutes realisation of a recognised empirical feature in the internal language of description of an abstract theoretical model. This interpretive process brings the analysis closer to accessing the causes of struggle with pāngarau by providing a common language of description in which to talk about all of the case examples.

The depictions of regimes generated using the analytical framework remain closely tied to the contexts of the data. This section explains how these contextually bound depictions are to be mapped into the abstract terms of an interpretive framework. The framework described in this section employs the concepts of specialisation which are drawn directly from Legitimation Code Theory (Maton, 2014).

A distinctive meaning is given to interpretation. In using the analytical framework, analytical concepts allow the identification of facts and their evaluations. This analytical interpretation uses forms of evidence in texts to infer a fact and its evaluation. It is a form of induction which generalises from particular instances to general forms of those instances. In this section, the type of interpretive process is one of mapping between two texts - the text of the contextualised depiction and the text of the abstract concepts. This type of interpretation consists of abductive and retroductive thought processes (Danermark et al., 2002). As an example (see figure 3.4), a teacher may produce comments such as “the main focus of the activities is to have fun” and “I don’t really worry too much about where they are in the pāngarau curriculum”. Analytically they are described (recognised) as referring to the prioritisation by this teacher of the emotional and social well-being of the students. The realisation rules of the external language of description indicate how these comments are interpreted as being congruent to an abstract statement in the interpretive framework such as a strong specialisation of the social relation. There will be other examples from the raw data collected together as examples of the prioritisation of social and emotional well-being and further illuminating the nature of the social relation.

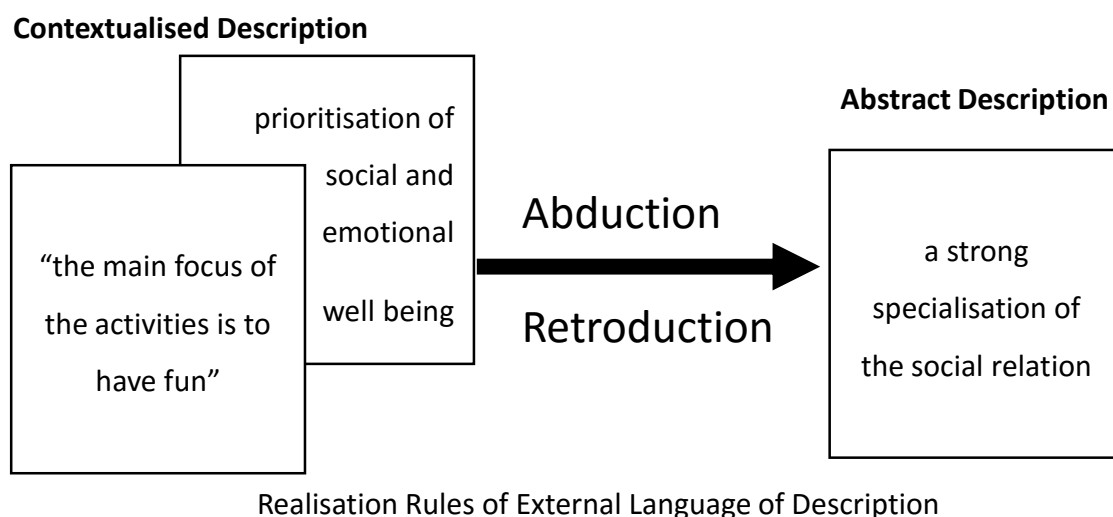


Figure 3.4. Conceptualisation of interpretation as realisation rules of the external language of description.

In terms of the theoretical framework of chapter 2, the description of specialisation, as a description of dimension of the legitimisation device, provides the settings of various ontological dialectical relations which underpin practices in the classroom regimes under consideration. For example, the nature of a pāngarau resource and how it is used will be dependent upon a prior determination of what constitutes legitimate pāngarau knowledge and what constitutes a legitimate pāngarau knower. Achieving this level of description of the legitimisation code in each regime in a common abstract language provides access to fundamental ontological premises, or legitimisation codes, which may then be compared and contrasted to reveal deeply-seated sources of harmony and discord.

Bernsteinian analysis of code and kura Māori.

In the Bernsteinian tradition, there are many examples of code analysis focussing on the nature of knowledge and pedagogic practices in relation to differential outcomes provided by such practices to different types of students. The basic thesis of Bernsteinian analysis is that pedagogic practices contain within them explicit and implicit structurations that construe legitimate meanings in particular ways and thereby selectively privilege students who are already pre-disposed to accept such meanings (Atkinson, 1985; Lerman & Zevenbergen,

2004). In general, national schooling systems are associated with a middle class orientation to meaning which legitimises decontextualized language and abstract thinking of a particular kind. Children who are not already so oriented on arrival at school experience greater difficulty in being successful (Power & Whitty, 2002).

Bernstein's sociology of education provides a set of concepts, and relations between those concepts, that form an abstract language of description for knowledge and pedagogy which go some way into explaining how pedagogy and differential outcomes are related. The concepts of greatest relevance to this thesis are *classification, framing, vertical and horizontal discourses* and *visibility*. For the purposes of this thesis, only working definitions of these concepts will be given with a brief indication of their relevance to kura Māori; a thorough treatment would require a separate thesis. Classification and framing, and vertical/horizontal discourses have already been referred to in chapter 2; classification is the degree of definition of knowledge categories and framing is the degree to which the definitions of knowledge are controlled through pedagogic practices. Vertical discourses involve knowledge structures which subsume lower level concepts in higher level ones either as a single hierarchical structure such as natural science, or as a series of *specialised languages* such as social science or the humanities (Bernstein, 1999, p. 159). Horizontal discourses accrete new knowledge by developing new knowledge *segments* alongside existing ones; the relations between segments derive from social/cultural contexts and social relations. Visibility refers to the degree to which evaluation criteria are made explicit to students; visible pedagogies make these criteria explicit and may be associated with strongly classified and framed activities, invisible pedagogies, associated with weak classifications and framings, mask the evaluation criteria (Lerman & Tsatsaroni, 1998).

The methodological relevance in this thesis of these concepts is that they go some way towards a language for describing the code that underpins the orchestration of social reality for students in pāngarau activities and in the Kura generally. These Bernsteinian concepts are themselves also subsumed in the concepts of Legitimation Code Theory which forms the interpretive framework.

For kura Māori the concern is not so much with countering the disadvantaging effects of certain pedagogic codes since, at least within each kura, students are generally not disadvantaged. The interest is more in the identification or creation of pedagogic codes to suit the purposes of the kura. With particular relevance in this regard, Bourne (2004)

discusses what she terms a *radical visible pedagogy*, with strong classification and framing, which she says is not concerned with individualised, competitive learning as is prioritised in a traditional transmission pedagogy. Rather, it aspires to the academic success of the collective

. . . not to induct them into the dominant society's middle class cultural norms but to develop ways of analysing the world and their own position in society, and to 'voice themselves' using – and in the process perhaps transforming – all the discourses available to them. (p. 73)

This perspective resonates strongly with kura Māori because they have an explicit interest in students becoming autonomously Māori, fully grounded in Māori cultural contexts, and also engaging on their own terms with academic knowledge.

Kura Māori also have to operate within the confines of existing New Zealand educational policies and regulations and so are subject to pressures and impositions from external agencies. Most recently, the New Zealand Government introduced a system of national standards for all primary schools which many kura Māori were obliged to adopt. Some kura Māori, including the one in this thesis, were able to reject these standards under a special provision in the New Zealand education act. Arnot and Reay (2004) explain that classification and framing can be internally generated by the classroom teacher or externally generated as, for example, when a national education strategy imposes systems on schools (such as national standards). Arnot and Reay show that a strongly classified and strongly framed system of national standards operating in the UK is experienced differentially by students from different backgrounds with middle class students being privileged. This situation is of concern for kura Māori because they do not have control over the pedagogic codes implicit in the implementation of national standards. There is therefore the potential for such standards to disrupt kura Māori in the development of their own pedagogic regimes.

Kidman, Chiung-Fen, and Abrams (2013) suggest that a segmental pedagogy in science learning in some kura Māori may be a factor in limited progress of their students into higher levels of science learning. Segmental pedagogy in this context is where learning is about a series of different contexts or segments without strong relations between segments - a horizontal discourse. This limits progress in higher levels of science which has a hierarchical knowledge discourse and a vertical knowledge structure. This perspective is relevant to kura Māori and pāngarau because it supports Bernstein's suggestion that struggle may arise from the relations between horizontal and vertical discourses operative in the same social context

(Bernstein, 1999, p. 163). The relations between the vertical knowledge structure of pāngarau and the knowledge structure of mātauranga Māori are thus indicated as a potential source of struggle with pāngarau.

In addition to Bernstein's concepts, Straehler-Pohl and Gellert (2013) discuss praxeology, the discourse about practice that accompanies all knowledge and pedagogy. This discourse refers to the nature of a practice and the location of the practice in relation to developmental stages (ages usually) of students and sequences of content. For example, an activity that practices memorisation of multiplication facts has a technical discourse about how to implement the practice and a praxeological discourse about when and with whom such an activity is appropriate. Such an activity with, say, year 3 students would be praxeologically strongly classified but the same activity with year 10 students would be weakly classified. This perspective is relevant to the context of pāngarau in kura Māori because it highlights how the praxeological location of practices developed in English-medium mathematics education can be considered as part of the totality that includes knowledge structure, assessment and problem-solving. A discourse that indicates what should be done, when and with whom in English-medium contexts may have strong and inappropriate effects when transferred uncritically to kura Māori. Recent official professional learning projects for kura Māori (Te Poutama Tau/New Zealand Numeracy Development Project and Ngā Whanaketanga/National Standards) contain a significant praxeological discourse; Ngā Whanaketanga are explicitly and exclusively praxeological.

Maton (2006) contends that Bernsteinian approaches to code analysis offer many insights into differential outcomes for students from different backgrounds but tend to emphasise an analysis of knowledge structure and knowledge practices without fully accounting for the social relations that accompany them. Maton broadens the scope by theorising the legitimation device which attends to anything that is considered legitimate in a social field and how people may access/possess it. Thus the legitimation device is open to an analysis of activities in social fields not just in terms of knowledge relations, but also in terms of (any) other dimension such as autonomy, semantics, social relations, criticality, and temporality. The legitimation device offers the possibility of integrating a wide range of disparate theoretical perspectives into a realist framework.

According to Maton (2014), the legitimation device also offers greater analytical delicacy by being able to describe more comprehensively multiple dimensions of legitimacy

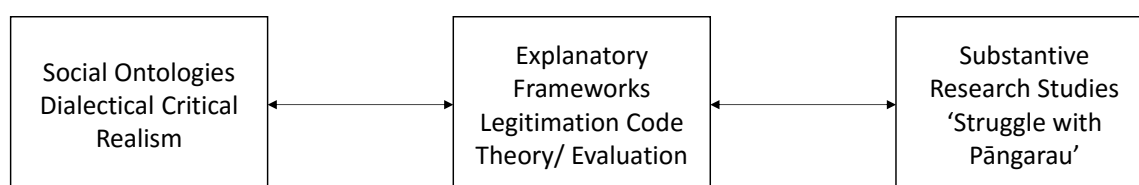
in a single framework. This makes apparent the dialectical relations between them. For example, a pāngarau classroom regime that has a strong knowledge orientation with a procedural lens is likely to experience tension with a neighbouring regime that has a strong knower/social orientation with an interactive lens. The possibility that these two regimes may have been formed in relation, resistance or opposition to each other may also be illuminated.

Legitimation Code Theory is adopted as the interpretive framework because it maintains the validity of the existing research using Bernsteinian frameworks (such as the few examples discussed above). It also maintains the Bernsteinian orientation towards code as illuminating phenomena of societal/social struggle and injustice, and thereby informing strategies which aim to mitigate them. By integrating Bernsteinian concepts in the broader legitimation device, Legitimation Code Theory provides greater scope for perceiving dialectical relations between real social entities. In particular, it is contended here that Legitimation Code Theory provides a balanced analysis that does not devalue social relations, or any other aspect of social life, but can recognise them as potentially important components of legitimation in a social field. In this respect, Legitimation Code Theory is consistent with the theoretical framework of this thesis which considers social life to consist of a wide range of entities always in open, processual change and interacting simultaneously. The many dimensions of the legitimation device and the levels of analysis within each dimension, provide scope for realisation of these entities as they are involved in legitimation schemes in a social field.

Currently Legitimation Code Theory is a growing new area of realist research with many dimensions of legitimation being recognised, theorised and investigated in empirical research projects (Maton, 2015). Empirical studies which use Legitimation Code Theory are relatively few in number and most focus on the specialisation dimension (see, for example, Carvahlo, Dong, & Maton, 2009; Chen, 2010; Howard & Maton, 2011; Macken-Horarik, 2011). Some studies have used semantic gravity (Kilpert & Shay, 2012; Maton, 2013), autonomy (Maton, 2005) and temporality (Matruglio, Maton, & Martin, 2013) but much more empirical research is required on all dimensions of the legitimation device. This thesis may make a contribution to this growing research area.

Legitimation Code Theory.

Maton (2014) locates Legitimation Code Theory in a critical realist paradigm which accepts that knowledge is socially produced but also real with properties, powers and tendencies that have effects. Following Archer (1995), he describes Legitimation Code Theory as an explanatory framework relating substantive research studies with social ontologies (figure 3.5). In this thesis, Legitimation Code Theory is conceptualised as forming the realisation rules of the external language of description. In this way it provides a link between evidence collected from pāngarau classroom regimes and Dialectical Critical Realist social ontology.



(Adapted from Maton, 2014, p. 15)

Figure 3.5. Social ontologies, explanatory frameworks and substantive research studies in the context of the thesis.

Legitimation Code Theory has the legitimation device as its central theoretical construct. This device generalises Bernstein's pedagogic device and relates to Bourdieu's field theory as the construct that defines legitimacy in a social field. Struggle is theorised to be always for control of the legitimation device. Maton (2014, p 197) explains that Bourdieu's field theory indicates what must be attended to in analysing social fields whilst Bernstein's code theory provides the means by which such analysis may be operationalised. Bourdieu's field theory requires the cultivation of a particular, sociological *gaze*; the researcher must "see as Bourdieu sees" (Maton 2012; 2014 p 19). The social conditions of objectivity are established but not the knowledge conditions. Objectivity means to establish a separation between researcher and object of study so that the object may be available to analysis. This requires social conditions of collectivity and knowledge conditions which organise relations between theory and data. With both social conditions and knowledge conditions clarified, researchers may develop a sociological *insight* to relate empirical

features to abstract concepts in consistent ways. Field theory provides a sociological *gaze* which must be cultivated through experience. Code theory provides a trained *insight* through which research may be conducted by researchers trained in the use of Legitimation Code Theory.

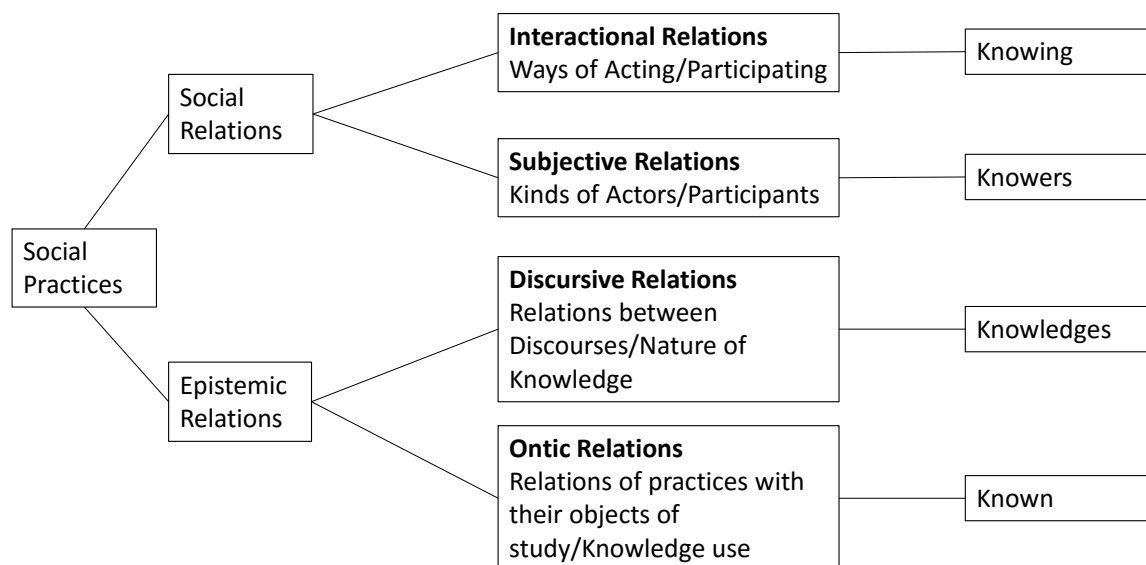
The legitimation device is theorised to have many dimensions one of which is *specialisation*. Specialisation extends Bernstein's concepts of classification and framing associated with knowledge practices (Maton, 2014, p. 201). The legitimation device also has dimensions relating to autonomy, density, semantics and temporality which are currently under development and not included in this thesis. For specialisation, Maton describes the 4-K model of knowledge practices (figure 3.6). This model integrates the current state of theorising of specialisation codes conceptualising them

. . . as comprising relations between practices and that part of the world towards which they are oriented (ontic relations), other practices (discursive relations), kinds of actors (subjective relations), and ways of acting (interactional relations). . . . when applied to knowledge claims this offers a '4-K model' of relations between knowledge practices and the **known, knowledges, knowers and knowing**. (Maton, 2014, p 192).

The 4-K model provides the basis of the internal language of description for specialisation which will be used to express contextualised descriptions from classroom regimes in the Kura in abstract terms. The 4-K model relates to dialectical perspectives by recognising that social relations are always a perspective on a participant/participation dialectic, and epistemic relations are always a perspective on a knowledge/knowledge use dialectic.

The internal language of description.

Specialisation is of the epistemic relation and the social relation. The specialisation of the epistemic relation describes how people and practices are related to knowledge. Specialisation of the social relation describes how people and practices are related as legitimate knowers to other knowers or organisations of other knowers.



(Adapted from Maton, 2014, p. 193).

Figure 3.6. The 4-K model of epistemic and social relations.

Maton (2014) provides a comprehensive description of epistemic relations and social relations which are further characterised in terms of *strength*, *type*, *gaze*, *insight* and *lens*. This provides an abstract framework of increasing delicacy allowing the identification of specialisations which provide the focus of, and the base underpinning practices.

Specialisation refers to those characteristics of knowledge and people that make “someone or something different, special and worthy of distinction” in the classroom, or in any social field (Howard & Maton, 2011, p. 196); these characteristics are legitimised. It is not the case that some characteristics are legitimate and others illegitimate but rather some characteristics have a greater degree of legitimacy than others so that display of these more valued characteristics receives greater acknowledgement (positive evaluations), and consequently greater accrual of capitals and status. A basic premise of this study then is that an analysis of what is *made special* in actual classrooms will give insight into the basis of legitimisation operating in the classroom which in turn will illuminate dialectical determinations. Such insight will allow the understanding of tension and conflict in terms of the degree of complementarity between sets of legitimising propositions associated with different actions in the classroom and in the Kura.

Relations, insights, gazes and lenses.

Legitimation Code Theory provides concepts and language which allow the detailed description of specialisations in a social field (Maton, 2014, pp. 171-196). These concepts include the epistemic relation and social relation and characterisations of these in terms of type, insight, gaze and lens. This section describes these concepts in detail.

The epistemic relation.

Specialisation of the epistemic relation is characterised by a definition of legitimate knowledge, knowledge structure and ways of seeing that knowledge. The epistemic relation is conceptualised as two broad types: **ontic** and **discursive**. Ontic relations attend to the relation of knowledge to its object of study. Discursive relations attend to the relations between different knowledges. Critical realism accepts that all knowledge is contained within discourses (as part of the transitive dimension) so, at first inspection the ontic/discursive distinction may appear paradoxical. The distinction is interpreted here to recognise a difference between a perspective which examines relations between and within existing discourses (discursive relations) and one which seeks to create new discourses or extend existing ones to provide a language in which to talk about previously extra-discursive real entities (ontic relations).

Greater delicacy is achieved by further identifying a *modality of seeing* in these knowledge relations. This modality of seeing is termed an insight. Insight is not located in the knower but rather it is co-related with the nature of the knowledge and its organisation. It is acquired and by this acquisition the knower becomes a legitimate knower.

Insights are characterised in terms of a balance between attention to ontic relations and discursive relations. Four insights, termed situational, doctrinal, purist and knower, are identified according to the relative strengths of their attention to ontic and discursive relations:

- Situational insights attend to the object of study but not how it is studied (strong ontic and weak discursive relations)
- Doctrinal insights attend to how the object of study is studied but not what is studied (weak ontic and strong discursive relations)
- Purist insights attend to both what is studied and how it is studied (strong ontic and discursive relations)
- Knower insights (or no insight) allow freedom of both what is studied and how it is studied (weak ontic and discursive relations).

Lenses re-focus an insight to attend to particular sub-groups of potential ontic and/or discursive relations. The range of possibilities for lenses is wide since there are many objects of study and many ways of studying objects. Ontic insights may have empirical or technical lenses (or others). Discursive insights, may have principled or procedural lenses (or others). Empirical lenses attend to particular subgroups of possible empirical objects of study. For example, in the area of atomic physics, an epistemic lens may attend only to atomic sub-particles or even a single type of sub-particle. Technical lenses attend to subgroups of technically derived objects of study. For example, in mathematics, an epistemic lens may attend to theoretically derived objects in combinatorics.

For discursive insights, a principled lens attends to inter-knowledge relations by applying sets of generalised principles. For example, in mathematics, an epistemic lens may attend to the relations between human generated proofs and computer assisted proofs by applying general epistemological principles of mathematical proof. A procedural lens attends to these relations by the application of established procedures. For example, in mathematics, an epistemic lens may attend to the relation of human proofs and computer proofs by measuring the efficiency of procedures involved in both types of proof.

The social relation.

Specialisation of the social relation is characterised by a definition of legitimate knowers, knower structures and the modalities of seeing of those knowers. The modality of seeing is termed a gaze. A gaze is a property of the knower.

Two types of social relation are conceptualised: subjective and interactive relations. Subjective relations base legitimacy of knowers on who they are. Interactive relations base legitimacy on how the knower interacts. Both of these are located in the knower and not any knowledge they may know. Subjective relations consider personal experience, gender, class or ethnicity. Legitimacy may be granted, for example, if you belong to the working class, are male or are Māori. Interactive relations consider patterns of interactions. Legitimacy may be granted on language use, or participation in practices, rituals and other protocols. For example, it is possible for a non-Māori person to be accepted in a Māori social field by being fluent in Māori and well versed in protocols, customary practices and ways of interacting with other people in the field.

Gazes are modalities based on a balance of subjective and interactive relations. Four gazes are conceptualised:

- Social gazes attend strongly to the identity of the knower but not ways of knowing (strong subjective and weak interactive relations)
- Cultivated gazes attend strongly to ways of knowing but not who knows (strong interactive and weak subjective relations)
- Born gazes attend to both who knows and how they know (strong subjective and interactive relations)
- Trained or Blank gazes do not attend strongly to either who knows or how they know (weak subjective and interactive relations). They do not specify a way of seeing at all (blank) or the knower is trained to see by following a procedure.

Lenses within these gazes have been identified as biological and social for the subjective relation, and ontic and discursive for the interactional relation. Biological and social lenses refer to legitimacy of the knower based on genealogy/genetics and social class respectively. Ontic and discursive lenses refer to legitimacy of the knower based on how a

knower interacts with empirical/material objects and how a knower interacts with discursively constructed objects respectively. Legitimacy might be based on interacting correctly with artefacts, peoples' bodies, land, animals or interacting correctly with bodies of knowledge, rituals, language use, or other protocols.

Specialisation trees.

With these distinctions of type, gaze/insight and lens, specialisations can be described to a high degree of delicacy in terms of the balance given to epistemic and social relations. The framework is represented diagrammatically as a *specialisation tree* in figure 3.7 with each node in the tree given a brief definition in table 3.3.

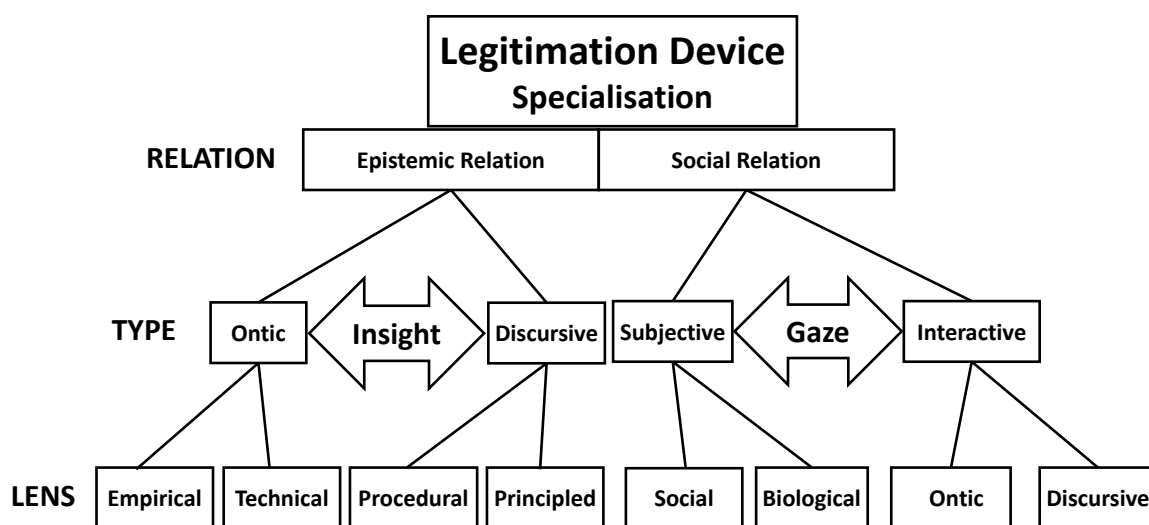


Figure 3.7. The specialisation framework/tree.

Epistemic Relations The definition of legitimate knowledge			Social Relations The definition of legitimate knowers		
Type: Ontic Knowledge relates directly to its object of study	Type: Discursive Knowledge relates to other knowledges		Type: Subjective The knower belongs to a certain group of people	Type: Interactive The knower interacts in a certain way	
Insights <ul style="list-style-type: none"> • Situational insights attend to the object of study but not how it is studied (strong ontic and weak discursive relations) • Doctrinal insights attend to how the object of study is studied, insisting perhaps on certain methods, but not what is studied (weak ontic and strong discursive relations) • Purist insights attend to both what is studied and how it is studied (strong ontic and discursive relations) • Knower insights allow freedom of both what is studied and how it is studied (weak ontic and discursive relations) 			Gazes: <ul style="list-style-type: none"> • Social gazes attend strongly to the identity of the knower but not ways of knowing (strong subjective and weak interactive relations) • Cultivated gazes attend strongly to ways of knowing but not who knows (strong interactive and weak subjective relations) • Born gazes attend to both who knows and how they know (strong subjective and interactive relations) • Trained or Blank gazes do not attend strongly to either who knows nor how they know (weak subjective and interactive relations) 		
Lens: Empirical Knowledge relates directly the contextualised/actualised/mat-erial objects of study	Lens: Technical Knowledge relates to abstract or technically derived objects of study	Lens: Procedural Relations between knowledges or different studies is based on procedures.	Lens: Principled Knowledge about relations between knowledges or different studies is based on general principles.	Lens: Social The knower belongs to a social class.	Lens: Biological The knower belongs to an ethnic group based on genealogy.
				Lens: Ontic The knower interacts correctly with material or technical objects	Lens: Discursive The knower interacts correctly in language use, protocols and rituals

Table 3.3. Generic descriptions for specialisation concepts.

Realisation of the empirical features of case examples.

For each case example, a set of contextualised statements was generated using the analytical framework. Each statement was then considered and related to the interpretive framework shown in table 3.3 and figure 3.7. A short description of the rationale for its location was also described. Repeating this for each contextualised feature produced a relation between each feature and its location in the interpretation framework (figure 3.8).



Figure 3.8. The translation of contextualised features to specialisation code.

Each contextualised statement may be an instantiation of several abstract categories; each abstract category may have several instantiations in context. This many-to-many relation is a positive aspect. Multiple interpretations enlarge and deepen the depiction of specialisation. Multiple instantiations allow nuanced interpretation of specialisation. As van Oers (2002) discusses, Bakhtin (1984) considers all statements to be polyphonic – they contain within them multiple voices that can be perceived through viewing the statement from different perspectives. Van Oers discusses a project in which the same video data were analysed from differing perspectives by different researchers; the collective of all analyses offers up unique insights. Jackson and Mazzei (2012) also analyse data from different theoretical perspectives elaborating a *post-methodologist* notion that data and theory are used for thinking with not for describing the actual structure of data (Lather, 2008; St. Pierre, 2013). In this polyphonal approach, data are always open to viewing from multiple perspectives. Rather than attempt to credit just one with validity, all perspectives are deemed to be present in the data. Statements being relatable to different types, insights/gazes, and lenses presents an opportunity rather than a problem. The multiple interpretation of statements relates to the persistent presence of traces of multiple historical voices

(legitimation codes) still detectable and sedimented in the present. As such, multiple interpretations are important in a consideration of historical totalities (voices) which are represented in refracted, diffracted and attenuated forms in the present contexts. Such a concept of refracted totalities made present in contexts, requires an acceptance that multiple voices are present simultaneously in texts and that multiple interpretations are thereby engendered in them.

Specialisations can be represented both on the two-dimensional topological plane as described earlier and as a specialisation tree. As each contextualised feature is realised, a picture is built up of which nodes and branches in the specialisation tree (as shown in figure 3.7 on page 110) are being legitimised. The result is a pictorial representation of the distribution of specialisations for the regime. Figure 3.9 shows an example of a simple specialisation in which great consistency is shown (only one branch in epistemic and social relations).

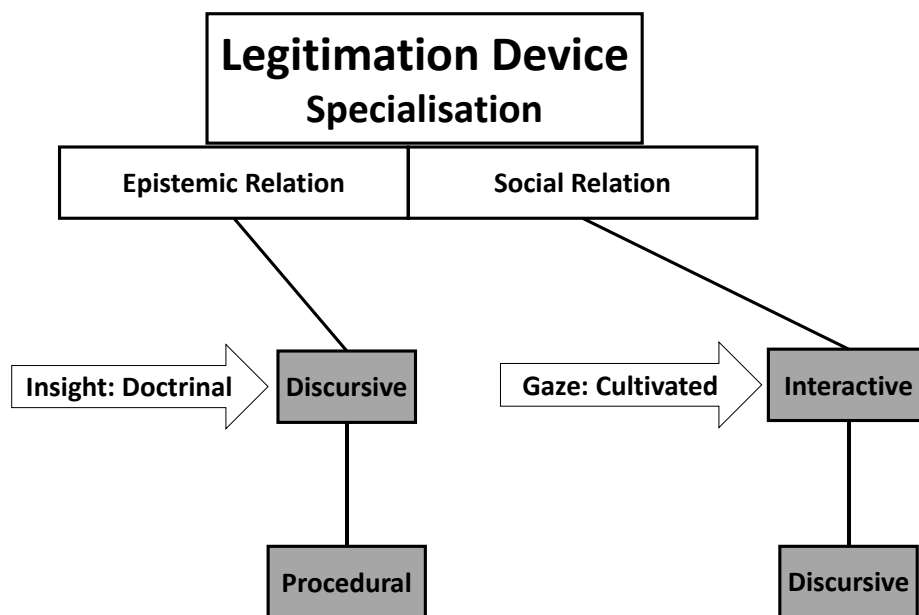


Figure 3.9. Example of a simple specialisation tree.

Figure 3.10, shows an example of a multi-specialised specialisation tree. Several branches are present in different strengths indicated by stronger or weaker shading. Even though some practices may exhibit strong, within-practice relations, a holistic judgement across all practices may indicate that several different specialisations are included in a weakly

defined and controlled manner - epistemic and/or social relations may be inconsistent and are holistically weak. Another multi-specialised regime may have a wide range of specialisations in evidence but all specialisations are orchestrated coherently. This case would display a range of specialisations (some of which may be weak) with holistically strong epistemic and/or social relations.

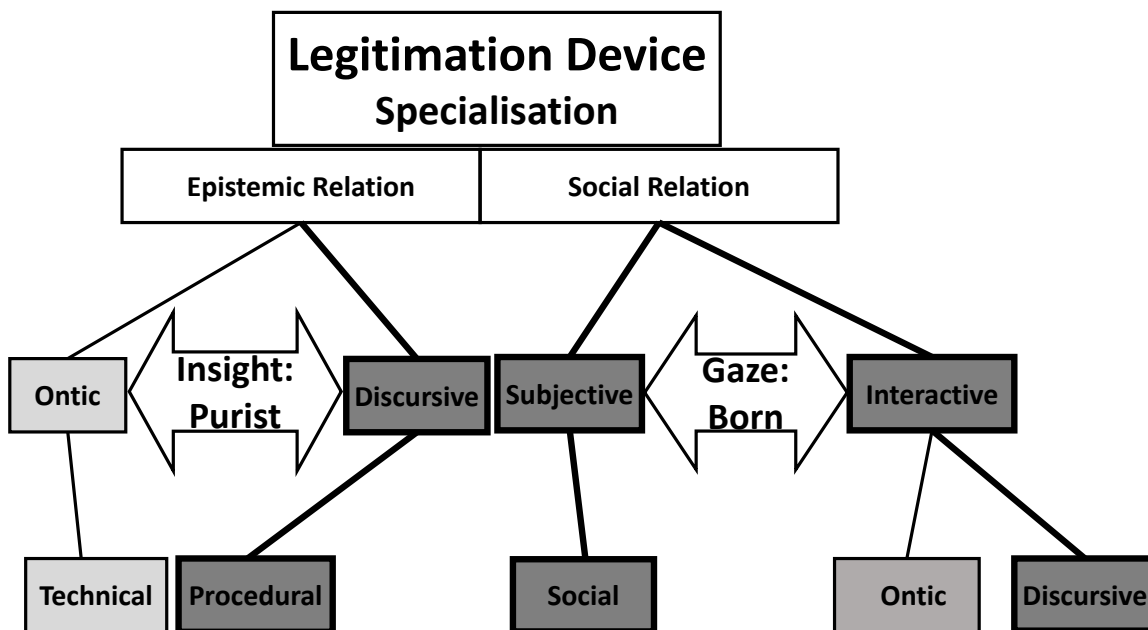


Figure 3.10. Example of a multi-specialised specialisation tree.

It is also recognised that many dimensions of the legitimation device which may be important are not included in the analysis. The legitimation device that co-ordinates practices in a pāngarau regime does so not only on the basis of specialisation. Considerations of semantic gravity, autonomy, temporality and density may also form part of the legitimate regime. Consideration of these dimensions is an important area of future research in the context of pāngarau education.

Classroom regimes are embedded in a wider institutional ethos which may be considered as providing the cohesive rationale for practice selection in individual classroom regimes. Glover and Coleman (2005) conduct a literature review of the use of the term *school ethos* concluding that ethos usually refers to “the more subjective values and principles underpinning policy and practice” (p. 266). Bernstein positions ethos as part of the pedagogic device as the set of recontextualising rules which converts original knowledge

available to schools into the contextualised form in which it appears to teachers, students and families (Bernstein 2000, Meaney, Fairhall and Trinick, 2013). These two conceptualisations are consistent with the notion adopted in this thesis that school ethos may be thought of as a collective, institutional legitimisation device for classroom regimes. Ethos is accessible to the same analysis of specialisation as used for classroom regimes but applied to collective practices and activities. The interfaces between classroom regimes and the Kura ethos become possible generators of struggle.

The strength of relations.

The strength of a relation refers to the strength of its classification and the strength of its framing. As previously discussed, classification refers to definitions of the relation and framing refers to how the definition is maintained in the practices of the social field. Bernstein's concepts of classification and framing are still controversial and contested. For example, Hasan (2010) considers classification and framing to be dialectically related so that relations tend to be strongly classified and framed, or weakly classified and framed. Situations in which relations are strongly classified and weakly framed, or vice versa, may present theory-practice contradictions implicated in the support of TINA formations (Bhaskar, 1993, p. 117). Strong classification and weak framing implies that knowledge has strong definitions and boundaries but this is not communicated. Students must guess what knowledge is legitimate without strong guidance; in practice, students who are already pre-disposed to this knowledge are advantaged. Weak classification and strong framing implies that students are strongly managed to learn knowledge that is loosely defined; in practice, learning becomes procedural and arbitrary.

Legitimation Code Theory fuses classification and framing together in the concept of relation strength. A relation is strong if it has both strong classification and framing; it is weak if it has both weak classification and framing (Maton, 2014, pp. 29-31). Relation strength thus accommodates both Hasan's observation and the theory-practice contradiction. This also aligns with Dowling's critique of Bernstein's concepts of classification and framing in which it is contended that framing is a redundant concept since it is dependent on classification (Dowling, 2009, pp. 69-109).

The strength of a relation is a continuous variable - relations are more or less strong/weak with a theoretically infinite set of possible values. Strength is also relative and context dependent – it is possible within one research context to compare relation strengths but very difficult or impossible to compare strengths between distinctly different contexts. What might be described as a strong relation (relative to others) in one context, could be weak if it were re-located in another context.

A social field has a particular specialisation of the epistemic relation and social relation both in terms of their strengths and in terms of type, insight/gaze and lens. The relative strengths of the epistemic relation and social relation may be represented as a single point on a two dimensional topological plane as shown in figure 3.11. This representation is useful because it shows how different regimes compare in global terms of relation strength. Thus, in this thesis, several different classroom pāngarau regimes may be compared in relation to their relative strengths of epistemic relation and social relation. This may then be related to the way struggle is expressed differently in those regimes.

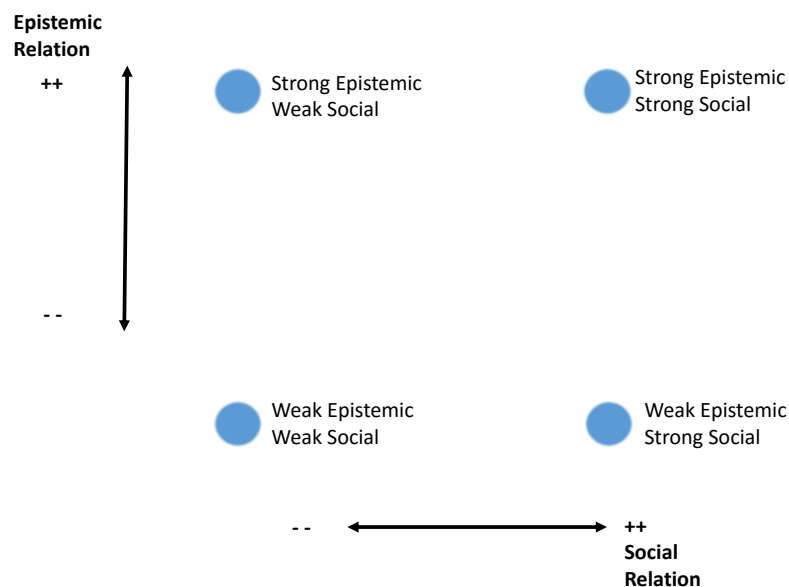


Figure 3.11. Representing specialisations on a topological plane.

To assess strength, a way of making a holistic judgement must be devised which draws on all available sources of evidence and attends to:

- the precision of definition and control involved within practices;
- assessing the cohesion between practices;

The latter point recognises regimes that have multiple activities each with different epistemic and social relations of different types and strengths. The cohesion of those activities becomes the focus of attention. Large amounts of inconsistency and variation of specialisations between activities would jeopardise the regime's recognition by the institution and by students as a legitimate regime.

In considering the strengths, types, insights/gazes and lenses of the social relation and epistemic relation, Legitimation Code Theory supplies interpretive tools (realisation rules) which allow the characterisation of the specialisation of classroom regimes more completely than in a purely Bernsteinian analysis. A Legitimation Code Theory characterisation of epistemic relations and social relations provides detailed information about the regime in a language that can be compared with those of other regimes similarly described on the basis of the logic of the specialisation framework.

The framework organises these concepts in a hierarchical manner – it has a strong grammar. This logic allows a substantive comparison of regimes not just recognition of differences between regimes. Specialisations in different regimes may exhibit complementarities and oppositions that illuminate dependencies between them.

Specialisation codes: knowledge-knower structures.

The *legitimation code*, a generalisation of the concept of code created by Bernstein (1981), refers to the set of organising principles underpinning actualisation of practices in the social field which themselves depend on specific determinations of dialectical relations. As such, legitimation codes can be seen as generators of social reality and the implicit dialectical determinations of intransitive entities contained within it.

In much Bernsteinian research which draws on the concepts of classification and framing, complicated symbolic representations are used to indicate relative strengths of classification and framing. For example, Hoadley (2008) supplies classification and framing codes for nine different aspects of pedagogic discourse from data in her research (p. 76). This approach is not used in this thesis because Legitimation Code Theory, as described earlier in this section, provides a graphical way of representing relation strength which makes the interpretation of specialisation codes more straightforward.

As open systems, social fields may possess several different legitimisation codes of varying strengths. These may clash because of contradictory sets of dialectical determinations inhering within them. Legitimation analysis can be thought of as a process of bringing to the surface deeply embedded propositions supplying the philosophical and cultural underpinnings of life in social fields.

This thesis considers only the specialisation dimension of the legitimisation device. In terms of specialisation, legitimisation creates social fields as *knowledge-knower structures* (Maton, 2014, chapter 4). *Knowledge-code* social fields legitimise knowledge so that any knower (in theory) can train to acquire the legitimate *insight* and thereby acquire a specialised body of legitimate knowledge. *Knower-code* social fields legitimise knowers so that any legitimate knower can turn their specialised *gaze* on any body of knowledge. Knowledge-code and knower-code social fields can be seen to be underpinned by distinctly different ontological assumptions about the nature of knowers and the nature of knowledge. In knowledge-codes, knowers are constituted by their competences in knowledge practices based on a structuration of knowledge. In knower-codes, knowers are characterised by their knower characteristics or identities which are assumed to underpin engagement with any knowledge practice and any domain of knowledge. Identifying the particulars of specialisation in a social field, and determining the field as a type of knowledge-code or knower-code, thus illuminates the details of an ontological determination about the nature of the human person in relation to their knowledge which underpins practices in that field. In this thesis, this analysis is applied to pāngarau classrooms and the Kura ethos.

Summary.

Bernstein emphasised the importance of the external language of description commenting that “a theory was only as good as the principles of description to which it gives rise” (Bernstein, 2000, p. 90). As Moss (2001) indicates, external languages of description cannot be produced in advance of the substantive research in which they will be used because they must relate context to theory. External languages of description are produced through a dialogic/dialectical negotiation between theory and data. Different external languages are needed for the same concept (Maton, 2014, p 137). In this study, each case example presents its own external language of description.

Table 3.3, which supplies descriptions for each node in the specialisation tree shown in figure 3.7, lays out the interpretive framework, structured hierarchically in terms of relations, gazes, insights and lenses. This constitutes the realisation rules of the external language of description. Once the specialisations of a regime have been described using the terms of the realisation rules, the practices of the regime can be related to fundamental issues of legitimation which underpin those practices.

In terms of the theoretical framework of chapter 2, identifying specialisations characterises the particular determinations of dialectical relations which are legitimised in a social field. The social relation indicates a particular perspective switch in participant/participation dialectics; the nature of participation or the nature of the participant is legitimised. The epistemic relation indicates a perspective switch in an intransitive/transitive dialectic; what is said about an object of study (always in relation to already existing discourses/meanings) or the intransitive (ontic) object of study is legitimised. Gazes, insights and lenses provide more delicate and nuanced characterisations of the perspectives on these dialectical relations that are legitimised in particular social fields.

Using the Analytical and Interpretive Frameworks

This section selects data from a case example to illustrate how the external language of description was applied to raw data. Many hours of analysis were carried out on data from all case examples, with multiple analytical sweeps through the same data. Reporting the full details of analysis is beyond the scope of the thesis. Therefore, this chapter illustrates this process by:

1. Explaining the overall analytical strategy.
2. Illustrating the application of the analytical framework to a selected passage of video and interview data.
3. Explaining how an overall summarising narrative of the contextualised findings of analysis was constructed.
4. Explaining how the contextualised narrative is then related to the interpretive framework to arrive at a final global assessment of specialisation.
5. Explaining how specialisations can be represented graphically in specialisation trees and topological planes.

The analytical strategy.

Most of the data is in interview form or naturally occurring form (video). Both forms of data are first analysed in the temporal order in which they happened. This facilitates the noticing of cumulative evidence where one part references previous parts.

Interview data are already partially clustered into themes due to the clustering of related interview questions (see appendix C). Analysis proceeds cluster by cluster in the order in which responses were made. Summaries of the findings of each cluster are then made.

Video data records the naturally occurring phase sequence of lessons. An overall phase structure and the details of each phase can be analysed. Summaries of each phase are then made.

Field notes are brought into play to add further support or detail to findings throughout the analysis.

The overall findings from all data are then discussed in a *narrative summary* which draws on all phase and cluster summaries. The narrative style is designed to allow straight forward access to the findings so that the reader is not overwhelmed by the fine details of analysis. This narrative summary is structured on the two broad themes of overall vision of pāngarau (external relations) and internal components of pāngarau (internal relations).

An *interpretation table* is then constructed which takes strategic statements from the narrative summary and interprets them in terms of a specialisation concept (relation type, gaze/insight, and lens). A holistic judgement is then made of the nature and strength of specialisation which allows the representation of the regime in a specialisation tree and on the specialisation plane.

The overall analytical strategy is illustrated diagrammatically in figure 3.12:

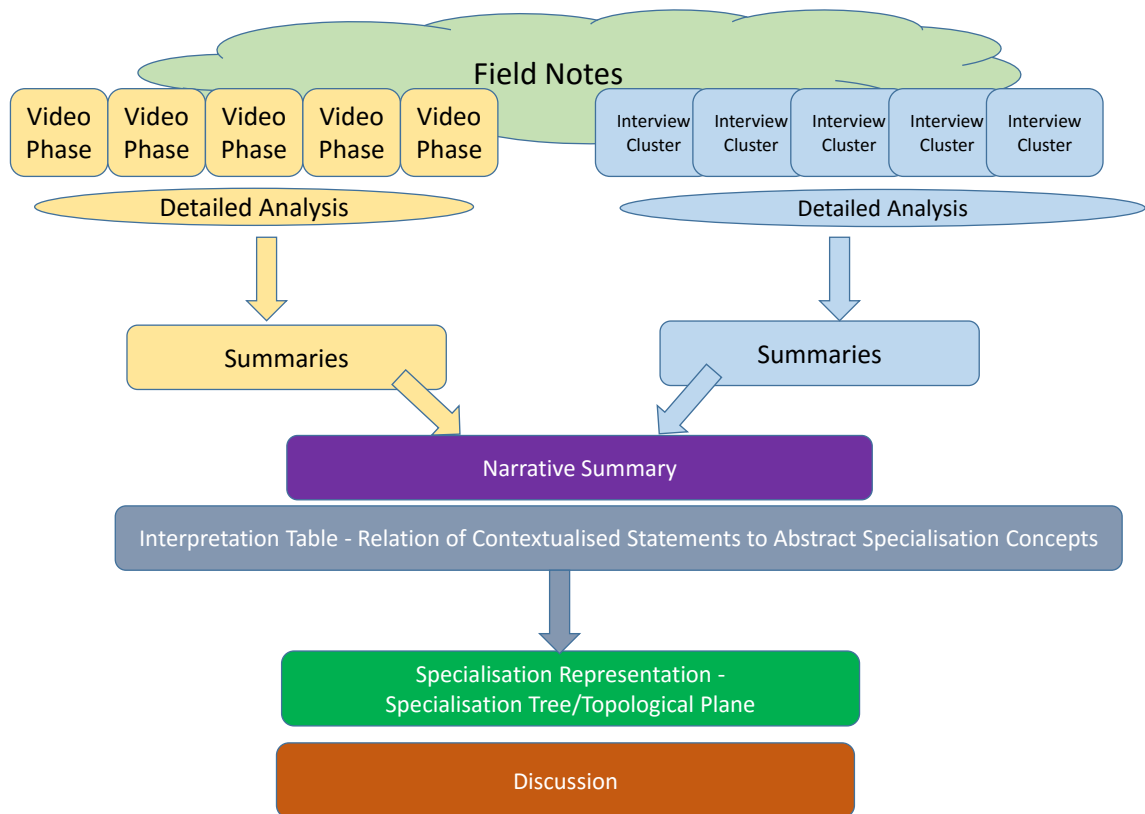


Figure 3.12. Analysis and interpretation strategy used in each case example.

Analysis of selected passages of data.

This section will illustrate the micro-analysis of raw data with an example from video data and an example from interview data from the Case Example of Whaea L (Miss L).

Video data.

In the table representing the video data, timings for selected actions are given. Each set of actions is numbered to allow reference. The numbering is a presentational convenience only. Actions are described using these conventions:

- Bracketed words describe actions happening simultaneously with speech such as gestures, facial expression and seating position, and/or qualities of speech such as, intonation, emotional charging, and voice timbre.
- A sequence of dots between speech items indicates a momentary, un-measured pause.
- Simultaneous actions by different actors are indicated in the timing or indicated directly in brackets along with the actions.
- The person acting or speaking is referred to by an initial. In this video data:
 - Wh is Whaea L;
 - F, G are female students;
 - Y is a male student.

The selected passage of video data is the first four minutes of a forty minute lesson. Whaea L writes up the learning objective (LO) for the lesson, the three students involved enter the room, sit down and get books out of their bags. This data represents the first phase of the lesson.

Vid Time	Line No.	Actor	Actions
0-3.00	1	Wh	(Whaea L writes the learning objective, the exemplar question and a list of new pāngarau words on the board.)
3.11	2	Y	Whaea should we write this down?
	3	Wh	(Writing up the question on the board - \$14 for each concert ticket, there are 4 tickets, how much altogether?) No..wait a moment..erm..(distracted, focussing on writing)
	4	Y	Large intake of breath (Strange drawn out croaking voice) I want to do my reading..
	5	Wh	Yes our reading is good ay (warm voice, firm agreement with Y, still writing on the board)
3 25	6	Y	Matua T...yes...he was a good teacher
	7	Wh	(breaks off from writing on the board, smiles, nods and points to Y) Oooh...That's a good thought, that is...Matua T is a good teacher...if you see him again
3 40	8	Y	Y sitting low in seat looking forward
	9	Y	(Interrupting Wh) I did (did emphasised)
	10	Wh	well..if you meet him again
	11	Y	(Interrupting Wh) I saw him in Auckland!
	12	Wh	you should say Hi and tell him that...(imitating greeting style) kia ora Matua T you are a good teacher!
3 47	13	Wh	(Definitely, firmly) We should start now ay..
	14	Wh	Sit up properly Y, sit properly please.. look this way...
	15	Y	Yes! (sits up and looks at the board) How do you do that...(exasperation in voice...looking at the work on the board)
	16	Wh	Kia kaha Māui...(waits for Y to sit up) ..Good! (Be staunch Māui!)

As students enter the room, Whaea L writes a learning objective (hereafter called the LO) at the top of the board in very clear, large black lettering. On the right hand side of the board she also writes down a list of six new mathematical words taken from the Te Poutama Tau books. The learning objective reads:

Kei te ako mātou i tētahi rautaki whakarea māmā mō te whakareatanga, ka whakamārama otinga e whai wāhi mai ana.

(We are learning an easy multiplying strategy for multiplication and explaining the answer that results.)

This learning objective is not taken from the Te Poutama Tau books; it has been created by Whaea L (field notes). The appreciation of the LO as being of high importance is indicated by being written in prime focal position on the whiteboard, by remaining for the whole duration of the lesson and by its naming as the learning objective. In addition, there are significant features in the wording of the LO itself.

Firstly, the whole LO is explicitly about learning a strategy and explaining the strategy. This monoglossic form of the LO defines the purpose of the lesson clearly and how a legitimate performance is to be made.

Kei te ako mātou identifies who is learning. The word *mātou* means a group of people, more than two, which includes the speaker but not the person or people being spoken to. For the learning objective to make sense in te reo Māori, it must be interpreted as being said by the group of students involved in the lesson as a collective to someone or some people who are not learning it, Whaea L. This contrasts with learning objectives in Te Poutama Tau books which consistently use the phrase *Kei te ako au*, which means *I am learning*. This departure, may be interpreted as an exercise of personal agency by Whaea L and a recontextualisation away from an individualistic linguistic form to a collective one which is more aligned with how Whaea L views the lesson – as a teacher working with, but separate from, a student collective. This LO frames the work clearly in terms of a group of students who collectively will learn the strategy and explain it, to a person, Whaea L, who already knows it. Very early in the lesson, Whaea L gets the students to chant the LO in unison which would be consistent with the use of *mātou*.

The phrase *tētahi rautaki whakarea māmā mō te whakareatanga*, appears to be over determined by its double reference to whakarea/multiplying. Translated into English as *an*

easy multiplying strategy for multiplication. This may signal a distinction being made between the operation of multiplying and multiplication as a concept in a more formal sense. In this perspective, *whakarea* is simply an adjective that qualifies the kind of strategy being used and *whakareatanga* refers to the general concept of multiplication. This suggests that Whaea L has a distinction between generalised concepts which define operations and specific examples of strategies that instantiate that general concept. In other words, multiplication is not just a collection of strategies that multiply. It is at a higher semantic level.

The word *māmā* (easy) is an example of evaluation of the strategy but raises the question of who is making this evaluation and on what grounds. Since it is pre-determined and new to the students, it must be Whaea L who thinks it is easy, or perhaps thinks it will be easy for the students. Thus the word *māmā* when set in a learning objective, carries a lot of evaluative weight and invites a comparison between student performance and the *easy* strategy. The *easy* evaluation, most likely, appreciates the strategy as being at the *easy end* of the Te Poutama Tau stage Whaea L has in mind. This hints at a possible classification of strategies, perhaps within each Te Poutama Tau stage, of hard, typical and easy. This is a classification based on the stage and technicality of the strategy not on the students' appreciation of the strategy.

The final phrase of the LO, *ka whakamārama otinga e whai wāhi mai ana*, means explaining results that literally *find a place/have a place* in the work. The results could refer to both the strategy and the final answer to the problem. The LO emphasises the importance of explaining. However, there are many ways in which the strategy could be explained; a straightforward description of the steps undertaken (low semantic level) or use of abstract concepts to explain the reasons for each step (high semantic level).

The exemplar problem is taken directly from the Ministry of Education resource *Whanaketanga: Pāngarau. He aratohu mā te pouako* (Te Tāhūhū o te Mātauranga, 2010) and is one of the very few instances of teachers in the Kura using official resources directly in an activity. The wording of the problem, the resources used and the way the strategy is written down on the white board match very closely to page 41 of *Whanaketanga: Pāngarau*. This is an evaluative action that appreciates the value/authority of official resources as being superordinate to her own.

The list of new words is given a privileged position - listed vertically and occupying the complete right hand side edge of the whiteboard. The LO, the problem and the list of new

words pre-figure the lesson to be oriented about strategy use but, just as importantly, talking about the strategy using official pāngarau words.

In line 2, Y asks if the LO should be written down. The copying of work into exercise books is an appreciation of its value. Although Whaea L indicates that students should not write the LO, she later gets all students to chant it in unison.

Lines 4 and 5 indicate a relative valuing of reading and pāngarau by Y and in a show of solidarity, by Whaea L. In line 4, Y uses a loud and strange croaking voice expressive of frustration and a desire to be elsewhere. For Y, reading would appear to be much more preferable to pāngarau. Whaea L joins in with a comment validating Y's desire to do reading and refers to it as "our reading". This establishes solidarity between Whaea L and Y with respect to reading. Whaea L does not attempt to encourage Y in his pāngarau work by commenting that *our pāngarau* is also good. This hints at a possible feeling in both Y and Whaea L that pāngarau does not belong to them whereas reading does. If this is combined with other evidence such as Whaea L's direct use of the whanaketanga resource, it seems plausible that this is the case.

In lines 7 to 12 there is an inter-change between Y and Whaea L in which Y interrupts Whaea L twice; they appear to be talking at cross-purposes. Whaea L, on hearing Y talk about Matua T, breaks off from her writing on the board to address Y's comment. This breaking off from writing represents an appreciation of Y's comment. It is important (and good) enough to merit the stopping of her work. Whaea L then indicates the positive appreciation of Y's comment explicitly in words and gestures and attempts to develop it by explaining what Y should do if he meets Matua T again. She emphasises the social/cultural value of acknowledging someone's good attributes but Y is talking about the details of his meeting with Matua T. A small tussle follows over control of the conversation which Whaea L ends with her indication of the need to start the *real* work at line 13. As if to emphasise the re-taking of control, she tells Y to sit up properly at line 14. Whaea L abandons her effort to convey this social value and asserts a tighter control over manner and behaviour, switching to what is presumably something of higher value at this particular time – the beginning of the pāngarau learning. This small tussle provides evidence of the evaluation of both the pāngarau content and the social content. Although social content is valued, pāngarau content takes priority. If it were otherwise, Whaea L would pursue the social skill of affirming others and relegate the pāngarau learning.

Lines 15 and 16 juxtapose two evaluative statements in an interesting way. In line 15, Y responds to Whaea L's request to sit up properly, that is, to show the correct manner for learning pāngarau, but also expresses some anticipated difficulty and trepidation with the pāngarau work he expects to be confronted with. He appreciates the forthcoming lesson as something difficult and involving some frustration. In response, Whaea L, uses a very Māori way of encouraging someone by likening them to the eponymous ancestor Māui. Māui is interpreted in this context as a symbolic personality possessing both human and god-like characteristics. Māui is associated with many characteristics but mainly those of curiosity, not recognising authority, risk-taking and experimentation to gain new knowledge. Māui is sometimes portrayed as a meddling, trickster who spoils the smooth running of an operation. Field notes indicate that, in the Kura, Māui characteristics are in fact highly valued because such characteristics lead to new knowledge; students who follow their own initiatives are generally respected. When Whaea L exhorts Y with the phrase "Kia kaha Māui" (Be strong/staunch Maui) she is at one and the same time, acknowledging his unrest, his agitation, his desire to be elsewhere and acknowledging his value and potential to learn and create. Whaea L, appreciates Y's behaviour as acceptable in general terms for the present time, but requests that those characteristics be suppressed for the purposes of learning pāngarau. By implication, the characteristics of Māui though generally accepted in Māori societal terms, are not to be accepted in this pāngarau lesson. As the first few interactions indicate, when the learning is not about pāngarau, when discussing the social learning of acknowledging others for example, the criteria for social interaction are relaxed.

Referring again to field notes, Whaea L is recorded elsewhere as using the phrase *Kia kaha Māui*. For example, every morning, whole school meetings are held. If children are unsettled, Whaea L can be heard saying "Kia kaha Māui" to various children or groups of children. The utterance is therefore more likely to be associated with Whaea L's general construal of school-wide behaviour in formally organised situations than specifically to pāngarau lessons. In any case, it does indicate that for pāngarau lessons, along with all other lessons perhaps, Māui is not welcome.

Summary

In this short sequence, evidence has been discussed suggesting that:

- Whaea L is inclined to rely on the frameworks of Te Poutama Tau and official resources - the official voice of curriculum and Te Poutama Tau is strong.
- Both knowledge and how pāngarau knowledge is learnt are tightly defined and controlled.
- Whaea L associates pāngarau with a particular way of being in which knowledge is orderly, sequenced and cumulative (in line with Te Poutama Tau frameworks) but requires the person to be similarly oriented in their social relations.
- Whaea L regards pāngarau knowledge as located separately from her and the students, not in her control, and not in the control of students but at the same time essential to learn.
- Her role as a teacher is construed as purveyor/conveyor of official knowledge.
- Whaea L prioritises pāngarau learning over social learning.

Interview data.

The following comments from Whaea L were given in response to the question: Why is pāngarau important?

- 1 The children at my last school are happy in maths because..in a psychological
2 sense..they are strengthening their minds and this strengthens their spirit...they think
3 “oh I am really good at pāngarau”...and they were sad before we started to develop
4 Te Poutama Tau because they felt they weren’t very good at it but now, after the
5 strengthening of their pāngarau, they are really happy...because they have overcome
6 a challenge and this is a good thing no matter what the challenge, to overcome it
7 strengthens the wairua (spirit).
8 Pāngarau is important because it’s all around us ..and I have seen a lot of children
9 who lack confidence and have felt that they are dumb and have hidden and shied
10 away from it cos they are scared that they might...cos they think they are
11 dumb...and they don’t want other people to see that ...
12 It’s a psychological thing...there is nothing wrong with building the child’s wairua
13 but the reality is that maths is in everything... this building has to do with maths ...
14 the Kura is run on maths really I think...

Throughout this passage pāngarau competence is depicted as important in the emotional and spiritual well-being of students.

Lines 1 and 2 make a generalised connection between competency in pāngarau and emotional well-being through strengthening the mind. Significant evaluative features are highlighted:

The children at my last school **are happy** in maths because...**in a psychological sense**..they are **strengthening their minds** and this **strengthens their spirit** ...

The phrase “are happy” imparts a permanence to the happiness experienced by those children at Whaea L’s previous school. It also contains an implication that children at her current school are not happy in maths. The happiness that derives from pāngarau competence is somehow solid and permanent.

In lines 2, 3, 4 and 5, Whaea L states:

they think **oh I am really good at pāngarau**...and **they were sad** before we started to develop Te Poutama Tau because they felt **they weren’t very good** at it but now, after the **strengthening of their pāngarau**, they **are really happy**.

This is a more contextualised repetition of the notions in lines 1 and 2 and so is another form of evaluation; repeating a statement in another form appreciates the value of the notions.

The phrase “they were sad before we started to develop Te Poutama Tau” implicates Te Poutama Tau in “the strengthening of their pāngarau”. It is here that clarification is made that it is actually good performance in pāngarau that makes the children happy. The appreciative phrase “really good at pāngarau” is increased in evaluative force twice. The first time directly in the phrase “I am **really good** at pāngarau” and the second time, inversely in the phrase “they felt they weren’t **very good** at it”. Both of these appreciate that pāngarau performance is linked with happiness but intensify its evaluative force by indicating that it is in fact higher levels of performance that cause higher levels of happiness.

Lines 5, 6 and 7 generalise the notion further bringing in the idea of *overcoming a challenge*:

because **they have overcome a challenge** and this is **a good thing no matter what the challenge**, to overcome it **strengthens the wairua (spirit)**

Pāngarau is identified as a challenge to be overcome. The connection to strengthening the spiritual well-being of children is established as being part of a more general notion that any challenge is automatically of benefit when overcome: it is good to overcome a challenge “no matter what the challenge”.

Lines 1 to 7 exhibit a *semantic wave* which begins with a partially generalised statement (lines 1 and 2), contextualises this in Whaea L’s experience (lines 2 to 5) then elevates it again to a somewhat broader generalisation that locates pāngarau in the general class of challenges that develop spirit (lines 5 and 6).

Lines 8, 9 and 10 elaborate the effects of pāngarau performance on spirit. Four signs of *weakness of spirit* are given in lines 7, 8 and 9:

I have seen a lot of children who **lack confidence** and have **felt that they are dumb** and have **hidden and shied away** from it...cos **they are scared**

These characteristics are all in relation to something else – the performance of pāngarau. They hide their performance or shy away from giving one. Children lack confidence when they are asked to give a pāngarau performance (explain a strategy or show their work to someone else). They feel they are inadequate in comparison with the observed performances of others or the expected performance. They are scared to show their poor pāngarau performance to others.

In lines 9 and 10, there is a repetition, and so a strengthening of the evaluative force, of the connection of a child’s sense of inadequacy with fear of other people seeing this. What is meant by being good at pāngarau then is giving a good public performance.

This passage communicates a high degree of sensitivity of the spirit of children to the quality of their pāngarau performance. Good pāngarau performance equates with high levels of confidence, self-esteem and strong spirit. Poor levels of pāngarau performance equate with low levels of confidence, self-esteem and weak spirit.

Lines 12 and 13, indicate a reason for this. This psychological sensitivity to pāngarau performance is related to the ubiquitous presence of pāngarau:

It’s a psychological thing...there is **nothing wrong with** building the child’s wairua **but the reality is** that **maths is in everything...** **this building has to do with maths ...** **the kura is run on maths really I think.....**

Line 12 acknowledges the importance of spiritual health but, through the phrase “but the reality is”, forcefully subordinates this to the need to attune to the fundamental presence of pāngarau in “everything”, by being good at pāngarau in Kura.

Here, developing a child’s spirit without developing pāngarau competence is appreciated as worthy but somehow lacking. The phrase “there is nothing wrong with” signals this evaluation. It indicates the opposite notion; there is something wrong with it - a lack of pāngarau competence.

In line 14, Whaea L uses the phrase “I think”. This is the only heteroglossic statement in this text. Whaea L indicates that she will accommodate other points of view. All other statements are stated monoglossically without any indication of alternative points of view. The nature of the elisions “is in”, “has to do with” and “is run on” are not elaborated but are tentatively stated with acknowledgement of uncertainty and the possibility of other voices commenting differently.

Summary

- Pāngarau performance is seen as necessary for a child’s spiritual health
- Pāngarau is part of a class of activities that challenge the child and develop spiritual health.
- Developing spiritual health without attending to pāngarau is undesirable.
- Spiritual health derives from good pāngarau performance because pāngarau is necessary for the world to function.
- Good pāngarau performance more strongly connects the child to a fundamental element in the world.

Synthesising the narrative summary.

The narrative summary synthesises the cluster and phase summaries into a readable form. This is a delicate and lengthy process of condensing a large collection of summaries whilst retaining features and evaluations. This involves constructing succinct sentences which make essential points and where possible use the participants’ own words or actions. Participants’ own words are shown in bold font.

The narrative summary.

Whaea L begins the lesson having already decided on the learning objective, which emphasises the strategy to be taught and being able to **explain the strategy**. There is a list of **new pāngarau words** displayed prominently. The LO pre-defines what is to be learned and how it will be learned. The lesson reproduces exactly a problem taken from the Ministry of Education Resource, Whanaketanga Pāngarau. The lesson is very strongly framed by the official curriculum resources.

The LO and the use of official resources positions Whaea L as a mediator between official knowledge and the learning of the students. Part of this mediation role is to inculcate not only good pāngarau performance but also appropriate social and behavioural characteristics. **Māui**, the personification of intuitive, creative, uncontrolled actions, though acceptable in other circumstances, is not welcomed.

Whaea L relates pāngarau competence to spiritual health. When children **overcome a challenge** their **spirit is strengthened**. This also derives from a stronger connection with the world because pāngarau **is in everything**. Whaea L elaborates this connection by relating poor pāngarau performance to poor spiritual health. **They don't want other people to see** their poor performance.

Pāngarau is in a class of activities that present challenges of a valuable kind; they develop spiritual fortitude. It is also necessary and important in the spiritual life of children because of the connection it gives to competence in the world.

Students F and G appear to be settled in Whaea L's pāngarau lessons but Y is not. He expresses strong affective distress about pāngarau which Whaea L responds to by relaxing conditions and acknowledging Y's Māui characteristics.

Realising the narrative summary in the interpretive framework

The narrative summary is in contextualised form and must be related to the abstract terms of the interpretive framework. Descriptions are selected directly from data or from the narrative summary and connected via a rationale to abstract terms. The rationale explains why each contextualised description is associated with that particular abstract term; it clarifies the abduction/retroduction that creates the association. This is presented in table 3.4. The left column contains contextualised descriptions and the right column the abstract term. The middle column contains the rationale that relates each contextualised statement to an abstract specialisation. The mapping between contextualised statement and abstract specialisation is many-to-many; each contextualised statement may be related to several specialisations and each specialisation may have several instantiations in context.

Table 3.4 shows a very definite discursive specialisation of the epistemic relation and an interactive specialisation of the social relation. The realisation of a discursive epistemic relation involves abduction of the recognised feature in terms of a relation between two or more knowledge discourses. In pedagogic situations this primarily involves relations between official pāngarau knowledge and the personal knowledge of students; pedagogy then constitutes the nature of relation between these two knowledge discourses. The realisation of an interactive social relation involves abduction of the recognised feature in terms of how students may legitimately take part in practices and routines and interact with people (including themselves), artefacts, resources and language.

Contextualised Statement	Rationale	Specialisation
Whaea L has already decided on the learning objective, which emphasises the strategy to be taught and being able to explain the strategy.	The objective defines pāngarau activity as problem/solution strategy/explanation – this genre is used to relate pāngarau knowledge to students' own knowledge.	Epistemic Type: Discursive
The lesson is very strongly framed by the official resources.	The discourses contained in official resources are transplanted wholesale into the classroom discourse.	Epistemic Type: Discursive
Māui is not welcomed in pāngarau	The ideal pāngarau student is one who interacts with people and knowledge in a controlled and conventional manner.	Social Type: Interactive
The LO pre-defines what is to be learned and to some extent how it will be learned.	It is expected that multiplication of 2 digit numbers will be learned and that it will be learned in a certain way – through a strategy that Whaea L will teach.	Epistemic Insight: Purist
“there is nothing wrong with building the child’s wairua but the reality is that maths is in everything... this building has to do with maths ... the kura is run on maths really I think”	Mathematics knowledge is said to be intrinsic to everything and is essential for children to learn. It over-arches other knowledges to do with social and spiritual understandings.	Epistemic Type: Discursive
	All other knowledges are conceived as somehow mathematical. Whatever the object of study it is possible to study it mathematically.	Epistemic Insight: Doctrinal
Pāngarau learning is the overcoming of a challenge which is intrinsically good for the child	The child needs to develop the attributes and ways of interacting that place them favourably to meet challenges.	Social Type: Interactive
	Personal self-knowledge and pāngarau knowledge are related through developing strength of identity when pāngarau challenges are overcome.	Epistemic Type: Discursive
Learning in pāngarau means knowing strategies and explaining them to others – a public display.	The public display follows clear procedures of what to say and do in a public display.	Social Lens: Discursive
	Students must learn to give public displays in a legitimate way by interacting with people, resources and language appropriately.	Social Type: Interactive
Pāngarau learning is challenging and develops the mind.	Pāngarau knowledge has a special and strong relation with proficiency in other knowledges in which a strong mind is required. The <i>strong mind developed in pāngarau</i> integrates different knowledges.	Epistemic Type: Discursive
The child’s spirit is particularly sensitive to pāngarau performance	Spiritual knowledge and pāngarau knowledge are related through public performance. Pāngarau is particularly important in the development of spirit.	Epistemic Type: Discursive
Using pāngarau words correctly is important	The specialised pāngarau register must be used correctly to relate contextualised knowledge and pāngarau knowledge.	Epistemic Type: Discursive Social Type: Interactive

Table 3.4. Realising contextualised statements as abstract specialisation concepts.

Discussion.

For epistemic relations there is a strong discursive specialisation, that is, learning is strongly classified and framed to attend to particular ways of relating discourses of knowledge. The curriculum defines the official discourse of pāngarau which is related through pedagogy to students' personal knowledge. The data presented in this chapter suggests a strong classification and framing of this relation; the curriculum provides a strong definition of knowledge and Whaea L strongly controls it in her pedagogical practices.

In addition, there is evidence of a procedural lens. This means that the learning follows a set of established procedures; the relating of the discursive configuration of curriculum knowledge with the knowledge of students is based on procedures such as the placing of appropriate numbers and symbols in the correct places in a standardised page layout (a procedure).

There is also some small evidence that a doctrinal or purist insight may be present. This hinges on further evidence about what is studied and how; which parts of the curriculum are studied, and how controlled the methods of learning are. If both are tightly defined and controlled, evidence leans towards a purist insight; if only the methods are tightly controlled and anything is available for study, a doctrinal insight is most likely.

For the social relation, the evidence suggests a distinct, strongly defined and controlled interactional specialisation; there is an *ideal student* who is most acceptable in pāngarau learning. For non-pāngarau learning however, this is relaxed. The ideal student is defined in terms of social interaction not the social or ethnic identity of the student. For pāngarau there is a strong interactive social relation.

There is also preliminary evidence of a cultivated gaze and a discursive lens for the social relation. For students to learn how to interact in a *pāngarau mode*, they must spend time in Whaea L's lessons. This gaze is learned not through explicit teaching/training but rather through being close to and interacting with others who have already acquired it. The lens is indicated by the importance given to the correct use of official words in the pāngarau linguistic and procedural practices of Whaea L's lessons.

The limited evidence illustrates that any learning area is not either epistemic or social in its treatment of specialisations. Both epistemic and social relations operate simultaneously

and to varying degrees are mutually constituted. Whilst pāngarau is construed as a strongly classified and framed knowledge-code, the social relation established in learning this knowledge is based on social interaction that adheres closely to conventions and procedures. This suggests a coherent rationale that unites epistemic and social relations - knowledge relations which are construed as strongly discursive (conventional/procedural) requires a person who will pay great attention to the details of convention/procedure. The epistemic relation determines the social relation. It is concluded, tentatively, based on the strength and uniformity of both epistemic and social relations together with a coherent rationale that relates them, that Whaea L's pāngarau regime is a strong knowledge-code.

Representing specialisation: the specialisation tree and topological specialisation plane

The epistemic and social relations may be represented in a specialisation tree and on the specialisation plane (figure 3.13). The tree represents the realisation rules as a hierarchical tree with the nature and strengths of specialisations by the weight of shading of each branch. This allows presentation of types, gaze/insights and lenses. The plane represents each regime as a single point indicating strengths of epistemic and social relations.

These two forms of representation provide visual graphs of both the nature of relations and their strengths. The tree is capable of showing multiple epistemic and social relations and their relative strengths within a regime. The plane is capable of giving a collective picture of all regimes facilitating inter-regime analysis.

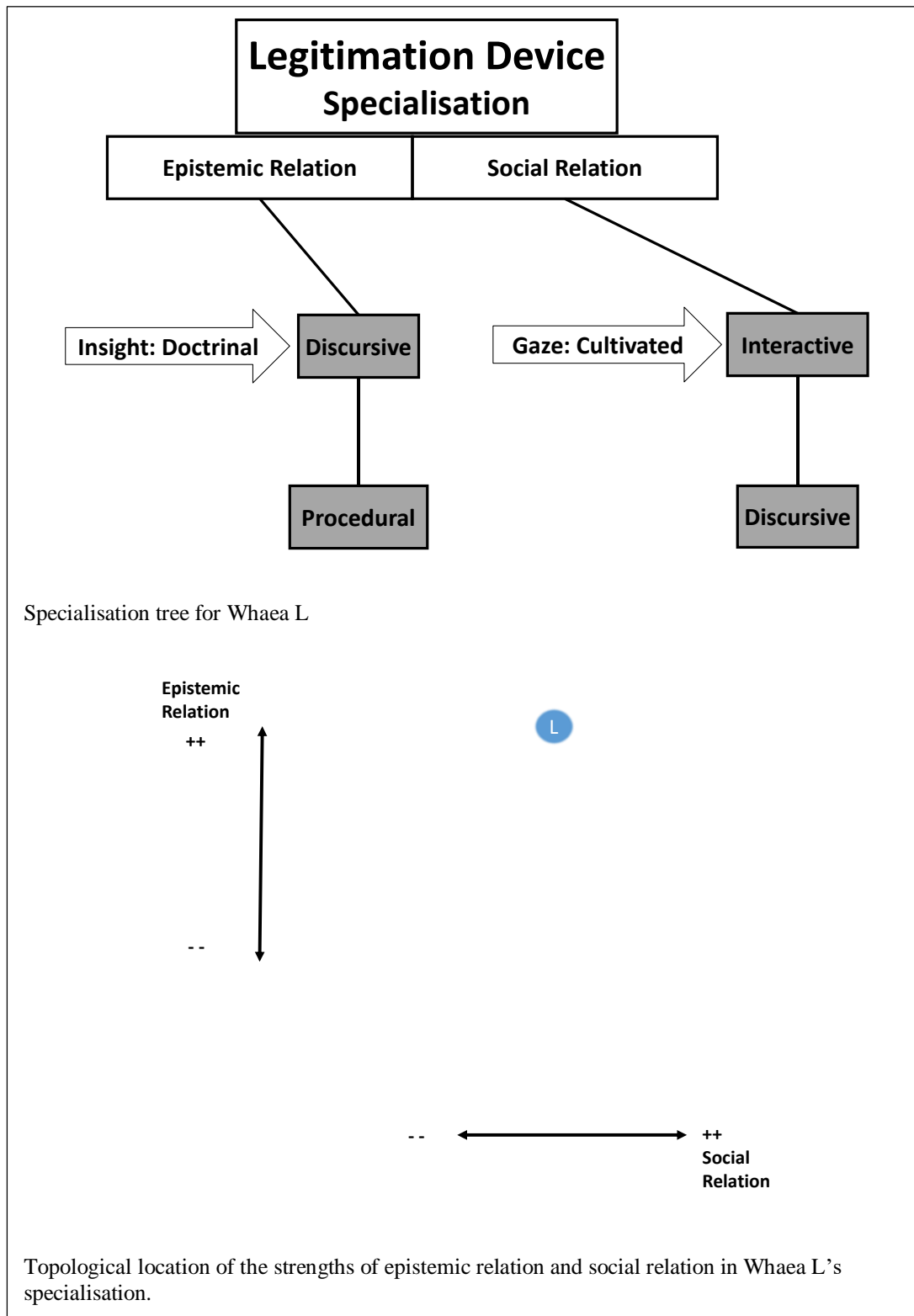


Figure 3.13. Provisional specialisation tree and topological specialisation plane for Whaea L.

Conclusion.

This chapter has attempted to present a synoptic picture of the methodology underpinning the engagement with empirical data and the production a final research product. Data collection methods have been conceptualised as empirical events, automatically embedded in a dialectical critical realist ontology, which provide an opportunity for knowledge generation about the phenomenon of struggle with pāngarau. Analysis of data from these events is understood as a dialectical interplay between features of empirical data, the researcher and the internal language of theory. The analytical and interpretive frameworks are intended to provide a non-circular way in which empirical data and theory can communicate with each other so that theory can be informed and transformed by data, and insights about data can be generated. Vital in this respect is the way in which theoretically informed analytical and interpretive frameworks do the work of recognising features in data and realising those features using theory. The researcher, though always present in the process, does not rely solely on personal judgement to select and interpret empirical features.

The total amount of data in the study was very large and the analytical process highly labour intensive. The use of narrative summaries, generated from the application of the analytical framework to raw data, is a way in which to capture the complexity of raw empirical data whilst also providing a workable platform for the use of the interpretive framework and the subsequent generation of a theoretical causal mechanism for struggle with pāngarau.

The theoretical mechanism, as the product of the research, is considered to be an emergent real entity which will find its place in various social fields as yet unknown. Perhaps it will be transient in some fields, more long lasting in others. Its continued existence and causality are dependent on the way it fairs in the flux of the various social realities in which it becomes embedded. In dialectical critical realist terms, this will be through the taking up of dialectical relations with other entities including relations of absence. Through refraction, diffraction and recontextualisation processes, new and different meanings may be invested in it so that what is presented in this thesis may take on very different forms yet still have its origins sedimented within it.

Chapter 4 - Case Examples

This chapter presents seven case examples following the pattern established in the last section of chapter 3. The intention is to take each case example to the point of a succinct yet detailed synthesis of the specialisations of each classroom regime and the Kura ethos. Each case example both synthesises the specialisations from empirical data in the terms of Legitimation Code Theory and discusses them in terms of the theoretical framework of chapter 2. This means describing the specialisation in abstract terms, discussing what this means in the contexts of the classroom regime and the Kura; and relating it to dialectical relations, forms of causality, absence/presence and being-in-becoming.

All six teachers and their students in the Kura provided empirical data for case examples. Four of them provide the case examples detailed in this chapter. Two are not included because they are very similar to one or other of the case examples included in this chapter and so support the findings but do not add extra insights.

Throughout this chapter, bold font indicates words or phrases used by the participants themselves.

Each case example is titled with the name of the teacher using the honorific *Whaea* (Mother/Miss) or *Matua* (Father/Sir) and an initial. These Māori honorifics indicate that the teacher takes on more of a parenting role than is usual in English-medium schools.

Whaea L

Whaea L has recently arrived from another school. She taught previously in both English-medium schools and kura Māori and is an experienced teacher. She has taken over the year 5/6 class reported on in the case example of Matua J. Whaea L provides insight into how the ethos of the Kura impacts on a teacher who is not yet accustomed to it. This brings into sharp focus her personal construal of pāngarau and the nature of the Kura ethos.

This section completes the analysis and interpretation of Whaea L's regime begun in the last section of chapter 3.

Overall vision of pāngarau.

Whaea L construes pāngarau as a distinct, powerful body of knowledge that stands apart from normal social and cultural life. It transcends language and culture. Pāngarau has its **own tikanga pāngarau** (rules/protocols of mathematics) which may be **explained in Māori** and enacted through Māori pedagogies.

Pāngarau is construed as having fundamental connections to the material world and human life. Pāngarau is necessary for understanding and being able to participate in the modern world. Whaea L expands the importance of pāngarau, which is the same as English-medium curriculum mathematics, from being about numbers to being about **the ability of people to speak and to understand the world**. It is a form of knowledge that underpins the nature of being human itself.

Whaea L relates competence in pāngarau to spiritual health. Pāngarau presents a challenge which fosters self-confidence and self-worth. By bringing about a stronger connection with pāngarau as a fundamental element in the world, personal sense of self-worth is enhanced. Whaea L indicates that the child's spirit is particularly sensitive to pāngarau performance; this sensitivity is due to the public nature of such a performance. This requires the overcoming of a challenge which is intrinsically good for the child. Pāngarau presents challenges of a valuable kind; they develop spiritual fortitude. It is also necessary and important in the spiritual life of children because of the connection it gives to competence in the world. Whaea L makes a very strong connection between pāngarau and survival in

everyday life. It is essential for survival because it is inherently involved in all activities. Curriculum mathematics is the knowledge that enables the **peeling of spuds, cultural activities on the marae and financial activities.**

Whaea L expresses a high level of anxiety about numeracy achievement data. Her concerns centre on the lack of adequate data which provides her with **knowledge of where the children in her class are at in numeracy.** She also expresses the strong desire that all teachers **follow the same journey and use the same assessments** so that each classroom can be located in the numeracy framework.

Whaea L expresses anxiety that the Kura does not prioritise pāngarau in favour of developing the **spirit of the child.** Her worry is that **outside the school gate there are numbers all around.** Children must be **literate with their maths** to deal with the numbers they will meet in their lives.

Internal components of pāngarau.

Pāngarau in Whaea L's regime is a conventionalised/proceduralised activity consisting of these components:

- a discursive configuration involving a genre form of *problem, strategy, explanation* and *single answer* as a unit of study for students,
- the hierarchical knowledge structure adopted from Te Poutama Tau/curriculum,
- a focus on number knowledge,
- a focus on public performance involving verbal description of strategy use,
- a particular way in which students should interact and
- contexts designed to match the structure of the calculation required in the problem.

Whaea L's notions are very closely tied to the curriculum. Number knowledge is the foundation for all pāngarau. She believes that knowing **what numbers are and what they look like** must be achieved **before being able to do operations with them.** Whaea L sees her agency as being in pedagogy. This delivers important knowledge in ways that children are able to understand.

Curriculum knowledge structure not only organises knowledge but also organises problems, solution strategies and mathematical words. Problems assume a genre form which allows association of problems, solutions and specialised words to Te Poutama Tau stages. Students able to solve such problems using such solutions and words, can also be located at a stage. The hierarchical knowledge structure of Te Poutama Tau/Numeracy Project is assumed; learning means movement from lower to higher stages.

A common practice is for each student to present their solutions to the whole class. Students write their work on the white board and explain them. This practice provides information about **where students are at** and **how confident they are which is a sign of how well they know the pāngarau**.

Whaea L expresses how the recent Ngā Whanaketanga Pāngarau (national standards) initiatives have **allowed her to teach some other curriculum areas of knowledge to the children** (apart from number knowledge). Teaching **circles has created enthusiasm for learning and has spiced things up**.

Whaea L relies on a particular discursive/procedural form. Careful attention is paid to the **equation**, the strategy and the answer. **Reading the instructions** is considered to be important and is strongly emphasised to students. The **instructions contain the explanation which is the answer**; by reading the instructions the answer will be revealed.

Most dialogue is about placing symbols at various, correct locations in a layout of symbols on the whiteboard. Interactions follow an initiation/response/evaluation routine testing student knowledge of the location of information within the layout. There are places which are related to operations so that it is possible to know that two numbers must be multiplied because they are in the *multiplication location*. This is a common way in which Whaea L justifies the operation.

Problems are placed in a designed context which closely mirrors the calculation required. For example, one problem was:

If four people buy tickets for a concert at \$14 each, how much does it cost altogether?

This problem only thinly disguises the numbers involved (4 and 14) and invites a multiplication of them. Material resources were copies of concert tickets with \$14 written on them.

Performance of pāngarau involves successfully following the discursive steps of the strategy **laid out on the page** with a public explanation of the steps using official words. After the initial introduction, the context of the problem is forgotten and the rest of the learning focusses on the symbolic layout on the white board.

Whaea L strongly establishes behavioural correctness when doing pāngarau. In terms of behaviour and interactions, students are strongly controlled to adopt a quiet, thoughtful approach and pay careful attention to correct procedures and language use. Throughout the video data there are many instances of this. Y, a student who has not yet become fully aware of the interactional requirements of the pāngarau regime, receives many reprimands to **sit up properly, pay attention and look this way**. Y often interacts at inappropriate times and frequently leaves his seat to be in inappropriate places in the classroom. All of these receive reprimands and corrections when they happen. It is clear that interaction is strongly controlled but the definition of what constitutes appropriate interaction is not explicitly stated.

Realising Whaea L's regime in the interpretive framework.

The realisations presented in table 4.1 build upon those of table 3.4. The inclusion of more recognised features from empirical data clarifies the epistemic insight as doctrinal and the social gaze as a composite cultivated/social gaze. Procedural and discursive lenses are also suggested.

The analysis of further data for Whaea L has not changed the identified specialisation. The strength of both epistemic relations and social relations, and the strength resulting from a high degree of coherence, implies that even small fragments of data contain a depiction of the regime specialisation within them.

Contextualised Description	Rationale	Specialisation
Pāngarau is powerful in the world, it applies to everything	Pāngarau applies to any object of study, regardless of its nature, but must be studied mathematically.	Epistemic Insight: Doctrinal
Pāngarau is essential for Human Understanding	Human understanding is a special case of <i>everything</i> .	Epistemic Insight: Doctrinal
Pāngarau stands apart from language and culture.	Pāngarau is identified as a special class of knowledge which can be translated to any cultural location, in other words any object of study.	Epistemic Insight: Doctrinal
Pāngarau has its own identity/authority	Pāngarau is identified as having a special methodology.	Epistemic Insight: Doctrinal
Pāngarau is the same as Curriculum Mathematics	Two bodies of knowledge are conflated as being the same thing	Epistemic Relation Type: Discursive
Pāngarau is necessary for Survival in the modern world.	Survival may require people to interact socially with each other using pāngarau	Social Relation Type: Interactive
	Pāngarau knowledge is necessary to be able to perform survival tasks of any kind.	Epistemic Insight: Doctrinal
Pāngarau is essential for spiritual health.	Pāngarau is essential for identity; it creates belonging, value in a social group that recognises pāngarau as part of identity - in this case, Māori.	Social Gaze: Social
	Pāngarau is assumed to apply to spiritual health along with all other objects of study.	Epistemic Insight: Doctrinal
Pāngarau has the Curriculum/ Te Poutama Tau hierarchical knowledge Structure	Two bodies of knowledge, Māori mathematics and pāngarau, two distinct discourses, are assumed to have the same structure	Epistemic Relation Type: Discursive
The teacher is a discursive explainer/enforcer. Students are discursive pattern learners.	The students' knowledge and pāngarau knowledge are related in a dialectical relation embodied in the procedural practices of Whaea L's classroom.	Epistemic Relation Type: Discursive
		Epistemic Lens: Procedural
Performance of strategy use and explanation of the steps is very important.	Student performance and legitimate performance (curriculum defined) are related by correct symbol and word use.	Epistemic Relation Type: Discursive
	Relations between student performance and ideal performance are based on demonstration of correct procedure.	Epistemic Lens: Procedural

Contextualised Description	Rationale	Specialisation
Contexts are <i>designed</i> and forgotten about after the introduction.	Contextual knowledge and pāngarau knowledge are related through a designed context that supports seeing context in pāngarau terms.	Epistemic Relation Type: Discursive
	Contextualised knowledge is assumed to be reducible to pāngarau knowledge.	Epistemic Insight: Doctrinal
The Problem/Strategy/Single answer form is central to learning pāngarau	Student and Official Knowledge discourses are related through the discursive configuration which is performed procedurally.	Epistemic Relation Type: Discursive
	The configuration is a procedural connection based on location within a pattern.	Epistemic Lens: Procedural
Number Knowledge is the foundation of pāngarau	Curriculum structure is assumed for Pāngarau knowledge	Epistemic Relation Type: Discursive
	This assumption is carried through into pāngarau learning uncritically by following the curriculum pattern.	Epistemic Lens: Procedural
Other strands are based on number knowledge and add variety.	Curriculum structure is assumed for Pāngarau knowledge	Epistemic Relation Type: Discursive
	This assumption is carried through into pāngarau learning uncritically by following the curriculum pattern.	Epistemic Lens: Procedural
Māui interactional characteristics are rejected.	The ideal student defines very strongly how students should interact when learning pāngarau.	Social Relation Type: Interactive
	Learning of this way of interacting is implicit by being with others who are like this.	Social Gaze: Cultivated
Material resources were copies of concert tickets with \$14 written on them.	Contextual knowledge (money) is related to pāngarau knowledge. No conceptual representations were used.	Epistemic Relation Type: Discursive
		Epistemic Lens: Procedural
Correct use of language and relating to others in pāngarau practices is important.	Students must learn to interact correctly in language use and the protocols of pāngarau practices.	Social Lens: Discursive

Table 4.1. Whaea L's pāngarau regime related to specialisation concepts.

Specialisation tree and plane.

The epistemic relation is strongly discursive with a procedural lens and a doctrinal insight. The social relation is also strongly specialised as interactive with a discursive lens and a cultivated/social gaze. The data are ambivalent about the gaze; it appears to be a composite form in which interactions are both associated with knowers being Māori (a social gaze) and with developing ways of interacting appropriately for pāngarau which is, in theory, available to anyone. Students must learn a series of *recipes* based on symbolic *layouts* about number calculations. The teacher lays out the discursive arrangements, trains students in their use and reproduction and assesses performance to locate students in a strict hierarchical knowledge structure. They must interact in conventional and orderly ways using correct official language and in correct Māori. They must learn to be like this by spending time with people who are already like it.

The specialisations of the epistemic and social relations are coherent. The strong discursive epistemic specialisation is consistent with a social relation that legitimises the dispositions of focussed attention to detail, respect for and competency in the conventions of talking, writing and interacting. This coherence strengthens the specialisation in the regime. Figure 4.1 shows this graphically in a specialisation tree and on a topological specialisation plane.

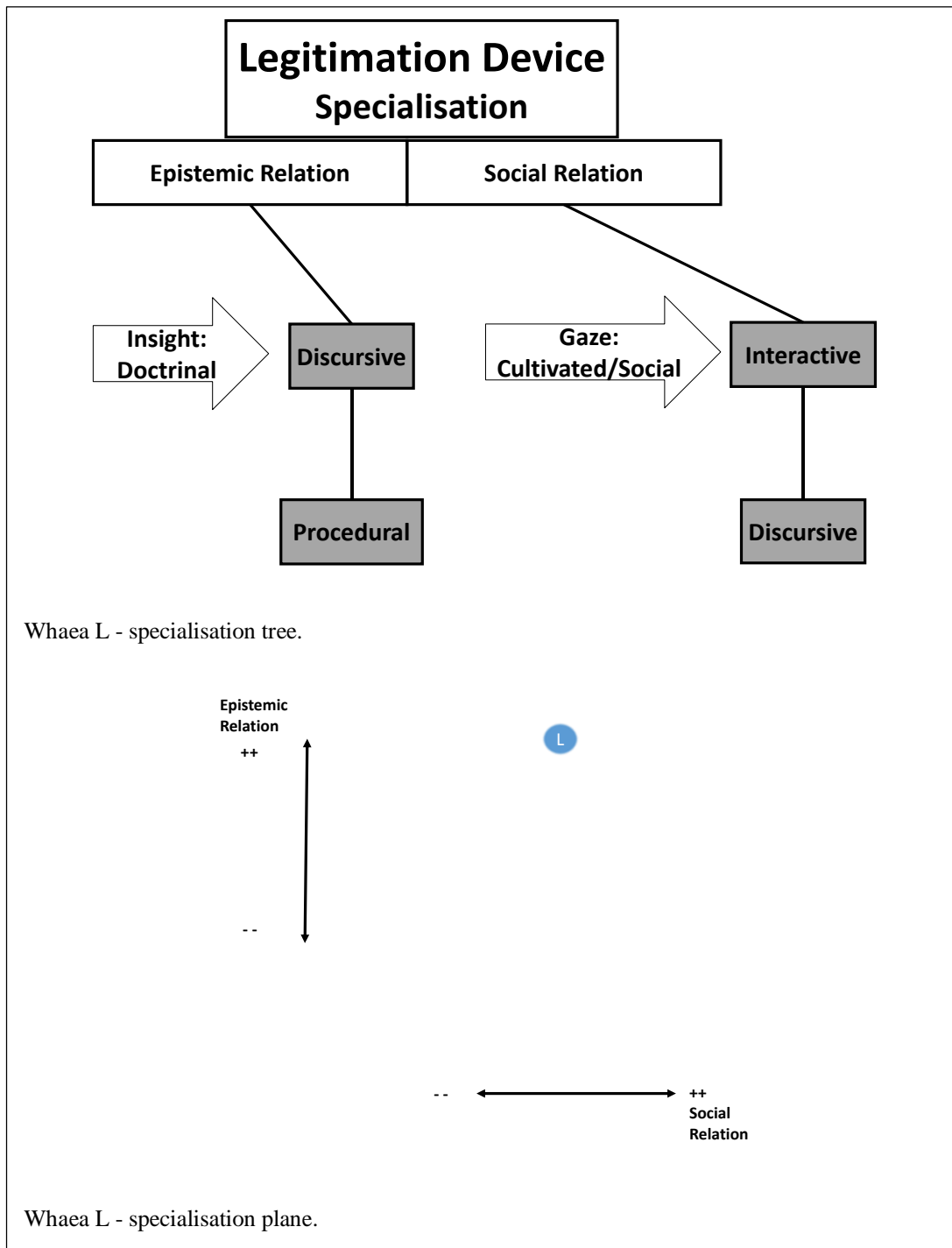


Figure 4.1. Whaea L's regime - specialisations of the epistemic relation and social relation.

Discussion.

Specialisation is both the basis and the object of the knowledge practices in a social field (Maton, 2014, p. 29). Knowledge practices draw their inspiration from specialisation codes and aim to produce outcomes aligned with them. Knowledge practices are involved in causal mechanisms which produce students whose consciousnesses attune with the specialisation codes of the pāngarau regime. The particular way Whaea L designs and manages knowledge practices and resources employs various forms of causality in order to achieve this. In addition, students themselves can be seen to exert personal agency in these causal processes to resist, modify or enhance the actualisation of the specialisation.

The *discursive set up* requires a teacher to explain the arbitrary way in which symbols are laid out on the page. Without Whaea L, the lesson could not function at all in this manner. Students must adopt a role of discursive *pattern learner* since the set up cannot be predicted or constructed by them in advance. Whaea L's assumption of the role of explainer/evaluator requires students to assume the role of pattern learner.

The specialisations of epistemic and social relations are strong. This presents students with a strongly defined choice and clear boundaries between legitimate and non-legitimate participation. They may participate in the discursive configuration of the learning which depends on and is tightly controlled by Whaea L, or respond using social, identity or other contingent/conditional features to bring the sphere of activity into the social arena. In the video data, students do both. In the activity involving three students, F, G and Y, F and G are accustomed to the regime and participate supportively in various ways. F actively engages in the regime, G passively. Y however, is located in the social arena with occasional forays into the pāngarau regime. Y appears to be not fully aware of the requirements of pāngarau and so responds to technical requests on his own social and emotional terms. This social response to technical requests initiates a *fence hopping* response from Whaea L. She makes a foray into the social arena, relaxing appreciative criteria about pāngarau performance, in order to *collect* Y and bring him into pāngarau. Conversely, Y fence hops to bring Whaea L back into the social arena. The following example of this *fence hopping* illustrates how evaluative criteria are relaxed, and personal characteristics acknowledged, when Y expresses affective distress in the face of a pāngarau challenge.

	1	Wh	Kia ora Y. Your turn now to explain now.
10 20	2	Y	(gets up to talk, bows, with embarrassed grin and gesture) Mine's wrong.
	3	Wh	(sitting down on the right hand side of the board) Hey no matter what it's like carry on and it will be fine..
10 41	4	Y	oh 18 times 4...oooooo (worried, uncertain)...I'll give this a go but I don't know that one..
	5	Wh	(Firm voice, definite enunciation of words, flat slightly rising intonation, stress on the word <i>will</i>) You will know how to do it...you are sharp...pay very close attention to the work.

Whaea L relaxes the performance criteria (line 3) in response to Y's distress (line 2). Y shows further distress (line 4) and Whaea L emphasises the required attributes for success (line 5). This example shows both perspectives on the explainer/pattern learner dialectic simultaneously. Whaea L relaxes criteria in an attempt to get Y to participate in the *discursive set up* of learning; Y uses affective distress in order to elicit such a relaxation and thereby participate on his own terms.

As identified in chapter 3, Whaea L refers explicitly to Y by the name Māui, a symbolic personality associated with unconventional creativity and rule-bending (pp. 164-165). In Māori mythology, there is another symbolic personality called Tāwhaki who is associated with the following of conventions and the protecting of traditional practices (H. M. Mead, 1996). Tāwhaki, also known as Tane-nui-ā-rangi, is considered to have ascended the heavens ('ā-rangi' means of the heavens) to retrieve three baskets of knowledge concerning practical knowledge, esoteric knowledge and genealogical knowledge. These three baskets conceptualise human knowledge as being concerned with practical survival on Earth, humanity's connection with a spiritual, unseen world, and the genealogical origins of the self. It is Tāwhaki who was given the task of retrieving these baskets of knowledge because of his respect for traditional and willingness to follow the established routes to find them.

Tāwhaki and Māui are interpreted here to be symbolic partners in a dialectical relation relating to the dispositional nature of the human person approximately analogous to a strong interactive specialisation of the social relation (Tāwhaki) and a strong subjective

specialisation (Māui). When Whaea L, in an elliptical, Māori way, refers to Y as Māui and exhorts him to be strong/staunch, she is also encouraging him to be more like Tāwhaki. Tāwhaki symbolises for Whaea L who the ideal pāngarau student is.

Tāwhaki is also implicitly referred to in the official pāngarau curriculum and associated with this knowledge. On page 40 of the curriculum (Te Tāhūhū o te Mātauranga/New Zealand Ministry of Education, 2008), the following proverb begins the discussion of pāngarau.

Kei hopu tōu ringa ki te aka tāepa, engari kia mau ki te aka matua

(Do not grasp the loose vines but grasp the main vine)

This proverb is associated with Tāwhaki and his climbing of a metaphorical vine to retrieve the baskets of knowledge. The main vine represents certainty and the established, traditional conventions and wisdom; the secondary or loose vines represent less certain, untried and potentially dangerous knowledge. Officially pāngarau is also associated with Tāwhaki not Māui.

The nexus of practices in Whaea L's regime is highly routinised (defined) and protected (controlled) so that success in pāngarau is about Tāwhaki-like social interactions and the following of discursively-formed symbolic patterns. This provides students with a limited range of options when participating in routines and practices. Rhythmically, they are strongly channelled to reproduce legitimate epistemic and social products which closely align with the specialisation code. Legitimate performance can be achieved by the following of rhythmic processes.

The nexus is underpinned by a set of assumptions about how pāngarau relates to people and the world. These assumptions represent necessity relations between the totality of pāngarau and external totalities. These necessity relations become transfactual causal relations in Whaea L's personal ideology: if pāngarau is learned in this way, students will be successful in the world.

The practices of the regime and the strong dependence on official resources and their construal of pāngarau for Whaea L, indicates a somewhat weak intentionality/transformational agency. She is uncritical of curriculum mathematics/pāngarau and conflates it with all forms of mathematics. Pāngarau teaching is about understanding curriculum mathematics; she has

not yet critically questioned the legitimacy of this. Furthermore, students themselves are not given opportunity to question it in the strong specialisations of the regime.

Rhythmic forms of causality dominate in the regime and exist in relation to strong specialisations of the epistemic and social relations; strong relations constrain students and teachers to the following of patterns. The situation is less clear when considering absences and presences. The Tāwhaki icon personifies that rhythmic processes which inhere within conventionalised, traditional practices and wisdom; Tāwhaki is sedimented within a Māori cultural frame as surely as Māui. Thus the suggestion that the strong knower-code of Whaea L's pāngarau regime makes Māui absent and Tāwhaki present, metaphorically, is not in itself an issue in the struggle with pāngarau. Perhaps what is more important is the conflation of Tāwhaki with curriculum pāngarau knowledge, its purposes and the types of rhythmic actions required in Whaea L's pāngarau regime. This may represent a form of cultural appropriation or recontextualisation of Tāwhaki for the pedagogic purposes of pāngarau learning which propagates the myth of the universality of pāngarau/mathematics knowledge (Dowling, 1998).

Although Tāwhaki is associated with convention and tradition, these are based on mātauranga not pāngarau. Mātauranga would give quite different purposes for such conventional actions and locate the following of conventions and traditions in a completely different social reality oriented to a very different interest. This interest would orient the following of conventions and traditions (social practices in other words) towards whānau, hapū and Iwi interests, and towards practical, genealogical and spiritual realms of knowledge, which may or may not include elements of pāngarau. In Whaea L's regime Tāwhaki is appropriated for the purposes of learning pāngarau for the sake of pāngarau and the access it gives for individual students to societal ways of *making a living*. In doing this, mātauranga is made absent using a metaphorical sleight of hand which switches the knowledge base with which Tāwhaki characteristics are associated and legitimised.

Conclusion.

The *fence-hopping* practice is important because this highlights the boundary of the pāngarau specialisation. It exposes the participation/participant dialectic that exists between students who must be a certain kind of participant and the specialisation of pāngarau which defines the nature of participation. Embedded in this are relations with knowledge structure, resources and Whaea L herself. A nested arrangement of dialectical relations can be theorised based on the realisation of the fence-hopping practice as exposing the specialisation boundary:

- The fence-hopping practice highlights particular small scale dialectics that exist between student Y and the immediate discursive presentations of pāngarau knowledge and resources. Y has to resolve dilemmas to do with how he interacts with these presentations, which threaten to expose his weaknesses, whilst maintaining his own self-esteem.
- Small-scale relations can be generalised as constituting a participant/participation dialectic between strong pāngarau specialisation (discursive epistemic relations and interactive social relations) and students who may have accepted different specialisations within the Kura (further details on this are given in the case example about the Kura ethos).
- Participant/participation dialectics can be seen to be part of a more fundamental determination about the nature of people - the knower/knowledge dialectic. All people are simultaneously both a person with a genealogy and an identity, and the set of ways of interacting and knowledge that they have learned. Each person therefore can be defined as some combination of who they are and what they know. Social fields must make determinations about what the legitimate combination of knowledge and knower characteristics is.

In this way, a clearer picture of fence-hopping practice as a response to nested dialectical dilemmas is gained. Fence-hopping attempts to compromise between the requirements of a strong specialisation of pāngarau and students' social identity. This in turn is part of a dialectical dilemma when the strong knowledge-code of pāngarau legitimises knowledge rather than the person who knows that knowledge. This also provides some insight into what diffraction/refraction of dialectical relations means; making a transitive

ontological decision about the nature of a person (that their knowledge defines their legitimacy) is refracted empirically in the curriculum knowledge structure, discursive configuration of activities and Tāwhaki-style interaction characteristics which allow measurement of a person in terms of a pre-defined knowledge system. The most fundamental reason (cause) for this configuration of pāngarau is seen to derive from the transitive ontological decision that a person is their knowledge.

Whaea M (Dominant Regime)

Whaea M is a young teacher who has been teaching at the Kura for 4 years. Whaea M teaches a year 3/4 class. Previously she taught at a primary school where she was introduced to the New Zealand Numeracy Project in its English-medium version. Her own schooling was in English-medium schools; she disliked mathematics because the teachers were authoritarian and the procedural work lacked creativity and interest. She made no personal connection with mathematics, just **going through the motions**, copying others' work if necessary. Whaea M is motivated to achieve social justice for Māori which manifests itself as a desire to lift Māori students from a state of dormancy or passivity into a state of active and critical engagement with life. This case example illustrates how a young idealistic teacher is confronted by the unavoidable requirements of teaching pāngarau which result in compromise, concession, tension, and potentially the emergence of a new pāngarau regime.

Whaea M's overall vision of pāngarau is unstable. At the time of data collection, a conventional, Te Poutama Tau informed regime dominated. However, there were several signs of an emerging *radical version* of pāngarau that rejected this conventional form.

Overall vision of pāngarau.

There is a sense of separation between Whaea M's knowledge and experience of mathematics and **academic stuff like algebra**. She appreciates scientists and mathematicians but knows no-one **like that in her world**.

Whaea M prioritises **real world** skills that are **needed to operate in the wider world**. This usually means **handling money** and **everyday activities like cooking and fishing**.

Whaea M discusses her usual practices and lessons in terms of pedagogical technique and pāngarau knowledge acquisition. Students feature in her discussions only in so far as their behaviour or attributes support or don't support the pedagogical practices or knowledge learning. She mentions adjusting practices sometimes if the students are unsettled but otherwise there is a consistent sharp focus on pāngarau learning and ensuring that students **stick to the point**.

Whaea M indicates a strong influence from English-medium mathematics education. She indicates that she has a quite limited perspective on pāngarau focussed strongly on what the teacher needs to do for students to **achieve the highest levels**. At the same time, despite having a somewhat limited perspective, she is also aware of a potential injustice that lies within the universal status of pāngarau:

I haven't thought about who wrote the Te Poutama Tau books and other resources in Māori....no doubt they are just translations of the English versions...it seems like assimilation... being pressured so that our ways of organising things and thinking about things are just the same as Pākehā (European New Zealanders)..we don't want that.

The tension she feels here is strong; she would rather reject these imposed practices. She suggests that developing unique, Iwi specific or Kura specific pāngarau practices and language is desirable but also suggests that this may contradict a need to be able to measure progress of students learning and **know whether you are at the national average**.

The strength of this contradiction creates a **weird situation**; she suggests that **we try and think maths and we don't relate it to the actual way we are**. Her own consciousness itself is changed when teaching pāngarau in part because she **has to think like this** (mathematically) and **you can't do what you want**.

Whaea M is conflicted in several ways about pāngarau and how it is learned. In terms of making progress through the stages of Te Poutama Tau, she professes impatience at not being able to **hurry up and finish tasks** but at the same time recognises the need for **patience and time** to allow students to develop deeper understandings. **Meeting Kura targets** causes anxiety which short circuits meaningful learning. She predominantly uses *designed* problem contexts but sometimes attempts integrated work to **increase the creativity**. However, the integrated work **doesn't feel like pāngarau anymore**.

Whaea M considers English-medium schools as sites of **education mass-production** which must attend to a standardised form of pāngarau. Kura are less constrained and can practice **pāngarau that is more free** to attend to local contexts and the identities of individual Māori children. She comments that the overall purpose of the Kura is to produce a **kind of person** primarily defined in terms of personal human attributes. Such a person is:

... a type of Māori person, a gentle person, caring, open to all kinds of learning, with humility...so we should be producing a sort of person who in the first place will be following their gifts and enthusiasms and that makes them all different but at the same time they will all be the same in other personal qualities like caring, hospitality, openness, respecting others.

Apart from a potential place in **following their gifts and enthusiasms**, Whaea M does not regard pāngarau knowledge nor any other kind of knowledge to be essential for this kind of person although they are **open to all kinds of learning**.

Whaea M points out what she considers as the demotivating and constraining effect on students of the designed problem/strategy/answer form of Te Poutama Tau. **It is narrow. If you add 5 and 6 you can't say the answer is 21; there is only one answer.**

She promotes the idea of integrating work to achieve an authentic task with connection to the children, rejecting in the process the idea of **doing pāngarau to show you have done pāngarau**. Instead she suggests an authentic task in which you **carefully think how you can learn pāngarau inside it**.

Whaea M does connect authenticity with being Māori not in a cultural sense but rather in terms of identity – Māori children require authenticity, relevance to their own contexts, because **that is what Māori children are**.

Whaea M contends that there is a destruction of the unique cultural understandings in traditional activities when they are treated as pāngarau exercises. She explains how she got students to examine number patterns in tukutuku panels (traditional geometric designs with symbolic meanings). She realised that **the cultural point of doing tukutuku** had been lost. She comments further:

I'd like to get them to make a real tukutuku, an authentic one..I should ask Nanny P (a Māori elder)...not just do nice pāngarau patterns as if they were tukutuku.

Whaea M strongly objects to Whanaketanga (Māori-medium national standards) and the idea of saying that *a child should be like this at a certain age when Whanaketanga don't have any idea about the child and the world they live in*. Whaea M calls this a **real affront to the child**.

In summarising Whaea M's overall construal of pāngarau, it is clear that there are in fact two construals that are in conflict. At the time of data collection, the conventional Curriculum/Te Poutama Tau construal is dominant and most lessons operate under this regime. Simmering in the wings though is an emergent, more radical pāngarau which rejects this conventional regime.

Internal components of pāngarau.

Whaea M's burgeoning radical sensitivities are constrained by a dutiful adherence to a conventional structure of pāngarau teaching and learning. This structure includes a contextualised problem, a solution strategy, a single correct answer and an explanation. This structure is characteristic of the New Zealand Numeracy Development Project/Te Poutama Tau.

Uppermost is a conventionalised hierarchical knowledge structure, coupled with pedagogical practices that **allow students to get to the next stage**. Whaea M adheres to a classroom organisation that is also conventional in Te Poutama Tau. Lessons usually have three phases: a whole class warm up phase, group work and a whole class review. Students are grouped according to their numeracy stage with the teacher attending to each group in turn in a weekly rotation. This focusses on **progressing** students through stages by **strengthening their weaknesses** and **getting what they need**. Students follow a rotation board which tells each group **what they have to do each day**.

Whaea M subscribes to a *building block* metaphor of mathematical knowledge – that the foundations need to be learned first, then the next layer, then the next, each being necessary before it is possible to learn the next level. Reading comprehension is important so that the pāngarau can be **taken out of the word problem**; the word problem is the vehicle carrying the pāngarau learning. She aims to **follow proper progressions** so that students **reach the highest levels**. This will create a stronger accumulation of knowledge over time by building on previous activities and establishing a **flow in the work**.

Whaea M focusses on conceptual development in the learning and relies on a variety of diagrammatic or material representative resources. Her aim is not to develop computational competence but to grasp the concepts that lie behind strategies. These

concepts are based on grouping and re-grouping of quantities (part-whole thinking). All activities in the data involve a problem to solve or an activity to complete that involves resources representing the grouping structure behind the strategy being used.

Problems, contexts and activities are specifically designed to direct attention to certain strategies. For example, when Whaea M works with a stage 4/5 group, focussing on a repeated addition strategy, the activity involves solving the problem:

In a field there are 4 horses and 2 chickens. How many legs are there in the field?

The word problem pre-figures the solution strategy by directing attention to combinations of groups of 4 and groups of 2 and thereby increases the probability that a repeated addition strategy will be used.

Whaea M's notion of strategy is a combination of the steps in the calculation and a pictorial representation of the grouping concepts involved. With this stage 4/5 group, pictures are semi-realistic depicting horses and chickens.

Whaea M uses a closed Initiation/Response/Evaluation questioning routine checking if students have identified the correct item of information. The general tenor of the activity is one of tight control of how students interact and of what is being studied and how it is to be worked out. Although the conceptualisation of strategy is broadened to include representational pictures, Whaea M also tightly controls the pictures remaining in control of the drawing of them and their use in the strategy.

Whaea M continues the lesson, working with a stage 5/6 group. There is a quite different tenor to these interactions. The problem they work on is of a different nature; it requires students to work backwards from an answer to arrive at a possible configuration of animals that gives that answer. There are several possible correct answers to this problem. The problem addressed is:

There are some pigs and chickens in a field. Altogether there are 40 legs. How many pigs and how many chickens might there be?

With this stage 5/6 group, Whaea M adopts a quite different position in the group both physically and in terms of control. She sits within the student group as if she is one of the students. With the stage 4/5 group she maintained the prime position next to the board. She also relinquishes control partially to the students who take turns to show their work. Students

decide how they will represent the ideas. Teaching moments take on the form of giving advice rather than instruction; questions are open, inviting students to show what they have done or explain what they think.

With the stage 4/5 group she prioritises what the students need to do to solve the problem. With the stage 5/6 group she prioritises the student's own strategies, not the requirements of the problem. With the 4/5 group Whaea M is strongly controlling both of the content and strategy use and of student interactions; questions are closed and aimed at ensuring that students select the correct information and perform the correct actions. With the stage 5/6 group, she adopts a much weaker position of control and allows students to manage the work for themselves.

A characteristic of all Whaea M's lessons in the data is her control of social interactions. Lessons are structurally tightly controlled so that students are working in stage related groups on differentiated work. When she works with each group, almost all interactions must come through her and be initiated by her. She generally asks questions to which she already knows the answer and directs these questions to particular students within the group. The distribution of questions and the type of questions depend on who is being asked and which group is being taught. In the lesson discussed above, the stage 4/5 group is treated quite differently to the stage 5/6 group.

A practice referred to here as *ratcheting down* often occurs. Whaea M pitches her talk at a certain conceptual level. Students often respond by attending to answers only, the literal meanings of words, other social contexts that the students associate with the activity or the common meanings of words. Confusion and tension results both in the students and in Whaea M who wants to **push on with the work and achieve something**. Whaea M responds by a gradual reduction of the conceptual level until the students receive a series of small steps that allows them to produce the same result as invited by the conceptually more dense initial talk.

Whaea M has recognised the tendency for students to take things literally and be unable to respond at higher conceptual levels. Whaea M attributes this to a **learned passivity** which is inculcated by a culture in the Kura which requires students to **spend a lot of time just sitting and listening**. The students **learn to switch off** and carry this characteristic into lessons.

Realising Whaea M's dominant regime in the interpretive framework.

The changing of the framing of relations for different groups is a significant feature of this case example requiring some careful thought in terms of relation strength. Higher stage groups have relatively weaker framing. Specialisation changes respond not to the ethnicity nor the social class of student, but rather to the notion of *ability* as measured by Te Poutama Tau assessments of numeracy stage. Even with variations of framing strength with different groups, legitimate knowledge and knowers are always strongly defined and legitimacy maintained in practices. Higher stage groups have weaker framing relative to lower stage groups, but this relatively weak framing is still effective in defending and maintaining legitimacy. Holistically, the regime is considered to have strong epistemic relations and social relations.

The suggestion is tentatively made that a new social subjective lens be created called *attributional*. This indicates that the legitimate knower possesses the same measure of an attribute, in this case *Te Poutama Tau ability*. In lower stage groups, there is a tendency towards a discursive procedural lens. In higher stage groups, a tendency towards a discursive principled lens. Table 4.2 relates empirical features of Whaea M's dominant regime to specialisation concepts.

Contextualised Description	Rationale	Specialisation
Disciplinary Form of Mathematics is devalued.	The disciplinary forms of mathematics are rejected in favour of a curriculum form.	Epistemic Relation Type: Discursive
Real world skills are most important.	Real world skills are those that are actually needed in practice in real life situations.	Epistemic Relation Type: Ontic/Discursive
Pāngarau is important in the world.	Pāngarau knowledge is part of/important in other knowledge.	Epistemic Relation Type: Discursive
Students are organised in stage related ability groups.	Curriculum levels and Te Poutama Tau stages determine who studies what knowledge and when/how it is studied (kinds of strategy to be used).	Epistemic Insight: Purist
Pāngarau has a hierarchical knowledge structure as in Curriculum/Te Poutama Tau	The knowledge structure of the curriculum/Te Poutama Tau are based on a particular discourse which is to be related to students and to mātauranga.	Epistemic Relation Type: Discursive
Learning is moving to a higher stage.	Both knowledge and students must be organised in a vertical hierarchy and ways of learning geared to the hierarchy.	Epistemic Insight: Purist

Contextualised Description	Rationale	Specialisation
Problem/Strategy/Single answer genre form.	Embedded in the genre is both the knowledge to be studied (the problem matched with a level) and the way it is to be solved (the strategy matched to the same level)	Epistemic Insight: Purist
Social interactions controlled by Whaea M, are differentiated in nature according to ability.	Social relations /interactions are tailored for different ability groups – membership of the ability group determines social relations. There is a dialectical relation between a student showing correct interaction in an ability group and the attribution of that (innate?) ability to the student.	Social Relation Type: Interactive
		Social Relation Type: Subjective
Higher stage groups have open social interactions, peer to peer with Whaea M	Social relations are tailored for the ability of the group. Pāngarau knowledge and student knowledge are related at a conceptual level	Social Subjective Lens: <i>Attributional</i> Social Interactive Lens: <i>Discursive</i>
		Epistemic Lens: Principled
Lower stage groups have tightly directed, closed interactions with Whaea M in a dominant role	Social relations are tailored for the ability of the group. Pāngarau knowledge and student knowledge are related by following procedures.	Social Subjective Lens: <i>Attributional</i> Social Interactive Lens: <i>Discursive</i>
		Epistemic Lens: Procedural
Designed contexts are used for problems with conceptual structure of solution strategy emphasised	The designed context attempts to relate real life knowledge to pāngarau knowledge. Conceptual structures form the link between the two. Concepts constitute principles of relation.	Epistemic Lens: Principled
Number Knowledge means part-whole thinking/grouping structures.	Group structures are specific concepts which relate in principle real context knowledge and pāngarau knowledge	Epistemic Lens: Principled
Contexts carry standardised pāngarau concepts and knowledge	Any context may be viewed as being pāngarau. Context is unimportant except that it carries pāngarau knowledge within it.	Epistemic Insight : Doctrinal
Interactions are carefully and tightly controlled by Whaea M to maintain a focus on learning the necessary pāngarau.	Interactions are related to how students interact with conceptual/technical materials and representations.	Social Lens: Ontic
Students must interact with each other within the rules of the activity and the procedures of usual classroom work (warmup/group work/review).	The rules of activity refer to arbitrary rules and routines derived from Te Poutama Tau discourse and English-medium mathematical education discourse.	Social Lens: Discursive
Students are expected to take responsibility for their work when they are not working with Whaea M	Students must carry with them from teacher led activities legitimate ways of interacting with each other and with technical objects.	Social Lens: Discursive/Ontic
Conceptual representations and understandings are prioritised.	The object of study (grouping structures of problems) and how this is studied (conceptual representation) are focussed on. Grouping structures are technical objects – the decimal system, for example, is one of many possible alternatives.	Epistemic insight: Purist Epistemic Lens: Technical

Table 4.2. Whaea M's dominant regime related to specialisation concepts.

Specialisation tree and plane.

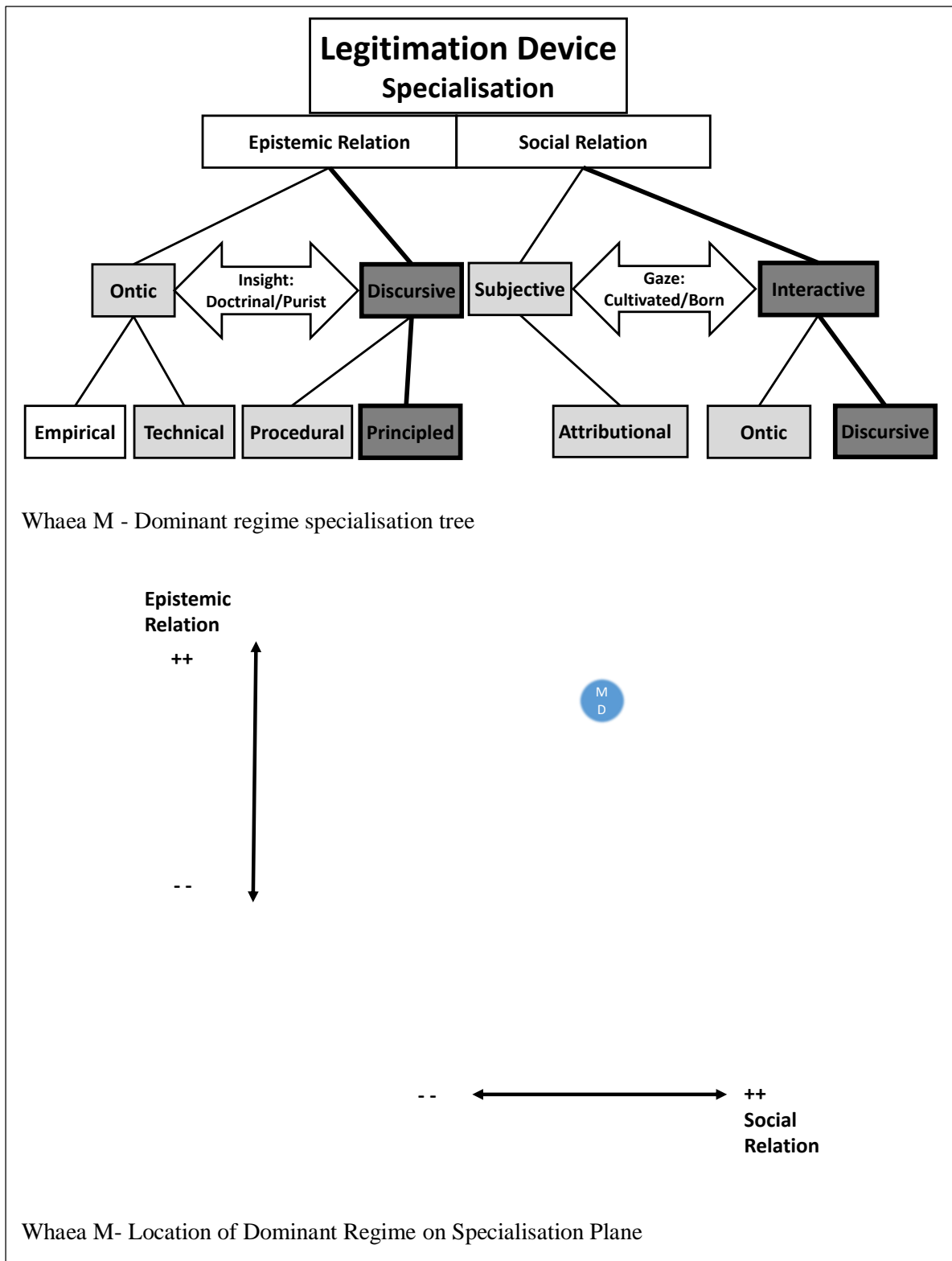


Figure 4.2. Whaea M's dominant regime- specialisations of the epistemic relation and social relation.

The representations in figure 4.2 paint a complex picture. Referring to the specialisation plane, the specialisation is summarised as being strong in both epistemic discursive relations and social interactive relations. The specialisation tree has dominant branches of discursive epistemic relations with a principled lens and interactive social relations with a discursive lens. These relations are compatible because students can engage with a strong epistemic relation defined in relation to a decontextualised, conceptual knowledge hierarchy by learning and conforming to interaction rules and practices based on the discourse structures of pāngarau education. The epistemic relation is incompatible with subjective social relations which are automatically bound to the context of the subject.

There are also weaker branches in the tree which indicate some tendencies towards ontic/technical or discursive/procedural epistemic relations and subjective/attributional or interactive/ontic social relations. These weaker relations move the social gaze from doctrinal towards a purist gaze, and the epistemic insight from cultivated towards a born insight.

Discussion.

Whaea M expresses some profound uncertainties about pāngarau exemplified by her comment that **it seems like assimilation**. Whaea M has an intuitive critical sense of the tension that exists in pāngarau between **meeting targets** and **achieving national averages** on the one hand and recognising students' identities on the other. This tension is represented in the specialisation tree as dominant discursive and interactive branches with weaker ontic and subjective branches.

In some circumstances, dominant specialisations may give way to weaker ones. This occurs in relation to perceptions of ability derived from Te Poutama Tau assessments, and experiences of frustration when students do not respond in accordance with the dominant specialisations. The former circumstance prompts a differentiation of social and epistemic relations for lower and higher stage groups. The latter circumstance prompts the *ratcheting down* response from Whaea M.

Te Poutama Tau ability is measured using standardised assessment tools which focus on competency in counting, part-whole and multiplicative thinking (a conceptual orientation). This suggests that in Whaea M's class, a formal measure of ability based on a Te Poutama

Tau/Numeracy Project theorisation of conceptual competence is causal in the institution of different epistemic relations and social relations for different groups of students. This illustrates how formal understandings of knowledge competencies embedded in a knowledge system (a partial totality), which take on meanings in relation to other components of that system, become represented in (are causal in) the everyday interactions of a pāngarau classroom. There is also a possibility that the different specialisation regimes operating in the different groups contribute to differential outcomes for those groups. In Bernsteinian terms, rather than a lower stage group being enabled to reach the higher stages of Te Poutama Tau knowledge, they are in fact, being constrained from reaching them.

The collected data have several interactions which suffer from misunderstanding due to a mismatch of the semantic levels of language use between Whaea M and students. The reasons for the mismatch however are far from clear. When Whaea M attempts to elicit a technical/conceptual response from students who do not respond at the same level (either conceptually or linguistically or both), students are confronted with a dilemma. They must respond in some way but clearly can't or won't respond in the way Whaea M requires (thinks is legitimate). They can only respond blankly or by offering a descriptive response which also has the effect of causing Whaea M to ratchet down the conceptual level. In this sense then, this situation is analogous to Whaea L's *fence-hopping* in response to affective distress in students. It can be considered as a dialectical formation because the confrontation of students by a request at a conceptually dense/high semantic level (relative to students) can be seen to cause the blank or descriptive response, which in turn causes the lowering of semantic level by Whaea M. This keeps the work at a level at which students can perform tasks successfully (and quickly enough for Whaea M) but does not lift conceptual understanding. Later, Whaea M attempts more conceptual work with the same result.

Other tensions and contradictions can be highlighted. For example, Whaea M expresses a lack of valuation of disciplinary mathematics yet adopts a conceptual approach to pāngarau which is the beginning of a disciplinary specialisation. She expresses a desire to integrate pāngarau in authentic tasks but fears the loss of a societally recognisable set of pāngarau practices. She recognises and values the purpose of the Kura to produce a *kind of person* but acknowledges that her pāngarau regime may not contribute to it. Whilst rejecting global measurements of children's attainment (through National Standards/Ngā Whanaketanga) she organises her pāngarau regime in alignment with Te Poutama Tau and organises groups of students in relation to a global measurement of conceptual ability.

Whaea M is also sensitive to the way *seeing pāngarau* in a traditional activity erodes its authentic understandings and purpose but still uses such contexts in pāngarau activities.

Whaea M has already embarked on an intuitive critique prompted by her experiences of the tensions, frustrations and contradictions just outlined. These experiences may all be categorised as dialectical because both Whaea M and students are placed in positions where a determination must be made about the nature and purposes of pāngarau knowledge, and the learner who knows that knowledge. Following Te Poutama Tau, from which her strong epistemic and social relations originate, Whaea M and her students must decide to comply or not with strong relations which create clear and well-defended boundaries between legitimate and non-legitimate actions. In terms of transfactual, rhythmic and holistic forms of causality, the dominant regime exerts considerable causal pressure on Whaea M and students to conduct pāngarau in a certain way. For example, Whaea M experiences frustration and anxiety when students do not quickly achieve tasks and meeting targets is put at risk. These targets are expected/predicted stage levels that students must reach by the end of the year. The framing of targets in this way, and the consequent tensions induced, are endorsed and holistically caused by Te Poutama Tau.

Te Poutama Tau/New Zealand Numeracy Development Project is based on several transfactual causal relations one of which is that better conceptual understanding will result in better pāngarau achievement (Hunter, 2006). This causes Whaea M to legitimise this kind of understanding in a wholesale manner for all of her students which results, amongst other things, in the ratcheting down practice with students who appear to struggle with concepts.

The day to day routines such as following a rotation with independent work interspersed with teacher led activities, use of conceptual representations and language use, can be thought of as employing rhythmic causality to create a dialogic context which legitimises a decontextualised, hierarchical knowledge structure in which students are measured and located. Whaea M locates herself in this knowledge structure - her change of social relations in higher groups indicates that she is more at home with these children than lower stage groups. In so doing it is reinforced that the higher stages are to be attained to be a legitimate knower.

Considering the dialectic of presence/absence, strong epistemic and social relations create strong boundaries between legitimate and non-legitimate actualisations. Strong boundaries defend what should be present and maintain in absence what should be absent

(according to the legitimation code). In this case example, Whaea M and her students, experience tension, frustration, and alienation as actualisations of the causal powers of the real absences of those totalities and entities missing in the dominant regime. Whaea M subjectively experiences these forms of causality as a type of alienation when engaging in pāngarau – an alienation from herself, from being Māori, and an alienation from some of her students.

Conclusion.

Whaea M is in an intuitive process of developing an alternative version of pāngarau. This alternative version was in the process of emergence during the data collection. This emergence can be seen to be caused primarily by Whaea M's own intentional form of causality (transformational praxis) based on a largely intuitive and itself emergent, critical engagement with pāngarau. This results from her experiences of tension, frustration, contradiction and alienation in teaching pāngarau with strong epistemic and social relations.

Whaea M's emerging pāngarau regime will be interpreted next.

Whaea M (Emergent Regime)

Internal components of pāngarau.

In a lesson captured on video, Whaea M experiments with an integrated approach that embeds pāngarau learning in an activity requiring students to construct a manu tukutuku (a traditional kite) from cardboard, paper and string. The activity is related to a theme of Matariki, a time of the year signalled by the first appearance of the star constellation Matariki/Pleiades (mid to late June).

The activity begins with a discussion of what children living in pre-colonisation times would have done at Matariki. The manu tukutuku was a common form of entertainment for children at that time of year (June/July) when winds are stronger. Whaea M has already constructed an example of a manu tukutuku. It is triangular, symmetrical and consisting of a three sided frame with strips of card running across the frame tied on with string.

The lesson continues with a discussion of a set of criteria which must be met. These are tightly focussed requiring the manu tukutuku to be symmetrical and triangular, and for students to use only the materials provided by Whaea M – 4 pieces of A3 card and a length of string. These criteria limit products to be very similar to Whaea M's example.

The criteria are displayed under a learning objective of *I am learning to construct a manu tukutuku*. The criteria are read out one after the other by individual students with a discussion of each led by Whaea M.

The criteria are:

1. The manu tukutuku must fly.
2. The manu tukutuku must be symmetrical.
3. The manu tukutuku must be unique.
4. The manu tukutuku must be triangular.
5. Only the resources provided may be used.
6. Resources must not be wasted.

Following a discussion of each criterion, students are given an extended period of time to construct their own manu tukutuku individually. Students are free to construct them

as they wish with very little input from Whaea M. Students repeatedly ask her to check their work but Whaea M responds by asking the students if their work meets the criteria. She leaves it up to them to decide.

Although students are working individually there is much collaboration, sharing of resources and helping each other. After many attempts all students successfully construct a manu tukutuku all of which closely resemble Whaea M's example.

All students then leave the classroom to test if their manu tukutuku will fly. The day is a very still day with little or no wind. Students spend about 20 minutes hectically running around trying to get the manu tukutuku to fly without any success. Returning to the classroom there is a short discussion about improvements that might increase the chances of flying such as making the manu tukutuku bigger, waiting for a windy day, or going to a hill top.

Overall, this integrated lesson follows the same general pattern as other lessons. Despite Whaea M's desire to do pāngarau differently, she retains her usual structure. This consists of a discussion of the pre-determined criteria (as if they were learning objectives), a hands-on activity in which students are free (to varying degrees depending on the activity) to complete the activity under their own direction, and ending with a discussion about the activity. In the first instruction phase, Whaea M controls the interactions in a very similar way to her dominant regime lessons, damping down inter-student interactions and insisting on one-to-one interactions with her.

The use of criteria for the learning objective is not present in other lessons. Although the criteria are very restrictive, they are a point of departure. Whaea M suggests that the lesson could be improved by broadening the criteria to give students more freedom in design and aesthetic appearance. During the construction phase, Whaea M gives no explicit instructions but returns the responsibility to students themselves to decide whether their work meets the criteria. She also does not comment on the air-worthiness of the manu tukutuku even though it is very obvious that many of them will never be able to fly. She leaves this to be discovered by students by experiment outside.

The different version of pāngarau that Whaea M desires can be seen to be emerging – although structurally the same as her other lessons, there are significant differences within some of the structural elements. These differences relate to the increased degree of student autonomy allowed (in the construction phase) and their responsibility for deciding on the

correctness of the work. Significantly, the empirical testing of the manu tukutuku is something that is completely absent from other pāngarau lessons observed. Finally, there is no differentiation of work for different groups of students; it is a whole class activity and students are free to associate with whoever they like during the construction and testing phases of the lesson.

Realising Whaea M's emergent regime in the interpretive framework.

Although the amount of data collected on the emergent regime is small in comparison with the dominant regime, a limited analysis of specialisation is possible.

Table 4.3 identifies several specialisations that operate simultaneously in Whaea M's emergent regime indicative of a regime in transition that retains some specialisations from the dominant regime and experiments with new ones. Ontic epistemic relations and subjective social relations feature more prominently alongside discursive and interactive relations.

Realising ontic epistemic relations involves abducting recognised features in terms of a relation to the object of study; ontic relations involve some form of direct involvement or experimentation with the object rather than attending to a discourse about it. Realising subjective social relations involves abducting recognised features in terms of how the already established identity of students provides legitimacy regardless of the quality of their participation in either interactive social practices or epistemic practices.

Judging the relative strengths of the different specialisations in a multi-specialised regime may prove difficult. In this case example, epistemic relations and social relations are different in the instruction phase (stronger relations) and the construction phase (weaker relations). There is however, a *movement towards* the specialisation in the construction phase which is therefore considered to be the primary specialisation. This can be seen in subtle ways; for example, when students approach Whaea M for explicit help during the construction phase they are referred back to the criteria. Incidents such as this indicate a rejection of a practice that was legitimate in the dominant regime (teacher checks of student work) in favour of a new practice based on a different legitimisation code (encouraging students to make decisions for themselves). Overall, the regime is considered to have weaker epistemic relations and stronger social relations.

Contextualised Description	Language of translation	Specialisation
Pāngarau learning subordinate to contextualised, real purpose learning	The actual activity itself is the focus, not pāngarau. The relation between the discourse of the real activity (a cultural discourse) and that of curriculum pāngarau is critically analysed. Pāngarau knowledge and practices are subordinate to cultural knowledge and practices.	Epistemic Relation Type: Discursive/Ontic Epistemic Lens: Principled
Conventional form of pāngarau suppresses individuality of children	The identity of the child is prioritised over the learning of pāngarau. Children as a group of knowers are prioritised. In particular, it is Māori children who are being considered.	Social Relation Type: Subjective
Cultural purposes of activities prioritised over pāngarau purposes.	The relation between curriculum pāngarau and traditional cultural activities is critically analysed. In particular Māori cultural purposes for activities are prioritised	Epistemic Relation Type: Discursive/Ontic Epistemic Lens: Principled
Authenticity required – learning done for an authentic purpose	In this regime, any authentic object of study is allowed, the way that students learn about this is open to interpretation and variation. Authenticity in Māori axiological terms becomes the key definition of what is an object of student.	Epistemic Insight: Situational
Real objects should be produced and tested out in real use	In activities involving the production of a material product, the correctness of the product is tested by actual use in the real context.	Epistemic Lens: empirical
Pāngarau learning embedded in the learning necessary for achieving a real task. Other types of knowledge combined with pāngarau to achieve task.	The authenticity of the task becomes the definition of what is valid, how it is studied is open with pāngarau being just one of many possible knowledges available.	Epistemic Relation Type: Ontic Epistemic Insight: Situational
Students are free to design their own solutions to tasks, as long as they meet the criteria, and to test them out in real use.	Real/authentic tasks define the object of study with students free to study them in their own ways. Empirical testing of any products is expected.	Epistemic Relation Type: Ontic Epistemic Insight: Situational Epistemic Lens: Empirical

Contextualised Description	Language of translation	Specialisation
Social interactions tightly controlled in instruction phases, loosely controlled in construction phases	In the instruction phase the social lens is discursive since it is about interacting with language and in interaction protocols (the usual teacher – student relations). In the construction phase, the discursive lens weakens with students required to interact with materials and technical objects (such as tools, and material resources used in the product).	Social Relation Type: Interactive/Subjective Social Lens: Ontic/Discursive
Criteria of the task determine what is learned.	The criteria establish a set of principles by which students may measure the correctness of their work. This sets up a relation between the discourse of the authentic task and the discourse of the students in attempting to solve the task.	Epistemic Relation Type: Discursive Epistemic Insight: Purist Epistemic Lens: Principled
Whole class activity, no differentiation of work to align with ability.	No differentiation of knowers is carried out, all knowers are assumed to legitimate by belonging to the group of Māori learners at the kura who are in years 3 or 4.	Social Gaze: Social Social Lens: Social/Biological

Table 4.3. Whaea M's emergent regime related to specialisation concepts

Specialisation tree and plane.

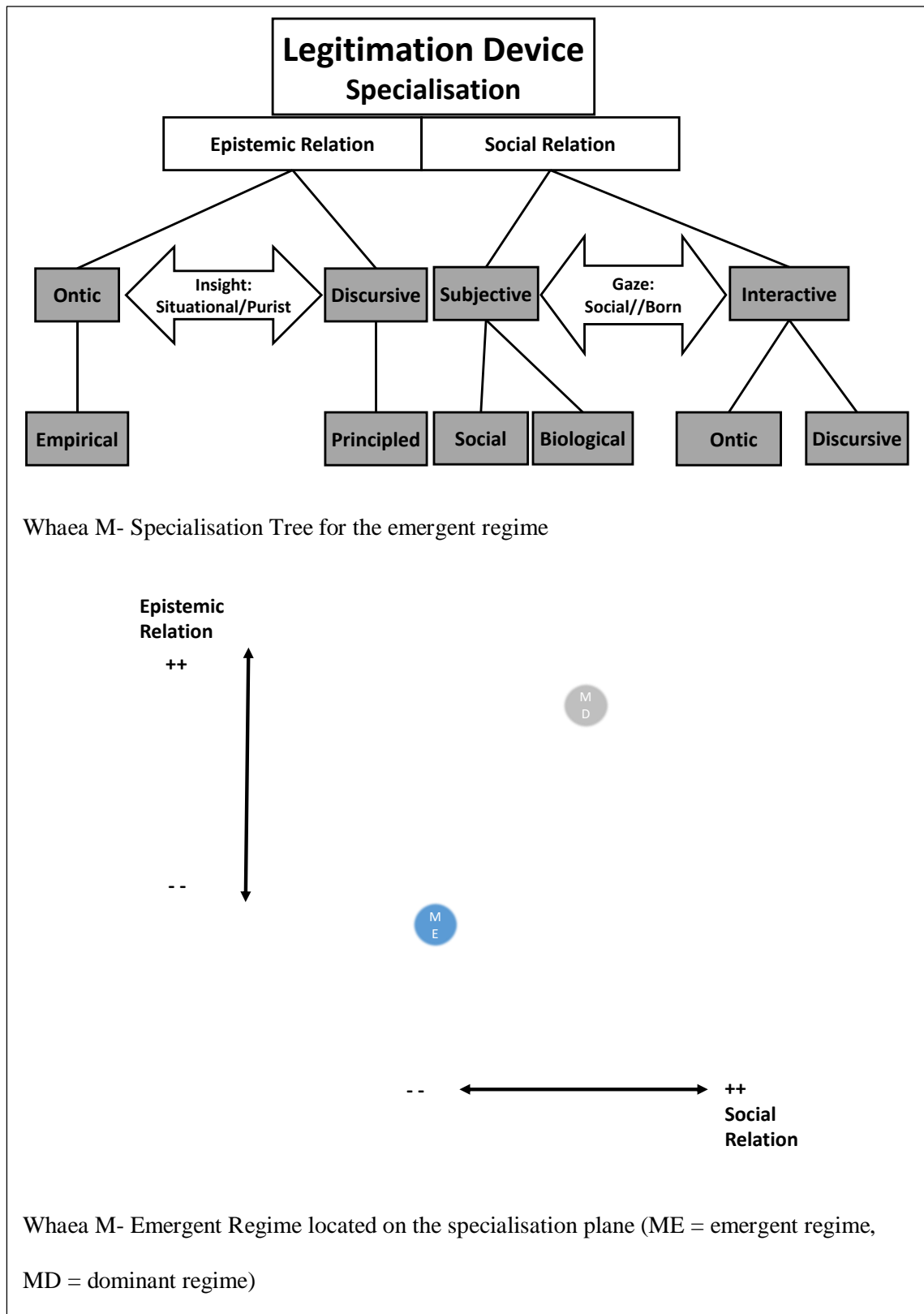


Figure 4.3. Whaea M's emergent regime - specialisations of the epistemic and social relation

Figure 4.3 represents the specialisations of Whaea M's emergent regime. All representations in all case examples are tentative but this representation is especially so because it is based on limited data. However, some comments may be made.

The branches from the dominant regime are also represented in the emerging regime but in weakened form. There has been an emergence of still relatively weak ontic, empirical epistemic relations and subjective, social/biological social relations.

The epistemic insight has shifted from purist/doctrinal, to purist/situational - a movement from doctrinal towards situational. This indicates a perspective switch from an insight legitimising method of study over what is studied (doctrinal insight) to an insight which legitimises what is studied over the method of study (situational insight)

The social gaze has shifted from a born/cultivated, to a born/social - a movement from cultivated towards social. This switches the perspective of the gaze from one which legitimises ways of participating/interacting (cultivated) to a gaze which legitimises the participant (social).

Discussion.

Weaker epistemic and social relations imply that boundaries between legitimate and non-legitimate actualisations are becoming porous in the emergent regime. Both students and Whaea M may bring into consideration methods/ideas from, in theory, any source. This aligns with the movement of epistemic insight from doctrinal to situational. In the emergent regime, a more situational insight accepts as legitimate any knowledge that can be related to authentic activities.

The emphasising of authentic activities (traditional, Māori activities) recognises the identity of learners as Māori and the knowing of such authentic activities as being part of their identity. How they come to know this tends to be weakly defined and controlled – they are given time in which to come to their own terms with it. This aligns with the movement of social gaze from cultivated to social.

The emergent regime tends towards a different balance of forms of causality. Weaker relations require that Whaea M and students use their own forms of agency more actively in

order to achieve tasks; this is in fact expected and legitimised. Weaker forms of transfactual and rhythmic causalities which emphasise decontextualised causal relations and routinised actions, give more space to holistic and intentional forms. Holistic causality is now based on situational totalities (Māori activities that relate Māori concepts and social entities) rather than Te Poutama Tau activities (which relate disciplinary and societal concepts and entities). However, whereas Te Poutama Tau supported strong relations in Whaea M's dominant regime which tended to absent Māori totalities, the emergent regime has weaker relations centralising Māori totalities but which may or may not absent Te Poutama Tau/curriculum totalities.

Conclusion.

The two case examples that Whaea M and her students have provided have given some unique insights into epistemic and social relations and the role they play in struggle with pāngarau. The dominant regime has shown how epistemic and social relations can exist in a relation which is characteristic of the particular knowledge-code conventionalised in the curriculum/Te Poutama Tau. This insight indicates how social relations are dependent upon a structure that is determined by knowledge criteria. Knowledge criteria are used to group students according to a global measure of the degree of presence of knowledge based attributes (conceptual understanding, the *ability* of the student). Once a grouping structure has been established, social relations can be established differently for each ability group. This process was quite tacit; Whaea M was completely unaware of this in her own practice. Not only is knowledge distributed differently, social relations are as well. The combination of the differential distribution of both knowledge and social relations provides a powerful conditioning (causal process) of each ability group which suggests that once students are placed in a group, they will tend to stay there. They become accustomed not only to the forms of knowledge they are presented with, but also how interaction happens and how things are conceptualised and spoken about. This is an important holistic causal effect of knowledge practices based on a hierarchical knowledge structure.

A second important insight in this case example is how the dominant and emergent regimes are related. Although the situation is not fully clear in the data, there is enough evidence to tentatively suggest that the characteristics of the emergent epistemic relations and

social relations are being formed in resistance and opposition to those of the dominant regime (table 4.4)

Regime	Dominant Regime	Emergent Regime
Epistemic Relation		
Strength	Strong	Weak
Relation Sub-class	Discursive(Curriculum)	Discursive /Ontic (Authentic)*
Insight/Gaze	Purist/cultivated*	Purist/Situational*
Lens	Principled, procedural, technical #	Empirical, Principled #
Social Relation		
Strength	Strong	Weak
Relation Sub-class	Interactive/Social*	Social/Interactive*
Insight/Gaze	Born/Cultivated	Born/Social (Māori/Child)
Lens	Attributional, Discursive, Ontic #	Social, Biological #

** The order indicates which type dominates; the first named is dominant.*

No order is intended; all characteristics may be equally represented

Table 4.4. Comparison of specialisations in Whaea M's dominant and emergent regimes.

For the epistemic relation, discursive relations give way to a discursive/ontic set of relations which confer some legitimacy to authentic, culturally based knowledge and principles that deal with ideas and actual events in their non-pedagogic form. Instead of a principled/conceptual lens which uses principles of conceptual relations (grouping structures) to establish validity of knowledge, validity is based on empirical testing of produced artefacts (both material and symbolic).

For the social relation, there is a shift from interactive relations, framed by a hierarchical, knowledge-based grouping of students, to social relations involving interaction with each other and material objects based on already established social relations. These

relations include straightforward friendships, conventional relationships, and ad-hoc relations.

In general terms, shifts of both epistemic and social relations represent a shift from a global, hierarchical knowledge system (that configures the social relations) to a localised, culturally based system that blurs conventional knowledge categories and allows knowledge to be learned within social relations. In the dominant regime, students are grouped according to their numeracy stage which severs existing social relations, splitting friends/social cultural partners who have different numeracy attainments; social relations are influenced by status according to position in the knowledge hierarchy. In the emergent regime, pre-existing social relations are re-established with learning of knowledge occurring within these social relations; knowledge acquisition is different for each student because of who they are and their situation in Kura-wide social relations still operative in pāngarau learning.

This regime change requires careful interpretation because the dominant regime does not completely obliterate naturally occurring social relations and the emergent regime does not completely disintegrate pāngarau knowledge hierarchy. The situation may best be described as a perspectival switch from pāngarau knowledge influenced organisation of social relations to socially influenced learning of pāngarau knowledge. In the dominant regime, naturally-occurring social relations may be temporarily suspended (but creating a real absence) and quickly re-established elsewhere. In the emergent regime, students may achieve a full, high-level grasp of pāngarau as they develop and accept, at the culturally appropriate time, different social/cultural roles.

A collective view of knowledge acquisition is also possible. Instead of all students knowing all necessary knowledge so that each individual student may function effectively in isolation (a conventional curriculum view), different students may have different knowledge which may be activated collectively through social relations to function effectively as a social/cultural collective and/or individual.

The case study also provides some insights into the nature of the emergence of a classroom regime in the context of the Kura. As just discussed, the specialisations of Whaea M's emergent regime are in opposition to those of the dominant regime but underlying this are some fundamental dialectical relations which involve contradictory yet intrinsically connected partners. Opposition therefore is never between two completely unrelated things; since they are unrelated, opposition is not necessary. When one partner in the dialectical

relation is forced to prominence in a social field (it is made present), a related partner is automatically made at least partially absent. This absence is considered to be real and to have real causal effects contributing to a tendency for the re-establishment of the absented dialectical partner which contributes to the emergence of new practices.

To add further complexity to this perspective, the concept of duality of dialectical partners is seen as somewhat artificial since any real intransitive entity may have many more than two transitive determinations. Pluralities may be a more accurate concept with a duality being a focus on just two dialectical partners within the plurality; dialectical relations are deemed to exist between any subset/all of the transitive conceptions of the same intransitive entity including not yet formulated ones. Because they all refer to the same entity they are related; because they are different they also inherently contradict each other by disagreeing about the ontological nature of the entity which connects them. A social field which emphasises just one or a few of these determinations, as all fields must, automatically absents the other potential and actual dialectical partners. Emergence then is understood to be embedded in the shifting of balances within these pluralities of dialectical relations.

For Whaea M's emergent regime, specialisations represent Whaea M's exertions of intentional causality/agency to shift dialectical balances; her experiences of the absence of what she describes as a *type of Māori person* (including an alienation of herself) in the dominant regime prompts her to make this person present by reconfiguring epistemic relations and social relations to legitimise (make present) a kind of knower.

Whaea D (Year 7/8)

Whaea D is an experienced teacher who is thought of as the main pāngarau teacher in the Kura. She has a long personal connection with the Kura, involved in the foundation of the Kura itself. She has **always been keen on pāngarau** and took this as her main learning area when the Kura was established.

She is unique in the Kura, teaching both a year 7/8 class and a Year 11 class. The contrasts between the two regimes organised by the same teacher provide more insights into specialisation and struggle with pāngarau.

Whaea D attended English-medium schools and studied mathematics to Year 13. She also derives mathematics knowledge from **general experience in the world**. In terms of official professional learning, Whaea D has not followed a formal programme; although she has had some involvement with pāngarau advisers it was **mostly ad hoc** and a **matter of asking different people for help and explanation**.

Whaea D describes her secondary school experience as being disengaged with mathematics in year 12 and 13 but completing it as a necessary qualification for further education or a career. Her memory of primary mathematics learning is more positive and she believes that it still provides **a good foundation** for her current teaching practices.

Whaea D was a support teacher for students studying pāngarau at National Certificate of Educational Achievement levels 1 to 3 via a video conference system allowing expert teachers from other Kura to teach students. Pāngarau knowledge was conventional but teachers related to students differently; they encouraged them all, there was no negativity if mistakes were made, and they **nurtured their spirit**. Māori contexts were not used by these teachers. Most important was the use of Māori language and the ways teachers related to students.

Overall vision of pāngarau.

Whaea D considers the resources of Te Poutama Tau to be valuable because of the emphasis given to **mental work whilst doing calculations**. She has had difficulty grasping all of the components of Te Poutama Tau because of the ad hoc nature of her professional learning experience which was like **clutching at this and that in the darkness**. For her, Te Poutama Tau has caused a neglect of other important knowledge like time and the Māori calendar by an intense focus on learning the system of Te Poutama Tau and the long term nature of achieving the **level of achievement that is desired by Te Poutama Tau**. She expresses learning as **the understandings that are constructed by the person as they are learning**. For Whaea D, the benefit of pāngarau learning **must be** for children to be **equipped with knowledge so that they can follow a pathway in the wider world**.

Whaea D acknowledges that specialist areas always have a specialist language and so the pāngarau register is necessary so that **pāngarau ideas can be expressed**. She has no concerns with the process of creating new Māori words in order to support curriculum initiatives. She has already accepted that this process is necessary in order to **grow the Māori language**.

Whaea D does, however, identify some problems with the pāngarau register. It challenges local Iwi (tribal) dialects. Having different words for the same concept could result in confusion and a lack of standardisation for pāngarau. She acknowledges the problem of maintaining dialects and establishing a standardised pāngarau register. A second problem is the **loss of culture** that may happen when a Māori word is created for a **foreign concept**. However, these are not major problems because Whaea D has **accepted that it's about our children living in the real world as it is now**.

Whaea D regards officially produced resources, such as those of Te Poutama Tau, as being **a form of guidance**. Such resources may be used to support the creation of her own activities. Presently she uses problems and activities from officially produced resources but changes them to suit her students. Whaea D, considers the resources to be derived from English-medium initiatives with Māori educationalists brought in to translate them. Māori resources accordingly would need to support Māori concepts and values such as working together and upholding traditional tikanga (protocols). Māori concepts and values should be learned embedded in Māori activities such as **the carving of pou (posts) in the whare**

(meeting house), the navigation of waka (canoes), and rāranga (flax weaving). Pāngarau resources therefore are not Māori because **they have been designed to support the aims of mathematics education not the continued health and well-being of a Māori world.**

Whaea D has a very pragmatic approach to curriculum and resources in general. She is unconcerned about any hidden political agendas that may lie behind the production of pāngarau resources because she understands that they can all be tested for benefits in the Kura. Such testing has the ultimate purpose of supporting the construction of the Kura's own curriculum designed to meet the Kura's own needs.

Whaea D recognises two purposes for learning maths which both result in **making a living in the world**; pāngarau is used in the performance of everyday tasks, and learning disciplinary mathematics leads to a job/career that uses mathematics explicitly. She places some value on the learning of statistics to higher disciplinary levels because she can see a connection with research but has found no use for other aspects of disciplinary mathematics such as calculus and advanced algebra.

For Whaea D a good pāngarau student can complete **a project no matter what is involved in the project**. She also considers curriculum to be a definition of **isolated skills and knowledge** with learning integrating them in extended projects. The learning of isolated skills/knowledge is not a **higher thought process**; the integration of knowledge in a real project is what counts as higher thinking.

Whaea D prioritises conceptual thinking which develops the dispositions of a **mathematical problem solver**. The purpose of this learning is not for students to become mathematicians in an academic sense but rather to **have lots of strategies and be able to choose the ones appropriate for the things they are confronted by**.

Whaea D is well aware of the need to balance localised knowledge and official knowledge. She emphasises the importance of indigenous Māori knowledge which she associates with integrated learning activities. At the same time education should increase the **chances of finding work** which requires seeing integrated activities that **may involve very deep learning** in curriculum terms.

In discussing the nature of the official resources such as the knowledge and strategy frameworks of Te Poutama Tau, she considers that the structuring of knowledge in official

curricula is simply a guide that someone has laid out to make teachers planning easier. It is **an ordering of the work to form a pathway according to someone; it can be changed.**

Whaea D makes a distinction between a **programmed style of learning** organised as a trajectory of ordered skills and knowledge that build one on the other, and a **holistic style** where skills are learned in action, in context without formal definition of skills or knowledge. She also associates different cultural bases to these ways of learning and how they may relate to power in wider society. The programmed style is **deemed important by the Pākehā** (European New Zealanders/General Society) with pāngarau being the **chief of those**. She comments that even though the Kura may not prioritise pāngarau, students still absorb the notion of its importance and power in the world from their experiences outside the Kura.

Whaea D thinks deeply about pāngarau and how it relates to the Kura and being Māori. She considers that **saying that number knowledge is the basis of pāngarau is someone's cultural view**. Thinking about pre-colonisation Māori ancestors, Whaea D speculates that they **may have been more geometrical**. They may have had an acute awareness of length, shape, space, motion and direction.

She also expresses a critical view of the ability to see mathematics in everything. A traditional activity such as weaving can be thought of as mathematical **if you wish** but such activities do not need to be classified as mathematics or science; they are what they are in their own cultural terms.

Whaea D offers up this heartfelt belief about her approach to learning:

I try to emphasise with the children that they should follow their hearts and their interests, that's one of the precious gifts of the Māori world; listen to your heart and you will be happy.

Internal components of pāngarau

Whaea D has recently implemented a new structure. Previously, she taught skills and practiced them in a conventional manner but became dissatisfied with Te Poutama Tau data which indicated that **students had not retained learning**. She attributed lower than expected numeracy stages to the de-contextualised nature of learning. Her solution is to

foreground a contextualised problem as the focus of learning. One of her aims in doing this is to provide students with a wide experience of different kinds of problems and for them to **realise that they can use whatever knowledge and strategies they have** to solve them.

Whaea D also has a clear understanding of the difference between **school problems** and **real problems**. Real problems **don't follow the rules** and don't have **beautiful answers**. She would like to bring the students to a point where they can deal with real problems. She also recognises that she has made a significant change in the classroom regime, commenting that she has concerns about giving students these harder, real problems when they are still getting used to the new regime.

Some students have become less successful in the new regime because it is no longer about **doing heaps of work and getting right answers**. Whaea D elaborates this further by suggesting that with a contextualised problem solving approach, students are able to use their contextualised knowledge as well as their pāngarau knowledge to solve problems and this is why the students who were **experts** in the old regime are no longer **winning all the time**.

Groups are organised according to similar numeracy stage but there is flexibility for students – Whaea D maintains an adaptive approach to grouping as she does in her planning. Whaea D explains that she will sometimes combine groups or students based on **complementary skills**. For example, students who don't know their basic facts but are good at contextualised problems work with those who know facts but struggle with contextualised problems.

Whaea D has several ideas for how she wishes to develop her new regime. She would like to involve students in designing their own problems. She also wants to link learning to significant events in the Kura such as organising sports events or trips; her aim is to involve students actively in organising these events.

This year she has implemented a 3 phase structure which is led by a contextualised problem. The problem itself generates the work. There is no formal whole class teaching of knowledge and strategy; instead, if she notices a student who lacks knowledge or skills she will take them aside and teach them the required knowledge. She will also teach groups specific pāngarau knowledge that she has identified for them.

Developing multiplication is prioritised because this is the **foundation of higher stages 7 and 8** (of Te Poutama Tau/Numeracy Project). Neglecting multiplication has not

helped the development of pāngarau in the children. Whaea D has a definite focus on moving students to higher Te Poutama Tau stages but also wants to develop students as problem solvers and to be more like real mathematicians. She wants students to acknowledge that **every solution method has value** but eventually they should **focus down on to fast ways of solving problems.**

The three phase lesson structure consists of:

1. Problem introduction and discussion.
2. Students work in groups to solve the problem using their own methods.
3. Groups present their work to the whole class.

The problem is usually selected from an official resource associated with Te Poutama Tau. It is in a context that the students know and can relate to but will also introduce a new strategy to learning. The same problem is attempted by all students who, loosely grouped on the basis of similar numeracy stage, may solve the problem using any strategy they wish. During this phase Whaea D circulates the classroom, answering questions or sitting with certain groups to teach specific ideas. Finally, each group explains their solutions for the whole class by standing together at the front of the class and presenting their work on the whiteboard. Students freely ask each other questions.

In the second phase, Whaea D explains that she **reflects the questions back so that students focus on the way they are doing the problem.** Her intention is that students always **keep the authority for doing the work.** Whaea D does not judge solutions or make direct comments about the correctness of a student's work. She encourages students to think about the merits of each possible approach for themselves.

In the third phase, a range of different solutions are usually produced. Class discussion between students is the process through which the merits of different solutions are made apparent. The students present their work with a combination of spoken and written symbolic or diagrammatic representations of their strategies. The more conceptual and de-contextualised representations are given more attention; Whaea D invites discussion and indicates the importance of these forms of representation.

Although Whaea D does not indicate until the very end of the activity what the correct answer is, some students express much confidence that they are correct well before this point.

They know they are correct **because of the method they have used and the context of the problem.** When Whaea D does announce the correct answer, it is greeted with cheers, raised fists and shouts of “yes! yes!” from all. Students are very happy to have got the correct answer.

The collective, community oriented nature of learning is emphasised; students are part of a Māori social structure of Whānau (most immediate family), Hapū (extended whānau collective/sub-tribe) and Iwi (tribal collective) and so don’t need to **know everything themselves.** They can share their skills with others and call on the skills of others - **through sharing, everyone’s skills will get better.** Emphasising that pāngarau is **not just for the experts,** Whaea D wants students to work together, discuss things, and get ideas from each other. This is **a good strategy for solving a problem.**

Whaea D prioritises the students’ **own mana** (self-respect/standing/sense of own value) **in their work** and so does not pass judgement on the worth/correctness of a student’s work. For her, **no matter what the standard of pāngarau of each student there is always a benefit that comes from their work.**

In all phases, Whaea D allows students to express themselves freely and sometimes very noisily and actively. This expression was always good natured with a distinct sense of fun. For example, students when presenting their group work to the class would often engage in humorous play acting and banter with the audience. Only in cases where comments or actions bordered upon personal comment did Whaea D intervene.

There is a very adaptive quality underpinning most practices. In planning, Whaea D has a generalised long term plan but the immediate contexts and results of learning activities drive what actually happens – long term plans are guides which can be changed. She explains that she **follows the learning** that she **wants to complete** which is the ability of students to **look at a task and decide on what pāngarau is needed and then to carry it out.**

There is a very strong prioritisation of local, Iwi knowledge and contexts emphasising that a **bottom line** is that curriculum knowledge be integrated into Iwi knowledge and not vice versa. She describes the curriculum as *our sea* and the current area of learning as *food* so that all learning relates to *our sea* through learning about the gathering and preparation of food from the sea. **Science, maths, whatever, all drop out of our curriculum.** At the same time Whaea D keeps in mind official curriculum learning goals. She tries to incorporate

problems involving multiplication and division together because students are **not strong at these things**. The aim is to not alternate between multiplication and division but **instead look at a problem that combines the two**.

Whaea D regards official resources as **helpful guides** which she uses to help her to learn for herself **how to create problems like that** so that **pāngarau concepts are produced**. She explains that a major part of learning is not the pāngarau itself, which is the **easy part**, but the reading, the language, the understanding of the problem and **deciding what to do**. In deciding on a suitable problem, she takes into account many factors such as pāngarau aims, characteristics of the students, and current contexts. She recognises that there may be many tacit **criteria** that she can't explain because she has **held them for so long** that she has **stopped thinking of them as criteria**. An over-arching criterion though is **that she won't do any activity that might belittle a Māori way of thinking or anything that belittles any other Iwi**.

The students provided a distinctive view of pāngarau learning. For them pāngarau was definitely about the mind and **sharpening the brain** so that pāngarau activities, primarily **working out answers**, could be done quickly and efficiently. Quickness is associated with sharpness of mind. Pāngarau is conceived by these students as addition, subtraction, division, multiplication, counting and basic facts. Students attribute the importance of pāngarau to having essential skills in order to **succeed in a career or get a good career**. One student commented:

If you want to have a good job you need pāngarau so that you will achieve in the world. Pāngarau will make you sharp...like on a scale of one to ten you will get a ten. In all activities you have to use pāngarau. Like in rugby you have to count the points and in your career you will need lots of subjects like English, Māori...and brainy people will do science and mathematics.

Students tended to make somewhat circular arguments such as:

Student 1: You will need pāngarau in your career.

Researcher: To do what?

Student 1: to do the pāngarau that is needed.

Student 2: Pāngarau will make your brain sharp

Researcher: Sharp in what sort of ways?

Student 2: So that you can be good at games.

Researcher: What sort of games?

Student 2: Oh...pāngarau games...like cool maths games

Researcher: How will mathematics help you when you are older?

Student 3: It will be very useful.

Researcher: In what ways?

Student 3: I'll be able to help my own children with the maths they have to learn at kura.

Commenting about pāngarau work, one student offered the opinion that it wasn't real maths because there was **too much discussing and drawing pictures**. Another student associated learning lots of pāngarau strategies for calculating **correct answers** with ability to **decide which pathway in your life is the good one**.

Students have a clear appreciation of pāngarau as a challenge to the mind. Without a challenge there **could be no learning** and through challenge **correct pāngarau learning** could be achieved.

Realising Whaea D's Year 7/8 regime in the interpretive framework.

Table 4.5 indicates that Whaea D's Year 7/8 regime is another multi-specialised regime. Whaea M's emergent regime was also multi-specialised but was a regime in transition; the different specialisations were formed in opposition with Whaea M's intentional agency motivating/causing a move towards the emergent regime. Whaea D's Year 7/8 regime presents a different situation in which different specialisations appear to exist with a degree of cohesion and consistency.

Contextualised Description	Rationale	Specialisation
A contextualised problem is foregrounded as the focal point of learning.	A contextualised problem relates knowledge in context to pāngarau knowledge.	Epistemic Relation Type: Discursive
Students attempt to solve the problem using any strategy they wish.	Students must know how to interact in the grouped setting of learning. They are all automatically a legitimate knower because of their membership of the whānau of the Kura. Solving the problems requires correct interaction with the resources and materials of the classroom which represent mathematical concepts and with correct language use, and protocols.	Social Relation Type: Subjective/Interactive Social gaze: Born/Cultivated
	The contextualised problem provides a localised grounding – the problem must be solved but with any strategy.	Epistemic insight: situational
Each group explains their solutions for the whole class by presenting their work on the whiteboard.	Private work is publicly presented – this involves correct use of language and presentation conventions (e.g. use of humour)	Social Relation Type: Interactive Social gaze: Born/Cultivated
Groups are organised loosely on numeracy stage with some differentiation of work for each group.	Students belong to groups: <i>learners at stage X</i> . Each group will interact differently with language, resources and technical objects but also comply with general class interaction rules.	Social Relation Type: Subjective/Interactive Social gaze: Born/Cultivated Social lens: ontic/discursive/attributional
Groups may be organised on complementary knowledge competencies/skills.	Students in these groups interact in certain (complementary) ways with technical objects (pāngarau knowledge objects).	Social gaze: cultivated Social Lens: Ontic
	Curriculum knowledge and student knowledge are related through principles deriving from the organisational principles of curriculum components/levels of knowledge. This applies regardless of the problems tackled.	Epistemic Type: Discursive Epistemic Insight: Doctrinal Epistemic lens: Principled
Students get wide experience of problems and realise that they are able to use whatever knowledge and strategies they have to solve them.	Any kind of problem/context may be studied using pāngarau strategy and knowledge use. The principle that connects context with knowledge/strategy is the wide applicability of generalised pāngarau concepts.	Epistemic Insight: Doctrinal Epistemic lens: Principled
Emphasising that pāngarau is not just for the experts, Whaea D wants students to work together, discuss things, get ideas from each other. This is a good strategy for solving a problem.	Students relate their knowledge to that of other students. Ways of solving the problem are focussed on including collaboration as a problem solving strategy. Collaboration constitutes the principle through which knowledges are related.	Epistemic Insight: Doctrinal Epistemic lens: Principled
In time real problems with harder features and ones that don't have <i>beautiful answers</i> will be included	Real features of problems will be included requiring contextualised, situational knowledge which may be of any type. The empirical features of the situation are emphasised.	Epistemic Insight: Situational Epistemic lens: Empirical

Contextualised Description	Rationale	Specialisation
Students are able to use their contextualised knowledge as well as their pāngarau knowledge	Contextualised knowledge refers to a direct attention to features of the object of study. Pāngarau knowledge refers to an expectation that certain knowledge and strategies will be used.	Epistemic Relation Type: Ontic/discursive Epistemic Insight: purist
learning linked to significant events in the Kura such as organising sports events or trips	Learning requires direct engagement with an actual event and the management of it in real time with real outcomes. There are however still requirements to use pāngarau.	Epistemic Relation Type: Ontic/discursive Epistemic Insight: Situational/Purist Epistemic lens: Empirical/Technical
Multiplication is the foundation for higher stages 7 and 8	Learning is related to a hierarchical knowledge structure. Principles embedded in relations between knowledge at different stages provide principles through which different contextualised problems, and associated knowledge are related.	Epistemic Insight: Doctrinal Epistemic lens: Principled
Students believe that they are problem solvers and can be like mathematicians	Students knowledge is related to disciplinary knowledge through a principle of a common insight ('being a problem solver')	Epistemic Insight: Doctrinal
Whaea D does not pass judgement on which method is best but encourages students to think about the merits of each. Faster methods are prioritised.	Different methods and their conceptual basis are compared and contrasted. The ways in which problems are solved is prioritised, not the solution.	Epistemic Insight: Doctrinal
"no matter what the standard of pāngarau of each student there is always a benefit that comes from their work"	Each student is valued for themselves as a member of the Kura whānau. What they do in solving a problem is not important.	Social Relation Type: Subjective Social gaze: Social
"it's really about acknowledging the students own mana in their work and they believe in themselves as problem solvers"	Each student is valued for themselves as a member of the Kura whānau. What they do in solving a problem is not important except in so far as they can identify with the technical requirements of pāngarau problem solving.	Social Relation Type: Subjective/interactive Social gaze: Social Social lens: Ontic
"if they are part of a community, a whānau, a hapū, they have some skills, someone else has other skills and through sharing everyone's skills will get better"	Students are considered as part of a wider social constellation which provides necessary support. Membership of this collective is sufficient to allow use of its resources for any legitimate purpose.	Social gaze: Social Social lens: Biological
"I follow the learning that I want to complete - that's the ability of students to look at a task and decide on what pāngarau is needed and then to carry it out"	Students are required to engage directly with any problem but must use pāngarau to solve the problem. Solving requires both empirical (contextualised) knowledge and technical knowledge of pāngarau concepts.	Epistemic Insight: Doctrinal Epistemic lens: Principled
A very strong prioritisation of local, Iwi knowledge and contexts emphasising that a bottom line is that curriculum knowledge be integrated into Iwi knowledge and not vice versa	Principles are used to establish that Iwi knowledge is foundational with curriculum knowledge sub-ordinate to it. Iwi knowledge/mātauranga is a way of understanding any object of study.	Epistemic Insight: Doctrinal Epistemic lens: Principled
	Local, physical and natural environments are attended to. How Iwi interact with actual events is prioritised. Iwi knowledge involves the use of mātauranga (Iwi concepts and constructs).	Epistemic Relation Type: Ontic Epistemic insight: Situational Epistemic lens: Empirical/Technical

Contextualised Description	Rationale	Specialisation
“science and maths and whatever, all drop out of the curriculum that is <i>our sea</i> so that I am teaching the children in terms of how everything fits and links in with our sea and the children will also know about how the Iwi relates to our sea”	Principles are used to establish that Iwi knowledge is foundational with curriculum knowledge <i>dropping out</i> of that. Iwi knowledge/mātauranga is a way of understanding any object of study.	Epistemic Insight: Doctrinal Epistemic lens: Principled
	Local, physical and natural environments are attended to. How Iwi interact with the natural environment is prioritised. Iwi knowledge involves the use of mātauranga (Iwi concepts and constructs).	Epistemic Insight: Ontic Epistemic insight: Situational Epistemic lens: Empirical/Technical
“We don’t look at multiplication for a while and then look at division, but instead look at a problem that combines the two”	The focus is on the technical conceptual objects of multiplication/division and that they will be studied together through a contextualised problem that requires both – both object of study and way of studying it are defined.	Epistemic Insight: Purist Epistemic lens: Technical
Official resources are helpful guides which Whaea D uses to help her to learn for herself how to create problems like that so that pāngarau concepts are produced.	Whaea D uses principles to investigate and relate official knowledge to her own knowledge and context. The focus is on how to form problems and generate concepts not the contents of the problems.	Epistemic Insight: Doctrinal Epistemic lens: Principled
“pāngarau is the easy part but the reading, language, understanding of the problem and deciding what to do is the hard part”	Knowledge of any Problem must be related to a plan of action which constitutes a different form of knowledge and a way of studying the problem. Interpreting through language relates contextualised problem knowledge to conceptual plan.	Epistemic Insight: Doctrinal Epistemic lens: Principled
“generally I won’t do any activity that might belittle a Māori way of thinking or anything that belittles any other Iwi..those sorts of things”	Whaea D makes decisions about activity based on socio-cultural considerations of appropriate ways of interacting.	Social Relation Type: Subjective/Interactive Social gaze: Social Social lens: Biological
	Iwi knowledge is prioritised with other knowledge related to it. No matter what the context, Iwi knowledge is used to interpret it. Critical principles relate Iwi knowledge to other knowledge.	Epistemic Insight: Doctrinal Epistemic lens: Principled
Generalised, de-contextualised representations of solution strategies are important.	Any contextualised problem must be seen as a pāngarau structure. The principles of mathematisation relate context problem to pāngarau structure.	Epistemic Insight: Doctrinal Epistemic lens: Principled
Students express themselves freely and may play act for the class	Any student can be humorous but must understand how and when to be humorous in the class.	Social gaze: Cultivated Social lens: Discursive
Some students know they are correct because of the method they have used and the context of the problem.	Structural representation of a problem informs students of correctness in the context of the problem - both method and context are important. Technical mathematical objects are the focus of attention.	Epistemic Relations Type: Ontic/Discursive Epistemic Insight: Purist Epistemic lens: Technical/Principled

Contextualised Description	Rationale	Specialisation
When Whaea D announces the correct answer, it is greeted with cheers, raised fists and calls of “yes! yes!”. Students are very happy to have got the correct answer.	Students unanimously are happy about getting the correct answer. This is not a feature of the classroom regime but something the students themselves bring to the class. The prioritising of the answer over the way it was achieved is a knower insight.	Epistemic Relations Type: Discursive Epistemic Insight: Knower
	Students perform the celebration ritual in a legitimate way, they know that this ritual may be performed at this time by any/all students.	Social gaze: Cultivated Social lens: Discursive
“Pāngarau will make you sharp ..like on a scale of 1 to 10 you get the 10”	This student view suggests that by being technically good at recognised pāngarau practices, the knower achieves legitimacy as a member of a group, <i>sharp people</i> , who are highly valued in society.	Social gaze: Cultivated Social lens: Ontic
“it wasn’t real maths because there was too much discussing and drawing pictures”	This student view associates pāngarau with a particular discursive form and compares this with the conceptual form of the class regime. For it to be legitimate pāngarau, it must follow the correct discursive form.	Epistemic Insight: Doctrinal Epistemic lens: Principled
“In your life you will have to decide which pathway is the good one and that’s like when you are doing pāngarau and you have to work out your own strategies for a problem so that you get the correct answer.”	This student view considers pāngarau knowledge, as presented in Whaea D’s class to be related to general life knowledge through an isomorphic principle – the general features of pāngarau problem solving are isomorphic with those of <i>life</i> .	Epistemic Insight: Doctrinal Epistemic lens: Principled
Without a challenge there could be no learning and through challenge correct pāngarau learning could be achieved.	This student view asserts challenge as an integral part of the way knowing is enhanced for all students. Challenge involves interacting with technical objects to produce a legitimate performance (a solution).	Social gaze: Cultivated Social lens: Ontic
	Knowledge must be more sophisticated than your current level. By trying to learn this harder knowledge, you develop your own knowledge and attain better (more correct) understanding. Challenge is a principle by which any current knowledge is transformed to more sophisticated forms	Epistemic Insight: Doctrinal Epistemic lens: Principled

(Note: Shaded areas of the table indicate student responses)

Table 4.5. Whaea D’s year 7/8 regime related to specialisation concepts

Specialisation tree and plane.

For social relations, there is a balance between two forms of specialisation.

Subjective social relations with a social gaze and social or biological lens reflect the concerns for identity of students as Māori. Weaker interactive social relations with a cultivated gaze and a discursive lens reflect the openness of the three phase structure where students are given much time and freedom to engage in groups with the problem. This requires detailed knowledge of how to interact with each other within groups and as a group with other groups in the public arena of the whole classroom.

Māori students are legitimatised as knowers because of their membership of the Kura whānau with social relations based on Iwi protocols. In pāngarau, these Māori knowers engage with pāngarau technical artefacts (concepts, representations and language) coming to know pāngarau through personal and group interactive processes and rituals (such as the public presentation of private work) which are underpinned by Māori social relations. Identity and value as individuals and as a collective is maintained in the subjective social relations which still allow the interactive social relations required to examine pāngarau. Subjective relations provide the ground on which interactive social relations are selectively used by students.

For epistemic relations, there is a tendency towards a discursive specialisation with a doctrinal insight and a principled lens. This reflects the balance between an emphasis on contextualised problems and the mathematisation of those problems. Students are required to consider contextualised problems translated into pāngarau structures. Prioritisation is given to relations between context and generalised structure. This specialisation is not completely dominant with a weaker sub-tendency towards ontic epistemic relations reflecting the desire to engage as problem solvers with direct representations of abstract mathematical ideas, and with real problems with *no beautiful answers*.

Representing a multi-specialised regime on the specialisation plane is problematic when different specialisations have different strengths. The location of Whaea D's Year 7/8 regime with moderate strength of social relation is a compromise; it considers strong subjective relations underpinning weaker interactive relations and represents this as a moderate strength social relation overall. Epistemically, relations are quite firmly defined by Te Poutama Tau and a strong conceptual orientation. It may be speculated that this epistemic

relation may lose its grip if Whaea D’s aspirations to include real problems, and fully contextualised projects are actualised. Epistemic relations are therefore shown as moderate/strong. The specialisation of social relations and epistemic relations are represented in figure 4.4.

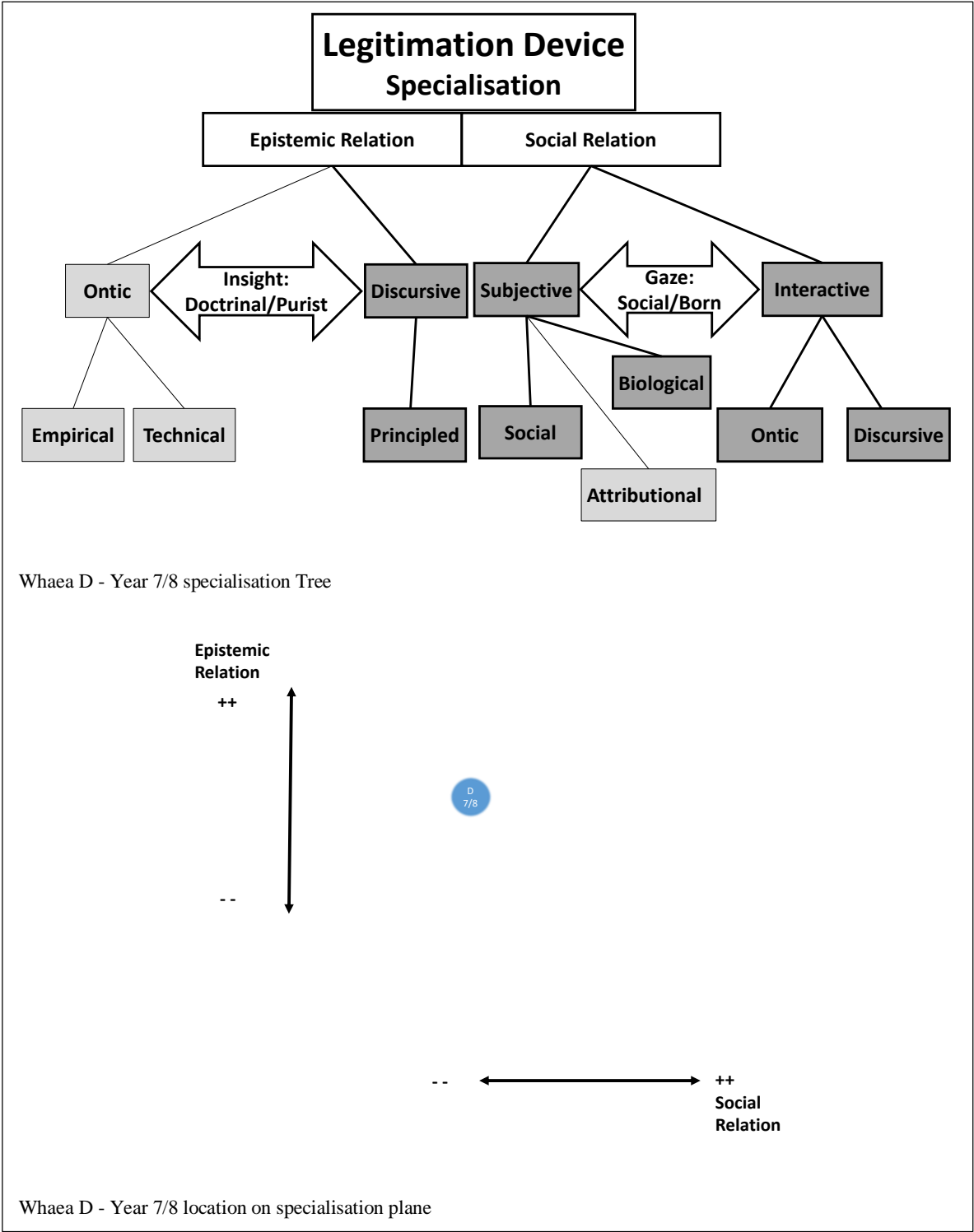


Figure 4.4. Whaea D’s Year 7/8 regime - specialisations of the epistemic relation and social relation

Discussion.

The year 7/8 regime offers insights into the processes of dialectical learning in more direct ways than other regimes. Relatively weak epistemic relations imply that legitimate knowledge has a degree of freedom about what that knowledge is and how students come to know it. The video data offers many instances where students can be observed going through a process of trying to establish legitimate meanings without explicit direction from Whaea D. This requires them to engage in multiple attempts to arrive at the legitimate meaning often resulting in an *aha!-moment* in which students have made a leap to the legitimate meaning.

In one pāngarau activity captured in video data, Whaea D uses a problem in which 16 teams compete in a touch rugby knockout tournament. The task is to calculate how many games would be played altogether in the tournament. As students work on the problem in groups, Whaea D circulates and interacts with students as necessary. In these subtle interactions a sense of the dialectical way in which things are evaluated and learned can be gained. The following short set of interactions illustrates this point.

Video Time	Line No.	Actor	Actions
3 40	1	S	(others in the group listening) How do you know who wins and who loses in each game?
	2	Wh	Oh ...no matter who the teams are...you might call one Team 1 and another Team 2 ...they play each other and one will win and one will lose..
	3	S	Oh...
	4	Wh	You choose..
	5	S	(Nods) Ah..
	6	Wh	Yes it's not important who wins and who loses
	7	S	(Returns to group work)

At line 1, the moment in which S asked the question, the problem simultaneously had several possible meanings including absent meanings (from both S's point of view and Whaea D's). S already has in mind several competing possible meanings for the problem based on previous experiences. The question is therefore a request for guidance about which

meaning is legitimate (including as yet new and unknown ones that need to be grasped). This legitimate meaning is already known by Whaea D but she does not directly instruct S. Rather, Whaea D's three responses at lines 2, 4 and 6 indicate the *kind* of meaning that is legitimate. Her responses do not directly suggest a strategy nor steps to follow. They indicate the epistemic insight as the recognition of generalised structures; who the teams actually are is to be absented. The small utterances of S and the consequent industry of the group on the problem indicates that this view is at least partially grasped by them. Viewed dialectically, what has happened is a collapse of the range of meanings that S had in mind to one particular meaning for the problem based on the evaluative responses of the teacher and the students own group dialogic context; the legitimate perspective on the team identity/tournament structure relation has been established. Other possible meanings, such as a completely contextualised one requiring knowledge of individual teams and an evaluation of possible winners, are now absented.

Holistic forms of causality predominate because students must become sensitive to the complete dialogic context of the learning – this context presents a complex of elements arranged in holistic *constellation*. Learning entails grasping this constellation and through knowing its structure being sure of future action based on it. Thus, certain students have greater certainty about the correctness of their work because they have grasped more of the holistic constellation of the dialogic context; their work structurally matches the problem context.

The interactive social practices of the regime, associated with engaging with pāngarau artefacts, are relatively weak. A small number of students legitimately opt out completely from engaging with some of the pāngarau learning – the underlying subjective social relations maintain these students as legitimate. They cannot opt out of Māori social practices such as speaking Māori which indicates the strong underlying social/biological specialisation of the social relation. This, along with a discursive/principled (conceptual) epistemic relation, renders rhythmic forms of causality less influential in the learning of pāngarau. Firstly, procedural learning is absented by the epistemic specialisation, thereby reducing rhythmic practicing of routines/procedures. Secondly, weaker social relations do not define and control social interactions strongly and so rhythmic sequences of actions which tend to reproduce similar social conditions are weaker.

There are also a number of transfactual causal relations operative in the background of the regime and supporting the forms of specialisation evidenced in data. Two of the most powerful relations are:

- both Māori knowledge and pāngarau knowledge are needed for students to be successful in the world;
- Māori knowledge must sub-ordinate pāngarau knowledge for the Kura to be true to a Māori emancipation project, or more simply, to be Māori.

Whaea D has a strong critical sense and awareness of the complex nature of maintaining being Māori in a colonised society. Her own intentionality/agency has created a deliberate and considered attempt to influence students to be highly competent in pāngarau but also engage this competency from a unique Māori perspective. Her cognisance of transfactual relations and her critical consciousness has allowed her to manipulate structural conditions and induce holistic forms of causality in the regime to increase the likelihood of this outcome.

An important component in this regime is Whaea D's ability to manage perspectival switches between doctrinal insights with respect to mātauranga and pāngarau. At a foundational level, Whaea D adopts a doctrinal insight with respect to mātauranga; mātauranga provides a concepts and methods with which to analyse any object of study. Interspersed with this is a doctrinal insight with respect to pāngarau; pāngarau also provides concepts and methods with which to analyse any object of study. At first this may seem to be contradictory but perspective switching of this kind is completely compatible with a dialectical understanding. Any object of study, since it is intransitive, may have multiple meanings (perspectives); an ability to switch between meanings/perspectives, whilst maintaining the centrality of a Māori perspective, is an important characteristic of intentional causality.

Conclusion.

This case example has provided some important insights into the relations between specialisation of epistemic and social relations with forms of causality. In particular, not only types of relation, but also their relative strengths play a part in how rhythmic and holistic forms of causality are actualised. In addition, the criticality of the teacher and the students is implicated in how holistic forms of causality may be used for emancipatory purposes.

A weakness of this thesis is the lack of data from students about their own subjective experiences of pāngarau. Students did not always respond in depth to focus groups or individual interviews. In this case example there are some indications that students do internalise the specialisations of the regime in which they learn. Although students gave quite different personal expressions about their pāngarau learning, they can all be related to the same specialisation - interactive, ontic social relations and discursive principled epistemic relations. These align with the social and epistemic relations established by Whaea D. A more thorough investigation of this would require more extensive data from students and a full analysis of specialisation. This is another area of future research.

Whaea D (Year 11)

Internal components of pāngarau.

The Year 11 class are to be assessed against National Certificate of Educational Achievement standards. In the National Certificate of Educational Achievement system, the term *standard* means a prescription of the knowledge and competencies required to be credited a qualification in a defined topic of curriculum knowledge, say, number, measurement or trigonometry. Many of these standards are internally assessed; the teacher designs an assessment task which aligns with the standard and conducts the assessment themselves in school-time. The teacher also marks the assessments and awards grades. Whaea D's Year 11 class is following one such internally assessed standard entitled: *Apply measurement in solving problems*.

In the year 11 class, there is the following four-phase structure:

1. Problem explanation – the students read the written explanation of the problem. Whaea D clarifies terms where necessary.
2. Required strategy explanation – Whaea D discusses with the students the steps needed to solve the problems and sketches out what needs to be done at each step. She checks that students know, or can look up, any required formulas needed to perform the calculations at each step of the process.
3. Students solve the problem individually by following the steps of the strategy.
4. Individual students are assigned to publicly explain each step in the solution. Each step is explained by a different student.

Calculators are used to perform calculations which involves using formulas into which appropriate values given in the problem are substituted. The formula governs how the calculations has to be done; the calculator is used to do the calculations.

Throughout the performance of the four phases, Whaea D maintains a tight control on both what is being done and the interactions of students. There are frequent interjections by her giving advice and instructions about what to do and how to set out the written solution.

She also notices off-task behaviour promptly and requests those students engaging in it to attend to what is going on.

Phase 4 of the process has some features from her year 7/8 regime. Students are asked for their views on certain aspects of the solution. There is a *wānanga feel* (a free discussion of the topic where all participants can contribute as they wish) but students are limited to following the official solution steps and to achieving correct answers. Whaea D intervenes in this phase to correct work, to ask students to re-write their solutions when written incorrectly on the board and to correct types of interaction between students.

In the written solutions to problems much emphasis is given to the correct setting out of symbols in their relative positions with respect to the formulas used, and ensuring that labelling conventions are followed.

In an example captured on video, there are four students in a group with Whaea D working on an area problem. The problem is contextualised as a plan of a house section in which two rectangles represent a house and a garage, a trapezium represents the whole section and the aim is to calculate the area of unused section (shown shaded in figure 4.5).

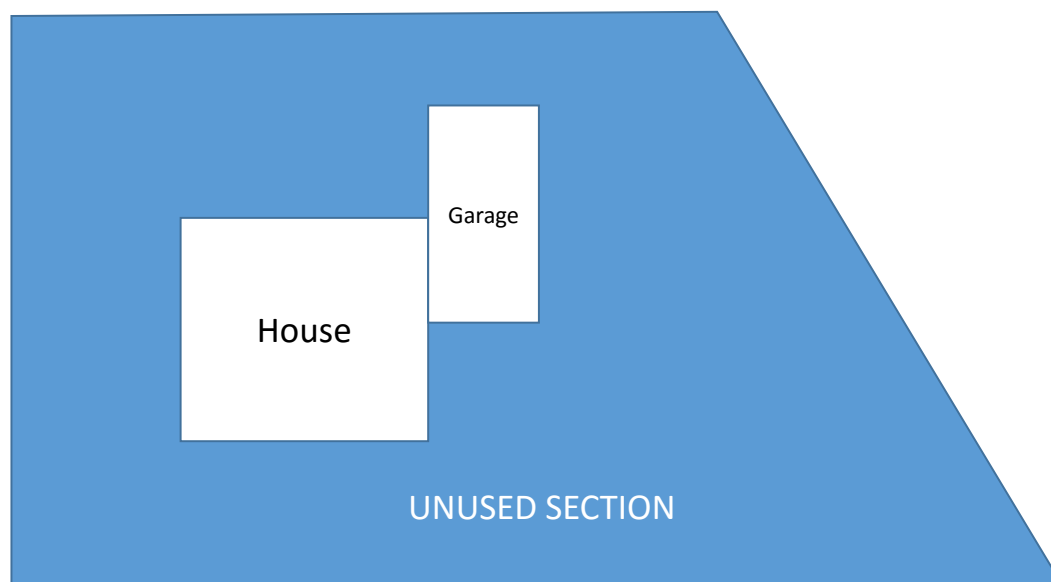


Figure 4.5. Area problem - find the area of the unused section.

The steps in the solution as laid out on the white board after a discussion lead by Whaea D are:

1. Calculate the area of the two rectangles.
2. Calculate the area of the trapezium.
3. Add the areas of the two rectangles together.
4. Subtract the result from the area of the trapezium.

Students work independently to follow these steps and arrive at an answer. In phase 4, Whaea D emphasises the importance of **following the formulas** and **sticking to the conventions** of the written form of the solution. Whaea D concentrates on the layout of the written solution and the location of symbols and numbers in their respective positions within the formula. Students are instructed to **bring down** symbols from one line to the line below it, to write them in the correct location relative to each other. They are also instructed to do just one calculation on each line so that **things aren't all mixed up**. Location in a formula is used to indicate which numbers and mathematical operations are to be used.

Whaea D also strongly regulates interactions. She constantly monitors for **off task behaviour** and uses a variety of techniques to maintain the interactional style she prefers. For example, Whaea D stands close to two students who are bouncing up and down on their chairs; they stop bouncing. She also uses certain looks, head nods and smiles to achieve the same effect. At other times there are direct commands for attention and correct interactions. Whaea D requires a style of interaction that matches the requirement to attend to the details of a conventional rules of laying out written solutions for pāngarau problems. Students must be prepared to subjugate their own personal styles and follow these conventions.

Whaea D tends to state rules for students without explanation; the rule is given monoglossically from a position of authority. Discussing the order in which arithmetic operations should be calculated in a formula, she describes multiplication and division as **having more mana** than addition and subtraction. She uses the Māori term *mana* (genealogical or social prestige) to correspond with the convention that multiplications or divisions should be calculated first with the results used in later additions or subtractions (for example, $4 \times 5 + 6$ should be calculated as $20 + 6$ and not as 4×11).

Knowledge is organised in a conventional fashion. The area problem discussed above is part of a unit about area and volume. Whaea D introduces the concepts of area or volume first then uses a contextualised problem to illustrate the application of the concept.

Whaea D expresses a lack of confidence in the students' ability to problem solve by themselves which prompts her to put the steps in place for them. She feels she is **being guided by the standard** and so she wants students to produce **the steps that the marker of the assessment wants to see**. She explains that the main aim of the work is not about the formulas but rather about **how clear the setting out of the work is and how that helps the students understand their own work**.

In another activity, students match pictures of 3D objects with appropriate volume formulas. The activity has two sets of cards, one set shows pictures of boxes, cones, balls and other similar 3D objects on; the other set shows the formulas for the volume of these objects. The students must match the picture with the correct formula.

Whaea D begins the activity with a general discussion about the concepts of perimeter, area and volume which focusses on connecting each concept with its method of calculation and measurement units. Perimeter is described as **adding the sides up** and is given in metres. Area (of a rectangle) is given as **multiplying the sides with a unit of square metres**. Volume (of a cuboid) is given as **multiplying the three sides with units of metre cubed**. The aim of this activity is **about how the diagrams and the formulas relate and how there is a clue in the formula**. Students must recognise the correct formula by recognising a characteristic element in the formula.

The learning is strongly geared towards the formal assessment of a National Certificate of Educational Achievement standard. Whaea D suggests that the standard has motivated her to encourage students to think more deeply because that's what is required at the merit and excellence levels of the standard. Without the standards she confirms that her lessons would be different. The year 11 work derives ideas and knowledge from the standard. She also recognises that ideas and knowledge from the standard have provided a motivation for both her and her students to get to **another level** of pāngarau.

Knowledge of National Certificate of Educational Achievement standards has influenced the year 7/8 work by making Whaea D **more aware of what real mathematicians might do and how they might think**. This means not finding answers but **taking into account many different characteristics, variables and features of a problem**.

The year 11 students comment in very limited terms about their pāngarau work. They offer very little in the way of evaluative comment. One student, however, said:

Well I don't really pay attention to a lot of it...I just focus on my own work and only listen to what others are doing to check if my own work is correct...beyond that I don't really worry too much.

This comment received strong agreement from the other students. The impression these students give of their pāngarau experience is one of compliance in following procedures to produce correct answers. Observations of students in the video data corroborates this view; a kind of detachment occurs from the learning. Students do the work as required but otherwise are content to be sitting quietly, **doing their own thing** or occasionally being off task (which is promptly controlled by Whaea D).

Realising Whaea D's Year 11 regime in the interpretive framework.

Table 4.6 shows that Whaea D's Year 11 regime is quite different to her Year 7/8 regime. The Year 11 regime is not multi-specialised; it has definite strong specialisations of epistemic relations and social relations which have a high degree of coherence. In this way, Whaea D's Year 11 class bears a striking resemblance in terms of specialisations to Whaea L's regime but operating at higher levels of curriculum knowledge.

Contextualised Description	Rationale	Specialisation
Calculators are used to perform calculations which involves using formulas into which appropriate values given in the problem are substituted.	Official knowledge is being studied in a procedural way through the use of formulas and calculations in order to develop students' knowledge of it.	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
Whaea D discusses with the students the steps needed to solve the problems and sketches out the steps of the strategy.	This process defines the problem and how it is to be solved. This defines the procedure through which official knowledge and students' knowledge are related.	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
In the written solutions to problems much emphasis is given to the correct setting out of symbols in their relative positions with respect to the formulas used.	as above.	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
Students are instructed to bring down symbols from one line to the line below it, to write them in the correct location relative to each other. They are also instructed to do just one calculation on each line so that things aren't all mixed up	as above	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
	as above	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
Whaea D uses proximity to signal that bouncing up and down on chairs is not acceptable.	Whaea D strongly controls students to attend to the symbols on the board, to be settled, and use correct conventions in written and spoken language.	Social Gaze: Cultivated Social Lens: Discursive
Whaea D requires a style of interaction that matches the attention to the details of a conventional following of the formulas and the rules of laying out written solutions for pāngarau problems.	as above.	Social Gaze: Cultivated Social Lens: Discursive
Students must be prepared to subjugate their own personal styles and follow these conventions.	as above	Social Gaze: Cultivated Social Lens: Discursive
Whaea D gives a rule to students without explanation; the rule is given monoglossically from a position of authority	There is a strong procedural nature of legitimate performance. The convention must be followed without question, taken on authority.	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
The area problem discussed above is part of a unit about area and volume. Whaea D introduces the work to students in terms of the concept of area or volume first and then uses a contextualised problem to illustrate the application of the concept.	The contextualised problem is related to area and volume, a category in the official knowledge organisation of the curriculum. Area and volume concepts must be studied first as abstract concepts then applied to contexts.	Epistemic Insight: Doctrinal Epistemic Lens: Principled/Procedural
"it's because I think I am being guided by the standard and so I want to make sure that the students follow the steps that the marker of the assessment wants to see."	Both what is studied and how it is studied must conform to the external requirements of the Assessment system. Relations are constructed between student knowledge and official knowledge system based on procedural requirements.	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
"it's how clear the setting out of the work is...and how that helps the students understand their own work."	Prioritisation is given to the discursive form of solutions as a way of students relating their own understandings to the required understandings.	Epistemic Insight: Doctrinal Epistemic Lens: Procedural

Contextualised Description	Rationale	Specialisation
Whaea D begins the activity with a general discussion about the concepts of perimeter, area and volume which focusses on connecting each concept with its method of calculation and the units the value is expressed in.	Formulas that are given in assessments are studied in designed contexts. Formulas are the framing for the layout of solutions so that location within the formula carries information about what should be written there.	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
“it’s about how the diagrams and the formulas relate and how there is a clue in the formulas ...and to see the relationship between area and volume ..it’s not about learning the formulas, it’s about using their prior knowledge to select the correct one.”	Formulas that are given in assessments are studied in contrived contexts. Structural information in the formula alludes to area and volume concepts. This forms a principle that relates formulas to diagram.	Epistemic Insight: Doctrinal Epistemic Lens: Principled/Procedural
The ideas and knowledge from the standards have provided a motivation for both Whaea D and her students to get to another level with the pāngarau.	The discursive notion of level is attended to strongly in order to relate current knowledge to a desired future knowledge state. The principles inherent in the levelling of curriculum knowledge form the principles of relating these two knowledges.	Epistemic Insight: Doctrinal Epistemic Lens: Principled
“because of my knowledge of the standards though it has affected my teaching of the year 7/8 class. I am more aware of what real mathematicians might do .how they might think...it’s not about answers but about the variables involved.”	The knowledge associated with standards are equated with higher mathematical understandings and being more like a mathematician. This has conditions on how something can be studied (by isolating variables, ideas, features).	Epistemic Insight: Doctrinal Epistemic Lens: Principled
“Well I don’t really pay attention to a lot of it...I just focus on my own work and only listen to what others are doing to check if my own work is correct..beyond that I don’t really worry too much”	Students focus on whether they have met the conditions for the layout and solution of problems. If these are met, known through a procedural comparison, that counts as success. This constitutes a procedural relation between students own knowledge and official knowledge.	Epistemic Insight: Doctrinal Epistemic Lens: Procedural
	Students have learned, and are strongly controlled, to follow conventions and know that personal expressions and interactions are limited to discussing work. Social interaction is directed mostly through Whaea D.	Social Gaze: Cultivated Social Lens: Discursive

Table 4.6. Whaea D’s year 11 regime related to specialisation concepts

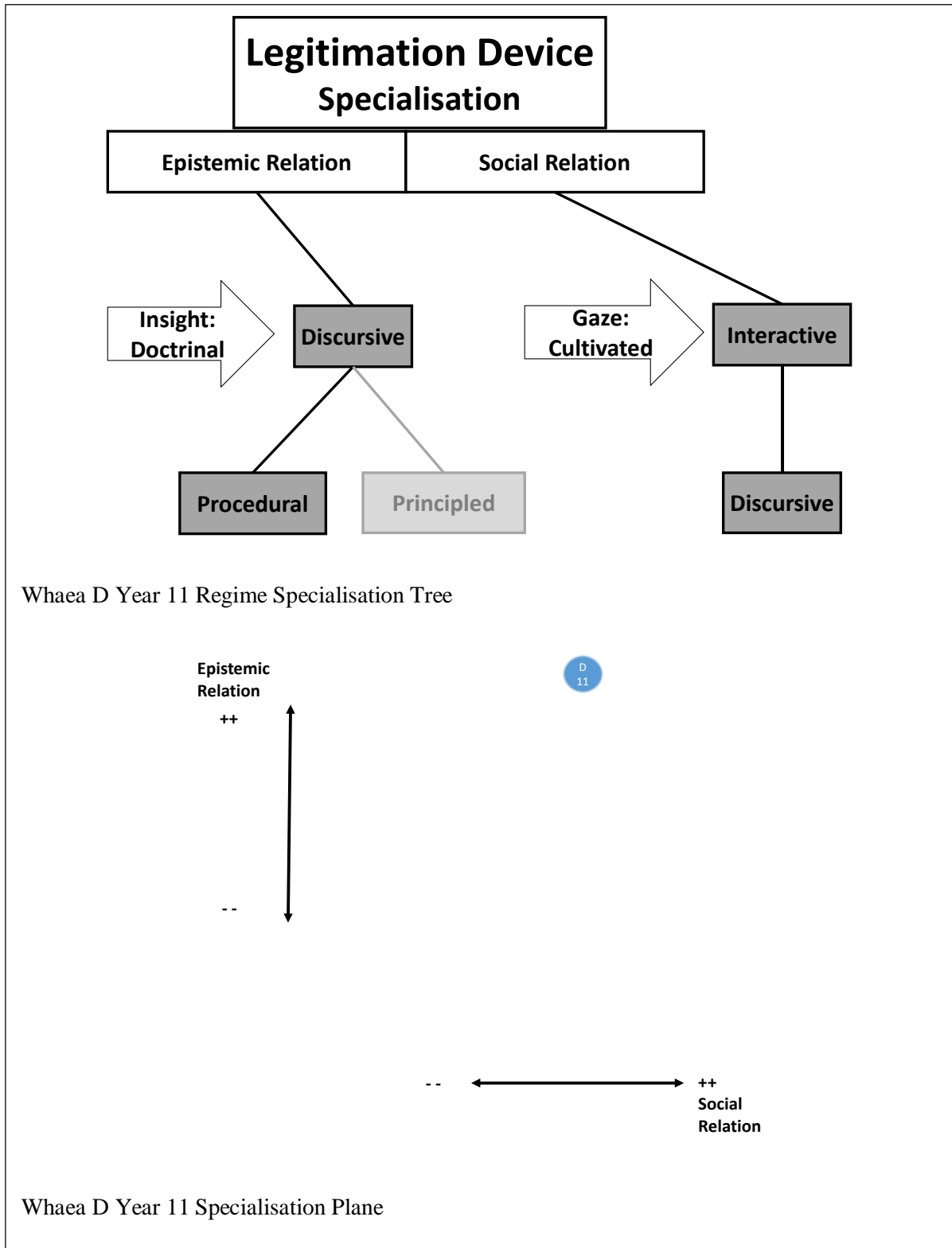


Figure 4.6. Whaea D's Year 11 regime- specialisations of the epistemic relation and social relation.

Specialisation tree and plane.

As represented in figure 4.6, the regime is characterised by very strong epistemic relations and social relations. It is remarkable for its purity and strength of both discursive, procedural epistemic relations and interactive, discursive social relations. The doctrinal epistemic insight legitimises the use of procedures and formulas as the way to study any problem. The cultivated social gaze legitimises very self-contained ways of interacting which are highly coherent with the doctrinal insight. As in Whaea L's regime the strong coherence of epistemic and social relations enhances the specialisation strength of the regime.

Discussion.

This is a regime dominated by the Whaea D's interpretation of National Certificate of Educational Achievement requirements. She has no agency in what these requirements are like. Success in National Certificate of Educational Achievement standards is strongly prioritised; Whaea D designs the regime in order to best achieve this aim – in critical realist terms, the assessment system holistically creates tendencies for strong discursive epistemic and interactive social specialisations which constitute a knowledge-code.

Epistemic and social relations tend to damp down the personal agencies of students. Their input is in following discursively formed procedures and symbolic layouts. Therefore, rhythmic forms of causality dominate – by repetition of procedures and symbolic layouts, students will eventually be able to reproduce them for themselves. Dialectical learning processes become reduced to iterative checking of personal performances of procedures against official versions.

Transfactual causal relations held in Whaea D's personal ideology/ethos endorse this approach. Such a transfactual relation is expressed clearly by Whaea D; she associates National Certificate of Educational Achievement standards with being higher level mathematics focussing on *features, variables and formulas*. Therefore, students need to become adept at *features, variables and formulas*.

The following of the assessment standard has a definite effect in changing the specialisation of the regime compared to the year 7/8 regime. The standard imposes non-

negotiable requirements which are influential in Whaea D's thinking. This is enough to cause Whaea D to alter the epistemic and social relations of her regime to attempt to guarantee (cause) that all students have the necessary skills and knowledge. In her year 7/8 class, lacking proximity to high stakes qualification, there are more relaxed relations with a wider variety of attainments being legitimised. This relaxation in the year 7/8 regime provides scope for alternate or simultaneous recognition of individual differences and personal expressions.

The proximity of the year 11 regime to an official, knowledge-based assessment, certainly prompts Whaea D to strengthen the relations but this may also be related to how close Whaea D is to what she feels are the limits of her own current experience in mathematics. She comments about how her experience with the year 11 class has given her a better understanding of mathematics and how this has influenced her year 7/8 class. She also talks about how creativity and pāngarau understanding are related:

. . . if you understand the topic and the purposes of the work you can extend to other topics and areas, lay down new ideas and use the creative processes but if you are unsure of what pāngarau is about, what the benefits are of it then maybe you aren't free or able to extend things and be creative, you don't think like that, your mind isn't free to use creativity in the work.

This comment expresses a clear doctrinal insight; understanding the "the topic and the purposes of the work" (the methods of mathematics) means "you can extend to other topics and areas". In other words, deep understanding of mathematics enables the solving of problems in a wide range of contexts. Conversely, such problem solving is limited by a lack of such understanding.

The year 11 class is close to the edge of Whaea D's own comfort zone. This appears to be a contributory factor in the strengthening of the specialisation. Further research would be needed to establish causal mechanisms between the location of knowledge in the comfort zone of a teacher and the specialisation operating in the classroom regime.

Conclusion.

The epistemic relations and social relations in Whaea D's year 7/8 class are balanced in the sense of a coherence between a blend of discursive and ontic epistemic relations, and interactive and subjective social relations. These are mediated successfully through the three phase structure. This balance shifts considerably in the year 11 regime with a disappearance of the ontic epistemic relations and the subjective social relations.

Figure 4.7 represents the regime shifting that occurs for Whaea D and her students between the year 7/8 and year 11 classes. In terms of the presence/absence dialectic, oscillating between these two regimes involves repeated absencing/presenting of ontic epistemic relations and subjective social relations. The evidence in this case example suggests that close proximity to National Certificate of Educational Achievement assessment and possibly to the limits of Whaea D's comfort zone in terms of mathematical experience conspires holistically to cause this regime shifting. Of particular interest is that the shift to the year 11 regime induces a strongly discursive epistemic relation in which students are constrained to follow established curriculum discursive conventions. An ontic relation would open these conventions up to investigation as objects of study in themselves and ask questions of where they have come from, why they are as they are, and investigate other possibilities. This ontic open-ness is still alive in the year 7/8 regime.

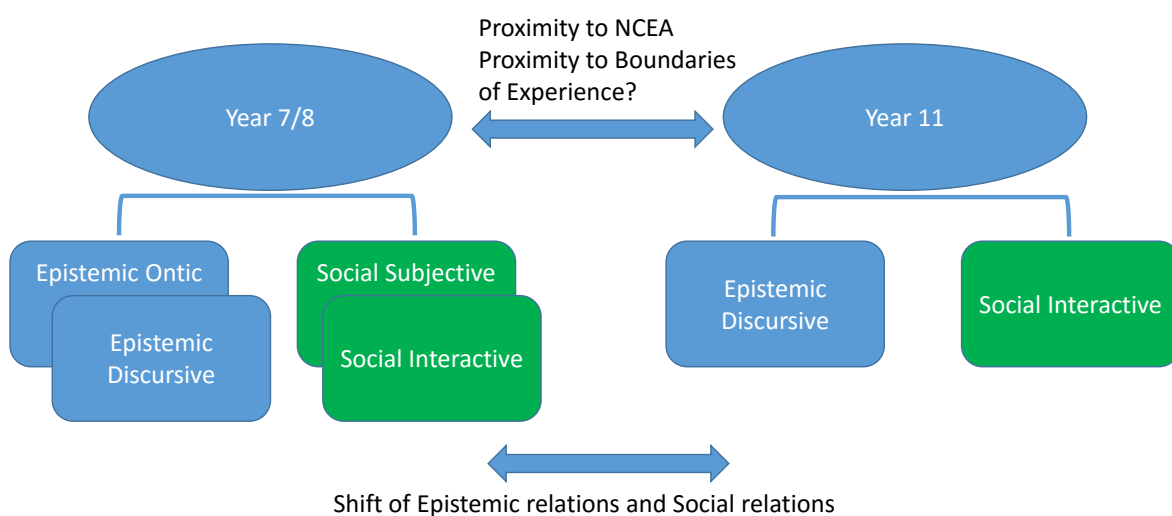


Figure 4.7. Shift of specialisations between Whaea D's Year 7/8 and Year 11 regimes

If the Kura, and kura Māori generally, wishes to maintain the ontic orientations throughout the Kura, which appears to be desirable with respect to cultural emancipation purposes, the flexibility of National Certificate of Educational Achievement system in New Zealand may be able to accommodate this. The organisation of the assessment system as discrete standards that can be achieved in different combinations to match student interests also allows for the creation of new standards. Creating new standards which require ontic investigation of highly conventionalised discursive curriculum areas such as mathematics is a possible avenue of future development for pāngarau not just in kura Māori but also in Whare Wānanga (indigenous universities); in other words, mathematics as a body of discursive knowledge can itself become an ontic object of study. At present, the discursive epistemic relation induces a concern with students' ability to produce legitimate discursive mathematical performances rather than an ontic investigation of what those performances are/can mean.

Matua J

Matua J is a young teacher who has been teaching at the Kura for four years. He is the only teacher who has been exclusively educated in kohanga reo and kura Māori. He is also a graduate of the Kura himself. He attended a different kura for his secondary education. Teaching at the Kura is his first teaching position. Matua J is teaching a year 5/6 class.

He is well-disposed to pāngarau and attributes this to his wharekura (secondary) teacher, who was Māori, and a motivated group of fellow students. He experienced a strong competitive spirit and a procedural view of pāngarau knowledge and competitive assessment situations with much value placed on the **marks**.

Because of his education in kura Māori he has no other versions of pāngarau/curriculum mathematics to compare with. For him, pāngarau is just pāngarau.

Overall vision of pāngarau.

Matua J's current view of pāngarau focusses on informal knowledge useful in the world outside of the school. This includes providing tools that support, for example, **dealing with finances and managing time**.

Disciplinary knowledge is thought of as being outside of his own knowledge base and only for specialists. At the same time the overall purposes of mathematics remain unclear to him, apart from facilitating everyday life outside of school. Mathematics beyond this is of no interest or use in Matua J's own life. He believes there are very few people who need academic mathematics, **people who go to NASA** perhaps, but for **him and people like him there are no benefits**. He prioritises work that is **relevant to things that will benefit students outside of the Kura**, but also teaches **stuff out of the book**.

Matua J expresses a belief in the universality of the basis of mathematics across languages and cultures. Mathematics has a common basis for all people in the world. This derives from a common experience that all people have such as navigating, cultivating, gathering food, and having shelter.

Matua J asserts that in modern times mathematics has become similar all over the world because of national school systems. He suggests that before such systems mathematical knowledge was more varied and dependent on context, language and culture.

Matua J remains distant from and uncritical of formal pāngarau knowledge and curriculum organisations of knowledge. He has only sampled some **small parts** of Te Poutama Tau and has not studied it as a complete system. He picks the parts that he thinks are most relevant to him and his students. He is most comfortable with the basics of adding, subtracting, multiplying and dividing, with a frank admission of **being lost with algebra and those kinds of topics**. He is also frank in his statements of a lack of understanding about why the curriculum is structured as it is.

Informal types of pāngarau are associated with traditional cultural activities such as rāranga (flax weaving), providing food for visitors, building canoes, navigating by the stars. He describes these activities as being **done without rulers and by eye**. This informality is contrasted with pāngarau resources which are regarded as formal and in need of contextualising.

He locates being Māori when learning pāngarau in the **delivery**. It is **the way you approach Te Poutama Tau that is the most important thing**. For Matua J, there is no **Māori thinking** in the resources themselves; rather it is **in the way the teacher works**.

Matua J's construal of pāngarau is strongly influenced by his own nature and his knowledge of the students in his class, many of whom are related to him. He chooses the **parts of pāngarau** that are relevant for him. The benefits for students from learning pāngarau are an ability to be successful in the world based on a strong sense of Māori identity derived from genealogy. Students will **know who they are**; they will know **the structure of the person** and be **settled inside**. Identity is important; **if identity is good, the journey in life will be good as well**. For Matua J, a major benefit of a kura Māori education is that students **know their identity and their whakapapa** (genealogical origins).

Matua J interprets the social and spiritual well-being, the **happiness of students**, as a sign of the strong grounding of identity and extends this to be a sign that the foundational philosophical principles of the Kura are being enacted successfully. There is a location of success in the student-teacher relationship with reciprocal notions of **give and take**; respect must be given to be received. In this way, he makes an explicit link to the philosophical

principles of the Kura in his pāngarau regime. This justifies a particular view of learning as being primarily about relationship, identity, positive participation and reciprocity.

He maintains the importance of a **family-like connection** with students where the teacher **knows each child** and comments that the Kura makes this easy because **you can go out of the class into other areas**.

For himself and his students, to be Māori means being kinaesthetic. He, like his students, cannot sit and listen for long periods of time, and must have plenty of action, movement and variety with a lack of routine. He states that it is **easier to learn by doing, by joining in with the work** and he maintains that for most students at the Kura it is **hard for them to be settled for a long time without moving and fidgeting, without doing something**.

The activities designed by Matua J usually involve physical movement or real material objects and are often unique. There is no routine phase structure in Matua J's lessons; instead students engage in a series of activities which may or may not relate to each other in terms of pāngarau learning. Pāngarau learning is another context in which the identity of students can be realised; the development of identity is the theme that relates different pāngarau activities and gives coherence to them over time.

Matua J clearly expresses that the Kura has a picture of an **ideal teacher** which he is a long way from being. This is due to his prioritisation of the practical and the integrated, coupled with his reliance on his own sense of what is useful, his own authority in determining what knowledge is of importance and how it should be learned.

Matua J considers other teachers as **predictable** and, by implication, **boring and routine**, this would appear to be a genuine, strongly felt tension between his practices and those of other teachers. He also feels vulnerable to criticism from other teachers and parents expressing a need to be **careful** because being **too far out of the box** is **dangerous**. This may arise because such people cannot recognise that pāngarau is happening in his lessons. In his view it is happening but **you just have to look carefully; it might not be what you are used to seeing**.

Internal components of pāngarau.

In all of the lessons in the data, students and Matua J are highly collaborative, physically active, very vocal and socially interactive. H does not maintain a separation between himself and the students, often participating in the activities. Matua J does not attend strongly to how students behave; students may **shout and stand on chairs, or whatever**. A sign of the success of a lesson is when students **come out of your class with a smile and are still keen on your lessons**.

He does not attend strongly to how students are acquiring pāngarau knowledge other than through participation in game-like activities. Learning is assumed to happen spontaneously as a natural result of participation in activities. Learning should be **in context** and have a **real purpose**. This involves integrating many learning areas in one activity.

Along with a focus on the practical and the integrated task, Matua J elaborates his view that formal resources are not focussed on the kind of maths required in everyday life. He relies instead on his own personal thinking and resources.

In the lessons captured on video, Matua J creates a series of activities styled as games. These always involve students in physical movement or manipulation of real objects. Most of the activities have a competitive element in which individuals or teams compete with each other in some way. Matua J relates this to his own positive experience of pāngarau during his own education. Such activities **develop a happy spirit so students want to join in**. He avoids activities which require students to **sit straight backed at a table**; this is a **problem**.

In one activity, designed to give students the opportunity to practice basic multiplication facts, students have A4 sheets of paper stuck to their backs and fronts with various numbers written on them. The game is to stand up and move to the correct position to display either the front or back numbers and thereby re-create a correct multiplication equation such as $3 \times 4 = 12$. For example, Matua J, as adjudicator, asks questions such as “What is 3 times 4?”. Students wearing a 3, a 4 and the answer 12 are then expected to stand up and move to the correct position to create the equation, $3 \times 4 = 12$. The answer is always on the back of a student so that they have to remember what number is on their back. This game was designed by Matua J.

Nine students are seated on the floor around Matua J who sits on a chair. Two students have already mastered their basic multiplication facts and adopt a role of *proxy teacher* within the group. By subtle and not so subtle means they orchestrate the other students to respond at the correct time to Matua J's questions. Four other students join in with the game but clearly rely on the two proxy teachers to tell them when and where to stand. Three students sit silently on the periphery of the group and never take part in any activity. Their numbers are not called.

There is much good natured humour with a wide range of behaviours exhibited without censure by Matua J. Throughout the game there is calling out, jibes and jokes, and some pranks, including several from Matua J. He also has numbers on his front and back and participates in the game as well as asking the questions. At one point, Matua J asks a question but forgets that the answer is on his own back. He looks expectantly at the students. After a moment he realises his error and stands up himself to uproarious laughter and jeers from everyone, including students from other classes who are watching from the side lines. Matua J takes all of this in good humour, and joins in with the laughter and jeers himself. Matua J is operating in the same social environment as the students.

Within the game, Matua J differentiates the questions to cater for the range of proficiencies within the group. He asks easy questions for the younger students – these involve multiplying by numbers less than 5. Harder questions are asked for the older students – involving numbers more than 5. To increase difficulty further the pace of the game is accelerated.

The game is introduced to students as a warm-up. However, it is clear that some students do not know their basic facts well enough to participate in the game. These students do not participate or simply wait for a signal from a proxy teacher. In terms of social interaction, the game is collaborative, dynamic and complex. It has a form of competitive spirit, perhaps best described a faux-competitive, in which students compete not for points or to win but to participate more fully in the game – to be a student who most competently completes the actions involved in the game. The activity is not a game in the sense of possessing winning strategies and having a means of identifying a winner. Yet, it is enacted in a game-like manner with turns taken and exhortations to complete the actions faster. Comparisons are made between who completed it fast and those who didn't.

The activities focus on participation and experience first with teaching input at the end. At the end of the above activity, Matua J briefly describes in words some calculation strategies that might help the students with their calculations.

The activity is followed by two other warm-ups which operate in similar style, extending the period of time spent in warm-ups to about 40 minutes. Following these warm-ups, students work independently for about another 20 minutes on a worksheet in which they complete more multiplications set in the usual genre form of a word problem.

In all the video lessons, there is no emphasis given to the learning of the pāngarau register. Matua J assumes that the students' language proficiencies are such that that they will learn any new language required. He also asserts that **it's up to each kura to use their own words for pāngarau; this is no big problem.**

In another activity, again uniquely designed by Matua J, part of a lesson about measuring lengths in metres and centimetres, a game of charades is used. The students are placed into two teams and each team is given a phrase which must be mimed by one member of the team for the rest of their team. The team that works out the phrase first wins 5 points. The phrases are all similar to the following phrase: *The height of the tree is 10.5 metres.* The mime must convey each word in the phrase accurately.

This activity is dynamic, collaborative, very noisy and hilarious. A majority of the students participate with great energy but some do not, passively being a part of the team and making no contribution. Two students hide in a different part of the room, returning at the end of the activity. Matua J does not comment on their absence. The activity lasts about 20 minutes.

The main body of the lesson involves students being outside the classroom, using a 1 metre measuring tape to measure the dimensions of several real objects around the Kura such as the length of a netball court, the length of a deck, the height of a climbing frame. The short length of the tape forces students to invent strategies for how they will measure longer distances. This occupies about 40 minutes. The aim of this activity is to see if students can measure lengths. The lengths measured are not used for any other purpose.

Students return to the class and Matua J, gathers the students together to check the correctness of answers. There is little or no discussion of the strategies used for measuring. Some students offer spontaneously their own explanations of what they did.

At the end of the lesson, Matua J is satisfied that they enjoyed doing the activity. He comments that students will acquire the ability to estimate lengths *soon*. Matua J suggests that through positive experience, in which students are happy and enjoying themselves, students will spontaneously learn pāngarau knowledge and skills.

Realising Matua J's regime in the interpretive framework.

Matua J's pāngarau regime is characterised by strong social relations and weak epistemic relations as figure 4.8 represents graphically. Social relations are broadly those of the Kura ethos carried over into highly social game-like activities in which pāngarau learning happens within the structures of social relations. In this sense, the regime is a strong knower-code and close to that of the Kura ethos.

Social relations are weak and interactional but these interactions are always backgrounded by the wider Kura philosophies which tie interactions to specific Māori concepts and student identity. Ways of interacting legitimately are broad and varied but this is justified by Matua J's strong conviction that identity of students is paramount. This presents a paradoxical-seeming situation in which what appear to be weakly defined and controlled interactive social relations are in fact strongly defined and controlled subjective social relations. The strong definition of Māori learners as kinaesthetic, unique Māori individuals, who need unstructured learning contexts implies that a wide range of interactions must be accepted. The weakness of social interactions is deliberate and strongly defined and controlled to be that way based on strong subjective social relations. This contrasts with Whaea D's Year 7/8 regime which has distinct but related subjective and interactive social relations. In Matua J's regime, strong subjective social relations *mean* weak interactive relations. In Whaea D's Year 7/8 regime, strong subjective social relations co-exist peaceably with weaker social interactive relations formed in relation to relatively strong epistemic relations.

Epistemic relations are weakly discursive and entail loosely defined principles of mediation and integration between formal pāngarau knowledge and contextualised knowledges. Knowledge acquisition and circulation between participants is based on prior social relations (established in whole Kura activities) with Matua J often-times being one of the participants rather than adopting a formal teacher role.

Contextualised Description	Rationale	Specialisation
Pāngarau is useful in everyday life on the marae.	Pāngarau knowledge and Marae knowledge (mātauranga) are related through pragmatic principles	Epistemic relation Type: Discursive Epistemic Lens: Principled
Aligns with a view of indigenous pāngarau is informal and <i>by eye</i> .	Traditional knowledge and pāngarau are related through pragmatic principles.	Epistemic relation Type: Discursive Epistemic Lens: Principled
It's about developing student identity	All activities feed into developing students' identities as Māori people.	Social Relations Type: Subjective Social Lens: Biological
Formal pāngarau is separate from language and culture but derived from a common human experience.	Disciplinary mathematics and contextualised cultural knowledge are related through principles derived from common human experiences.	Epistemic relation Type: Discursive Epistemic Lens: Principled
Personal agency is in pedagogy not knowledge	Pāngarau knowledge is regarded as fixed, pedagogical knowledge/practice mediates this fixed knowledge.	Epistemic relation Type: Discursive Epistemic Lens: Principled
Formal pāngarau is a product of education systems.	Pāngarau knowledge is a socially produced form of knowledge abstracted from contextualised knowledge.	Epistemic relation Type: Discursive Epistemic Lens: Principled
Social basis of activities are derived from the Kura Philosophy.	Ways of interacting are legitimised based on relations derived from a specifically Māori philosophy.	Social Relations Type: Subjective/Interactive Social gaze: Born Social Lens: Ontic/Discursive
Formal pāngarau has little relevance.	Disciplinary mathematics knowledge is related to contextualised knowledge through pragmatic principles/ since disciplinary knowledge is unknown, it is procedurally excluded.	Epistemic relation Type: Discursive Epistemic Lens: Principled/Procedural
Pāngarau skills , about number and measurement, are used as tools in other contexts	Pāngarau knowledge is related to contextualised knowledge by a principle of recontextualising knowledge as tools.	Epistemic relation Type: Discursive Epistemic Lens: Principled
Learning is spontaneous gained through positive experience in contextualised activities.	Learning of pāngarau occurs in a wide range of contexts and participatory activities. Of primary concern in these activities is how the students interact and the students' spirit/identity.	Social Relations Type: Subjective/Interactive Social Gaze: Born/Cultivated Social Lens: Discursive/Ontic Spiritual Lens?
	Knowledge is learned without specifically attending to how it is learned. The object of study is the contextualised activity itself.	Epistemic Insight: Situational Epistemic Lens: Empirical
Learning is Informal and practical, integrated into real contexts.	The real contexts are prioritised with students interacting directly with elements of the context without reference to procedures or principles.	Epistemic Insight: Situational Epistemic Lens: Empirical
Matua J relies on his own internal authority for knowledge and contexts	Knowledge is about a contextualised situation: his own nature, his students, and the Iwi location of people.	Epistemic Insight: Situational

Contextualised Description	Rationale	Specialisation
Answers are checked but not explained. Explanations are given at the end of an activity Products of activities are not used for other purposes.	Since activity happens first with explanations, answers or products provided at the end and not related to other learning, who is learning what and how they learn it has a degree of freedom. What counts as knowledge and how it should be known is left up to students to decide.	Epistemic Insight : Knower
Pāngarau activities are structured as competitive games	Games are configured so that participants must interact within the rules of the game. The effectiveness of the games depends on the social relations between participants.	Social Gaze: Cultivated Social Lens: Discursive/Ontic
A wide range of types of participation are acceptable.	Despite having rules of participation in activities, these rules are not strictly enforced. Participants may participate in a wide range of ways and all are usually acceptable.	Social Relations Type: Interactive/Subjective
Pāngarau skills practiced in games	Skills are not considered to be part of the game itself, the game is a mediating context for the learning of a skill in the contextualised knowledge of the game.	Epistemic relation Type: Discursive Epistemic Insight: Situational/purist
Formal pāngarau curriculum is weakly represented.	The weakness of the presence of the curriculum, is due to pre-occupation with the real contexts.	Epistemic relation Type: Ontic/Discursive Epistemic Insight: Situational
Routines and formal, regular practices are eschewed.	Matua J associates being Māori with being a participatory or experiential learner who dislikes routines.	Social Relations Type: Subjective/Interactive Social Gaze: Biological/Born
Learning is primarily about relationship, identity, positive participation and reciprocity.	Māori students and teacher interact in distinctive Māori ways.	Social Relations Type: Subjective/Interactive Social Gaze: Social/Born
The development of identity relates different pāngarau activities and gives coherence to them over time.	Activities are designed to develop Māori identity. The Māori person/identity is the common element in all activity – the entity that experiences them all.	Social Relations Type: Subjective Social Gaze: Social Social Lens: Biological (Spiritual?)
Skills are learned in isolation using worksheets.	Knowledge of skills must be related to contextualised knowledge (eventually). Both problems and solutions are attended to – word problems and their solutions are units of study.	Epistemic relation Type: Discursive Epistemic Insight: Purist

Table 4.7. Matua J's regime related to specialisation concepts.

Specialisation tree and plane.

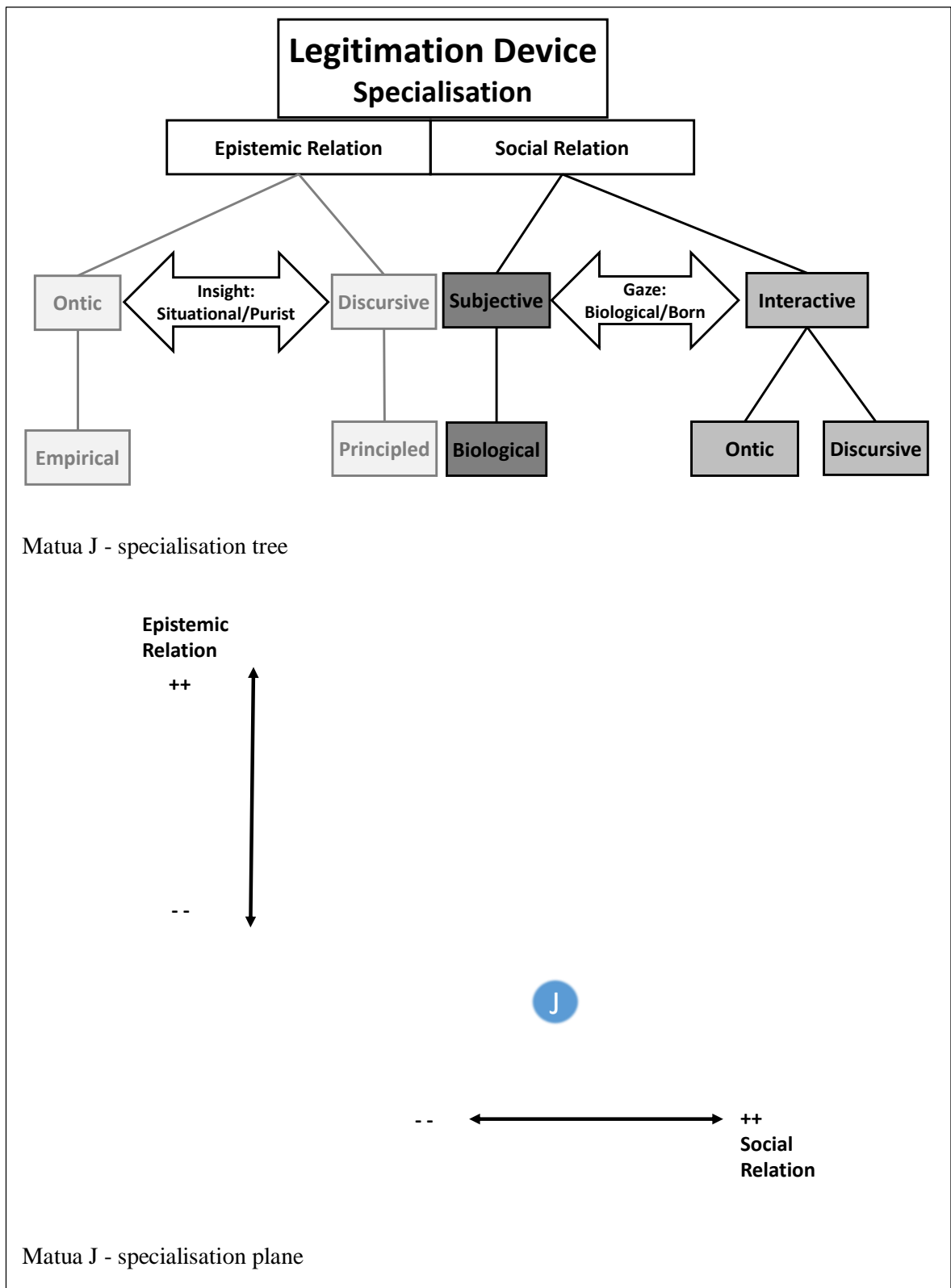


Figure 4.8. Matua J's regime - specialisations of the epistemic relation and social relation.

Discussion

Matua J's regime confronts students and places them in a dialectical position where they have to make a choice about the terms on which they will participate in the regime. That each student does so on different terms is clear in the empirical data. Despite Matua J's claim to the contrary, several students do in fact absent themselves almost completely from some activities. Two students adopt proxy-teacher roles in which they function inside the participating groups as guides and prompters of correct interaction in the activity. Others wait to be prompted by these two students and appear to show competent independent participation. Others participate in an uncontrolled fashion showing little restraint in their highly mobile and vocal actions all of which are accepted by Matua J.

The dialectical nature of these responses is apparent because such responses are framed in opposition or support of the official configuration of the learning regime. Matua J attempts to increase participation by making the activities into games and invoking characteristics intended to increase motivations and general happiness. In response to the unavoidable request to participate, students must formulate the terms on which they are able to participate and in doing so shift the nature of the activities to be more suited to that type of participation. Because a seemingly unrestricted range of ways of interacting are legitimate, students can decide for themselves how to interact but must do so largely on personal engagement in the dialogic context as it unfolds. In other words, the dialectical learning process is largely about the meaning of legitimate participation rather than the meaning of pāngarau concepts.

The ways of participating by students appear to be largely tacit. Matua J's students were interviewed both independently and as a focus group and appeared to be quite unaware of these decisions they were making in the data. They were very vague or unable to comment on the reasons for their actions. It would seem that such tacit or intuitive decisions are formed in the moment as participation happens with the substance of the decision being non-existent before the activity and being quickly dismissed from conscious awareness after the activity.

There are a number of transfactual causal relations operative. These relations associate success in the world with a prioritisation of Māori identity coupled with contemporary knowledge competences. In particular, there are strong transfactual statements

regarding the kinaesthetic nature of students. These relations are recontextualised in Matua J's regime as a justification for the strong subjective definition and control of weak social interactions.

Students must attend to holistic configurations in order to abduct/retroduct knowledge. Holistic forms of causality dominate in a learning environment that shows little formal regularity or routinisation of practices (something that Matua J strongly defines and controls by absencing them). Lack of routinisation reduces the effectiveness of rhythmic forms of causality.

Matua J has yet to develop a critical insight into his own practices. There is evidence of the beginnings of critical awareness such as understanding that pāngarau is a product of the education system, and awareness of the sources of tension between his own regime and those of other teachers and the expectations of the wider Kura community. There is a sense in which Matua J deliberately establishes his pāngarau regime in opposition to his view of the normal regimes of other teachers. The normal teacher is perceived as being predictable, routine and boring; he deliberately eschews routine and predictability. A lack of routine increases motivation for students but causes problems of co-ordinating with other systems of the Kura and increases vulnerability to critique based on a conventional view of pāngarau.

These tensions have an important consequence for Matua J. In response to the lack of ability to recognise conventional features of pāngarau in his preferred regime, Matua J arranges times in which students complete conventional worksheets. This practice is completely out of phase with the specialisations of his preferred regime but is included as *window dressing* so that other teachers and family members can observe and recognise that pāngarau happens. Window dressing is a response to pressure to produce a societally endorsed form of pāngarau. This is interpreted as a recontextualised or refracted form of the more general pressure that the Kura as an institution feels when faced with compliance with societal systems such as National Certificate of Educational Achievement assessment system.

The window-dressing compromise can also be interpreted in terms of absence and presence; Matua J explicitly talks at length about tensions he experiences with other teachers and parents who cannot see conventional mathematics learning activities in his lessons. Such activities are absent most of the time. This absence, along with its configuration with the presences of perceptions and beliefs (causal relations) of teachers and parents are interpreted to be part of the causation of the window-dressing practice. When Matua J and his students

work on the conventional activities (worksheets usually) a reversal of absence/presence occurs with Matua J's notions of being Māori made absent. This absence and Matua J's beliefs operating as causal relations create an opposite kind of tension which increases the tendency for game-like social activities.

The circulation of knowledge through social relations is emphasised in Matua J's regime. Since epistemic relations are weak, students must confer amongst themselves (which also includes Matua J when he is acting as another participant in the activities) to establish knowledge. More knowledgeable students distribute knowledge to their peers through established social relations; this is clear in the actions of the proxy-teachers in activities. The case example also suggests the notion that a person's identity developing through apparently disparate experiences is itself the theme that unites them and constitutes an accumulation of knowledge across contexts and experiences. This is an area of further research suggesting the possibility that knowledge growth can occur in horizontal discourses through social mechanisms rather than epistemic mechanisms.

Empirical data about students' experiences of the practice of *window dressing* are limited but still suggestive of potentially significant comment. Students do not question the switch between game-like activities and completing worksheets. They appear to be content to engage with both. They clearly enjoy Matua J's activities and generally participate with enthusiasm but also settle to work on conventional activities without resistance even when there is no obvious connection between them. This suggests that students in Matua J's class do not experience absences and presences to the same extents and in the same ways as their teacher and their parents. Whereas Matua J resists conventional activities because it causes *being Māori* to be absent, some parents and other teachers resist Matua J's activities because they absent societally endorsed and recognised forms of knowledge. The difference between students' experiences of absence/presence and adults' experiences may be related to different stages of development of beliefs about being Māori and conventional knowledge. Matua J's students are still quite young and their unquestioning acceptance of Matua J's activities may relate to their, as yet, relatively undeveloped sensitivities to tensions generated by such absences and presences. In the terms of the theoretical framework, this may be related to the conception of people themselves as totalities in a process of emergence. In this regard, adults are interpreted as being more or less fully emergent as real entities with causal properties and more fully and intentionally employed in engaging with causal mechanisms. Students, on the other hand, are still in process of emerging and achieving a more stable emerged form.

Indeed, this is why the education they have in the Kura is important in their emergence as Māori which will require, as adults, a position to be taken in relation to societal knowledge and their own Māori identity. Empirical data suggests, especially in field notes, that there is an under-current of discourse amongst students about societal knowledge in the Kura which older students express more clearly in their desire to engage with National Certificate of Educational Achievement assessments to gain qualifications which will open doors to careers in general society. This observation supports a very tentative suggestion that students do develop viable positions in relation to societal knowledge based on being Māori first and foremost; these positions require developed sensitivities and intentional agency in negotiating the absences and presences generated by engagement as Māori in general society. This tentative suggestion is another area in need of further empirical research.

Conclusion.

Matua J's regime is distinctive and offers its own unique insight into the workings of causality and specialisation and the diffraction/refraction of dialectical relations. In particular, how transfactual relations derived from the Kura philosophy justify (cause) the strong subjective social institution of weak interactive relations.

Window dressing is also a significant practice because it represents an empirical feature that is construed as a compromise between societal requirements and Matua J's own prioritisations of students' Māori identities. Thinking about dialectical relations which might lie behind this window-dressing practice, insights are gained which suggest that Matua J's regime is an inversion of Whaea L's strong knowledge-code and derives from the same knower/knowledge dialectic. Matua J presents students with game-like activities with a deliberate weakness of control of social interactions emphasising students' identities as individuals and as Māori. The structuring of the activities and the resources places students in a position of having to participate in highly social and collaborative ways based on the social relations already established in the Kura. Resource/resources use and knowledge/knowledge use dialectics in Matua J's regime take on a very different complexion; resources are creatively used and re-purposed in unique activities that Matua J creates, knowledge is created by each student in potentially unique ways through relatively unconstrained dialectical learning processes. Participation/participant relations are biased

towards the participant with the nature of participation centring on the characteristics of students. The regime legitimises the knower rather than the knowledge they know and constitutes a strong knower-code.

The case study also highlights another significant point with respect to the balance of knower and their knowledge. Matua J has no agency in the nature of pāngarau knowledge itself and so must focus his efforts on ensuring that being Māori is reflected/made present in pedagogy. This is underpinned by some transfactual beliefs espoused by Matua J about the universality of mathematics knowledge and its presence in all languages and cultures. This represents another form of compromise practice deriving from a conflict between the strong knower-code of Matua J's regime and knowledge-code pāngarau.

The Kura Ethos

The Kura is small with less than 100 students and 6 full time teachers. Students come from kohanga reo (Māori language pre-schools) and are required to have a certain level of competency in Māori before being accepted into the Kura. In addition, parents and whānau (family) are expected to become involved in one or more work groups dedicated to carry out duties to do with the functional areas of the Kura such as property management or finance.

Whānau involvement is considered to be a vital and unique component of the Kura ethos. Monthly whānau meetings occur in which all aspects of the operation of the Kura are open for discussion. The meetings have a *wānanga style* with all participants able to have their say on any matter. While the principal and teachers have a large degree of autonomy over the operation of the Kura in its basic operations, significant strategic issues must always be *taken to the whānau* for consideration.

Students are organised into classes based in a conventional manner on age: year 1/2, year 3/4, year 5/6, year 7/8, year 9/10 and at years 11 to 13 individualised programs of learning. At the time of data collection, learning followed a *kaupapa nui*, an integrating theme that unified learning across different curriculum areas. These themes are significant themes in mātauranga Māori (Māori knowledge) and Iwi (tribal) histories, lands and resources. The Kura has a particular orientation towards students being kaitiaki (custodians) of their lands and natural resources, being upholders of the Māori language and, above all, being exemplary representatives of the Iwi.

The school day is divided into eight parts: a whole school morning hui (meeting), learning session 1, morning interval, learning session 2, lunch, learning session 3, chores, and a final whole kura hui.

Each day at the Kura begins with a whole Kura hui in which groups of students take turns in leading a set of karakia (traditional chants/prayers) that are chanted by everyone. Following this each teacher speaks acknowledging the group that has led the karakia and offering up their information and thoughts for the day. These comments can be purely organisational or thought provoking, challenging or philosophical. Each teacher has an opportunity to introduce ideas of their own. These hui are generally forums for positive encouragement of each other, acknowledgment of qualities or acts however small, celebrations of birthdays and the like. There is also acknowledgment of whānau members in

distress or bereavement or more formal mihi (acknowledgement) of people and events. Occasionally there is need for admonishment of unacceptable behaviours or discussion of wrong doing. This is always with a restorative intention – that unacceptable behaviour or breaches of tikanga (cultural protocols) be thought about, discussed and correct observance of tikanga and behaviours re-established.

The morning hui can also be a time for deliberate teaching and learning for specific purposes. One such example was a focus on eradicating common mistakes in the speaking of Māori by the use of humorous performances by teachers which are both entertaining and instructive.

Following the teachers talk, the whole Kura performs a waiata ā-ringā (songs accompanied by actions). The hui is completed by the performance of a haka (posture dance) by the boys. Waiata (songs) and haka vary from day to day. The aim of this repetition of karakia, waiata and haka is to build a repertoire that will enable students to participate appropriately in any cultural event. Students learn to participate in the waiata and haka, learning words and actions as they participate. Younger children can be seen loosely joining in and gradually coming into line (literally) in the waiata and haka. As an example, one particular child new to the Kura initially simply played and sometimes interfered with others during the haka performance for several weeks. The child was gently dealt with but not forced to comply. After a few weeks the child simply joined in. Later in the year, the child's performance in haka was wholehearted, all actions and words in place.

The morning hui is often a time when significant thoughts or ideas are brought up. Quoting a kaumatua (an elder, *Koro*), one teacher made this statement:

Koro says that we must learn all of the real names of places and the histories of them in our Iwi area. If we don't we will be just like the Pākehā (European New Zealander) who are only visitors to our lands and will soon be gone.

This is a significant statement indicating the ties of students to the land in which their ancestors lived. There is an important duty derived from ancestors to inhabit and look after the Iwi lands for future generations. That this comes from a kaumatua, carrying an ancestral voice, lends particular evaluative weight to the statement.

Following the morning hui, a short learning session follows. The length of this session depends on the length of the morning hui. Timings of sessions can be variable and

changed instantly if something occurs to warrant it. Sometimes the morning hui takes up most of the time until morning interval.

For interval, the whole school will again gather for kai (food). A karakia is said, kai eaten and then a mihi (formal acknowledgement) given for those who have prepared the kai. The Kura provides kai for all students if they want it. This kai, usually cereal, is prepared and distributed by a small group of students rostered for this task. Students are then free to play until the beginning of learning session 2.

Lunch is a similar process to morning interval with a longer period of play. It is a feature of the Kura, that students can freely access all rooms and spaces and use the school kitchen to prepare their own kai and drinks. The Kura is intended to be a second home for students. With this freedom also comes the responsibility to do chores.

The chores period is a short time, about 15 minutes, in which all students attend to various chores around the Kura: picking up rubbish, tidying the kitchen and classrooms, and recycling. The doing of chores is an important aspect of tikanga. The Kura is thought of as a second home for students, and teachers. It is common for teachers, students and visitors to sleep overnight in the Kura. There is a supply of mattresses for that purpose. As the *hau kainga* (people of the home) of the Kura, teachers and students have a responsibility to look after the kainga (home). The relation of all to the material grounds and buildings of the Kura is direct; responsibility for its upkeep rests with everyone who lives in the Kura. It is not contracted out to an external third party.

The day ends with a whole school hui which, as well as a time when notices may be given, is primarily a time when the achievements of the day are acknowledged. As in the morning hui, teachers take turns to mention and acknowledge the achievements of their students, single out certain students for particular praise and reinforce the valued knowledge and personal attributes. For example, praise is given to students who have been noticed speaking Māori in particularly effective ways, achieved national qualifications, or shown personal attributes such as perseverance or skill in dealing with problems.

The practice of tuakana-teina (older/experienced person – younger/inexperienced person) is a strong characteristic of inter-personal relationships between students. Older students can always be seen interacting with younger students at morning interval and lunch. Often older students will help teachers in the lessons with younger ones, acting as de facto teacher aids. Tuakana-teina is a relative concept: within each group the older students are

tuakana so that, for example, in the year 1/2 group the year 2 children are tuakana. As students progress through the Kura they take on more status in this tuakana-teina relationship so that year 12 and 13 students have a tuakana role throughout the Kura.

Conventional discipline systems are absent since behaviour and the child are seen differently. Each child is unique and special. Therefore, no child is unusual. Each child is seen as simply who they are without judgement about normality or measures being taken to assess degrees of difference from normality. This is not to say that tensions, emotions and conflict between students and teachers do not occur. When they do, however, generally speaking, it is treated as learning for all concerned not a discipline problem.

Although discipline is not seen as an issue in the Kura, a possible exception is where behaviour constitutes an obvious break in tikanga (cultural protocols). However, this is a difficult point since all behaviour can be considered to relate to some aspect of tikanga. For example, students who do not participate in waiata or haka according to expectations, usually expectations of infusing energy, enthusiasm and life into the performance, or students who are flagrant in breaks of tikanga such as regularly speaking English in the Kura will be admonished. Students who are remiss in some way in participating in tikanga when the Kura is involved in local or national events risk some form of corrective action. This highlights the centrality of tikanga in the Kura.

Visitors to the Kura must be able to speak Māori and interact correctly in tikanga. If a visitor is able to do this regardless of ethnicity, they may enter the main areas of the Kura. If not, they must remain in an area of the Kura reserved for non-Māori speakers.

An attempt to define tikanga will not be made in this thesis because tikanga is not defined in the Kura explicitly; it is not written down in a book for reference purposes. Tikanga is not a set of policy statements. Rather tikanga is correct actions learned through participation in real cultural activities under the guidance of tuakana. In this way, it is something learned by children through being embedded in a cultural milieu.

Several comments from various teachers during whānau and staff hui re-iterate the prioritisation of language and tikanga. The prioritisation is certainly related to both a need to protect the Māori language and tikanga Māori as well as a response to perceived oppression. Two such examples are given here:

What's important is that our own knowledge is fed to our children..we have been oppressed for long enough by those external systems that tell us what knowledge we should be teaching and how we should organise ourselves

What's important is not maths, it is the reo (language)....maths is not endangered it can look after itself and will be there when we are ready for it...if we don't speak Māori it will die.

A general feature of the Kura is a prioritisation of naturally occurring, experiential learning. This does not mean naïve forms of discovery or inquiry learning. Priority is always given to real cultural events such as pōwhiri (welcome ceremony) and tangihanga (funeral). Often the whole Kura will travel large distances in order to attend such events. For example, a student achieving entry into the national manu kōrero (speech) competition finals may cause significant numbers of students and teachers or the whole Kura to attend in support of that student. Similarly, the gaining of a place in a national kapa haka (group performing arts) competition would require such attendance. Students in such cases, will spend significant amounts of time being present, experiencing the events and participating in tikanga of kai, mihimihi, waiata and haka. They will also engage in *whanaungatanga* with students from other kura - establishing, renewing and maintaining relationships with other students under the unity of the common purpose of being a kura Māori.

The Kura is a genuine cultural organisation that engages in actual cultural life. Pōwhiri are real. Tangihanga (funerals) are real, someone close to the Kura has died and it is proper observance and participation in this that constitutes an education in a Māori reality. Celebration of times of the Māori calendar are real participations. For example, the celebration of Matariki in June or July is not a school learning experience but a genuine celebration of the changeover of a natural cycle in Aotearoa/New Zealand – it is a cultural connection with the land, a recognition of change and the continuing presence of ancestors. One teacher commented on it in this way:

Participating in Matariki re-establishes a spiritual link with ancestors. In the early morning, it is still dark, its cold...the connection is easier to make...somehow Nanny is close and I remember her and mihi to her for all that she has done for us...she is still doing it right now actually.

Attendance at cultural events is a real cultural experience not a practise for a real event. Engaging in this way with tikanga, as a way of developing and maintaining a spiritual

connection with ancestors, is a fundamental of life in the Kura and students experiencing a Māori reality.

The attitude towards officially mandated learning as required in order to gain National Certificate of Educational Achievement (NCEA) qualifications is different. One teacher commented as follows:

The standards are done as quickly as possible so that we can get on with what really counts in the Kura...developing students as Māori people located in a Māori world.

Official knowledge may appear to be devalued but this is completely consistent with the Kura's prioritisation of tikanga and real learning through real cultural participation. Students must have qualifications in order to gain access to university or other tertiary training or employment, but the real job of the Kura is to grow Māori speaking and thinking people, or, more specifically, Iwi speaking and thinking people.

Teachers and students are often heavily committed to participation in real cultural events which do not specify the length of time of involvement. Such events will always take priority so that if students must attend a tangihanga, assessment work will be suspended for as long as is necessary. This places pressure on the time available for learning in relation to NCEA assessments. One response to this is the Kura practice of wānanga (intensive, extended periods of time spent on one area of learning).

A wānanga involves a suspension of normal proceedings for up to a week in which a teacher and a group of students focus exclusively on one learning area. This includes evening sessions and both teacher and students may sleep on site in the Kura. This intensive focus on one learning area, and a selection of NCEA standards, mitigates the constraints on NCEA learning time due to the prioritisation of tikanga.

The Kura curriculum is hard to identify. Attempting to see the equivalent of the New Zealand Curriculum or Te Marautanga o Aotearoa creates problems because there are only partial elements recognisable as curriculum in this sense. The closest to such a hierarchically structured curriculum is Te Poutama Tau. Someone attempting to see curriculum in the conventional sense will see only partial glimpses of the familiar.

Ngā Whanaketanga (National Standards) have been rejected by the Kura not on the grounds of the required knowledge involved, but on the grounds of assessing progress of

learning against arbitrary, age-related measures of development. The tumuaki (principal) of the Kura expressed it in this way:

It feels like a real intrusion, an intrusion of judgemental thinking into our whānau where the development of our tamariki mokopuna (children and grandchildren) as people is the most important thing.

Despite a strong tendency for integrated and thematic approaches throughout the Kura, pāngarau remains as the most defined, standalone, learning area. All teachers have dedicated times when pāngarau knowledge and strategy learning happens in isolation. There are also dedicated assessments of knowledge and strategy stages of students. Targets in the Kura's strategic plan include increases in Te Poutama Tau stages resulting in some scrambling to meet such targets at the end of the year.

The tumuaki also commented on a mismatch between whānau interests and the Kura ethos in relation to pāngarau:

Even when we report how well children are doing in terms of growing and learning in their Māori identities like growth of manaakitanga (caring), tautoko (support) and knowledge of karakia, they still want to know where their child is in pāngarau. I think even if we reported about integrated pāngarau they would still want to know about basic facts and levels...and it's all pressure from outside, it's not our kaupapa, it doesn't belong to us, if the compliance thing wasn't there pāngarau could be very different.

The Tumuaki expresses a very strong feeling of frustration with external compliance constraining internal desires and tendencies. The curriculum in the Kura is a work in progress and has yet to fully confront such constraints. The thinking is certainly present that the Kura should create its own curriculum. Coupled with a rejection of a curriculum that is designed in levels that are used to measure students learning (for compliance), there is a desire to ground any new curriculum in the local Iwi context. One teacher put it like this:

I went through an English-medium school and the teachers knew exactly what we were going to do each lesson ...but that destroyed my creativity...it was like I couldn't have my own thoughts...that's why I think it's better for us to create our own curriculum so that the people who are based here, who live here, decide what's in it and how its organised ... how it can be planned so that the students are alive in it.

Generally, there is a very high level of teacher autonomy in the Kura. Teachers are expected to construct their own programs based on a collectively agreed theme. There are no explicit written guides for what each teacher should be covering with their students. Each teacher is expected to learn about their students or already know them so that learning can be organised appropriately for them. In terms of control of learning throughout the Kura, there is a very light touch. Teachers have great freedom to design activities and learning content, and to include their own values, ideologies and interpretations in their classroom regimes.

It is clear that the Kura as an institution prioritises the personal development of each unique child located in a Māori speaking reality. This is partially constrained by the need to gain NCEA qualifications which in fact trickles down throughout the kura and influences learning programs thereby restricting the tendency to move towards a completely student-centred approach. However, what binds this collection of unique and very different people together is their common understandings of tikanga, Māori language and Iwi identity. Moreover, it is tikanga that is intended to provide a central common grounding that is the basis on which individual expression is made. The following two comments the first by the tumuaki and the second by a senior teacher express this aspect of the Kura:

Tikanga is about meeting each person's physical and spiritual needs...that's really what Maslow's hierarchy of needs is about as well... when a person's needs are met, they have everything they need to become who they are, they will be able to do anything they want.

Rather than preparing our children for university and conventional careers we should be preparing them to exist in the world as unique people defined in their own ways...it's not about economics even, or about preparing students so that they can bring skills back for the Iwi, like becoming doctors or accountants...it's about students being their unique selves in the world.

Realising the Kura ethos in the interpretive framework.

The relatively weak strength of epistemic relations compared to the social relations is apparent in several aspects of the Kura ethos. Mātauranga (Māori/Iwi knowledge) is clearly prioritised but is not explicitly defined and is learned largely through participation in real activities. Mātauranga is normal and not in need of definition. It is to be lived, not learned; it is an ontic specialisation in which understandings are always tested out in each new context (empirical lens). Where official curriculum knowledge is dealt with, pāngarau being the most noticeable example, specialised lessons are organised with a quite different specialisation (as detailed in other case examples). Weak discursive, principled epistemic relations apply to the way pāngarau is managed within the Kura.

Social relations, on the other hand, are more strongly defined in terms of tikanga and strongly controlled. Breaks in tikanga are serious and action is always taken. Rules of tikanga are not to be found explicitly written out, but tikanga is demonstrated implicitly every day in the routines and rituals. Social relations are therefore strongly subjective because tikanga is specifically about being a member of the Iwi and following Iwi specific cultural and social relations. Genealogically based relations are also strongly respected and maintained as in observance of cultural events that occur in the wider whānau, hapū and Iwi. Observance is obligatory because of genealogical closeness.

There is a biological lens but also glimpses of a *spiritual lens*. Children are Māori but also *ira atua* (refractions/diffractions of the gods). People are *on loan* from a spiritual realm regarded as their true home in which they are always fully formed. Children may be considered to be already fully formed when born and so must be allowed to develop through education. This emphasises the strong knower-code of the Kura ethos.

There are also significant interactive social relations derived from subjective relations. Subjective relations ground social life in Māori identity and protocols but ways of interacting are available to anyone. Visitors to the Kura must abide by tikanga and speak Māori or remain in a part of Kura reserved for non-Māori speakers. If they can speak Māori and interact competently according to tikanga, they may participate fully in the Kura.

Contextualised Description	Rationale	Specialisation
Whānau involvement is considered to be a vital and unique component of the Kura ethos Students must have proficiency in te reo Māori.	Being a member of a family with genealogical ties to the Iwi and therefore the Kura is prioritised. Knowledge of protocols and language is also required. .	Social Relation Type: Subjective/Interactive Social lens: Biological/Discursive
Whānau meetings have a wānanga style with all participants able to have their say on any matter.	Participation in hui requires competence in the interactional principles of wānanga.	Social Relation Type: Subjective/Interactive
Learning followed a kaupapa nui, an integrating Māori theme that unified learning across different curriculum areas.	Distinct Māori knowledge is prioritised as the object of study but how this is learned is left up to teachers to integrate into other activities.	Epistemic Insight: Situational
Students are being kaitiaki of their lands and natural resources, being kaitiaki of Māori and, above all, being exemplary representatives of the Iwi.	Students are seen as located in the Iwi and in the lands of the Iwi. Their roles are pre-determined because of who they are. They are expected to abide by cultural practices in the role of kaitiaki and to engage with contextualised knowledge.	Social Relation Type: Subjective Social Gaze: Born
		Epistemic Relation Type: Ontic/Discursive Epistemic Insight: Purist Epistemic Lens: Empirical/Principled
Groups of students take turns in leading a set of karakia that are ritually chanted by everyone	The words and form of the karakia are important as is learning them experientially by chanting in unison.	Epistemic Relation Type: Discursive Epistemic Insight: Purist
Kura hui are generally forums for positive encouragement of each other, acknowledgment of qualities or acts however small, celebrations of birthdays and the like.	The characteristics of students as Māori knowers are prioritised.	Social Relation Type: Subjective Social Gaze: Social Social lens: Biological
Discipline is always with a restorative intention – that unacceptable behaviour or breeches of tikanga be thought about, discussed and correct observance of tikanga and behaviours be re-established.	Correct interaction with tikanga and establishment of the valid identity is prioritised. Students as valuable people, must be developed and treasured.	Social Relation Type: Interactive/Subjective Social Gaze: Social Social lens: Biological/Social
“Koro says that we must learn all of the real names of places and the histories of them in our Iwi area” This is contrasted with transient Pākehā settlers.	Students as Māori and Iwi must learn (by visiting and experiencing) all the places in the Iwi region. Social Relation Type: Subjective	Social Relation Type: Subjective Social Gaze: Born
	Contextualised, cultural knowledge must be learned by direct experience and engagement with actual events.	Epistemic Relation Type: Ontic Epistemic Insight: Situational Epistemic Lens: Empirical
Timings of sessions can be variable and changed instantly something occurs to warrant it.	Actual events are prioritised over structural (discursively formed) requirements (such as an arbitrary timetable)	Epistemic Relation Type: Ontic Epistemic Insight: Situational Epistemic lens: Empirical
All students do chores in the Kura every day	Students must engage in cleaning and tidying practices at the correct time and place and in the correct manner.	Social Relation Type: Subjective/Interactive Social Gaze: Born Social Lens: Social
As students progress through the Kura they take on more status in the tuakana-teina relationship so that year 12 and 13 students have a tuakana role throughout the Kura.	Students who are Māori are expected to automatically participate in tuakana-teina relationships whatever their age. Students are simultaneously tuakana to some and teina to others.	Social Relation Type: Subjective/Interactive Social Gaze: Born Social Lens: Social

Contextualised Description	Rationale	Specialisation
Each child is unique and special. Therefore no child is unusual.	The identity of the students is completely prioritised, interactional/behavioural issues are absented.	Social Gaze: Social
Breaches of tikanga will invoke admonishment and in being admonished further learning of tikanga occurs.	Interactional competence in correct participation in cultural practices is paramount, especially in engagements with external agencies. In these cases, who is doing the interacting is subordinate to the way they interact.	Social Relation Type: Interactive Social Gaze: Cultivated Social Lens: Discursive
Rather tikanga is correct actions learned through participation in real cultural activities under the guidance of tuakana.	The way of coming to know tikanga is through experience with real activities. It is not to be explicitly taught and learned in an academic fashion. In theory, this pathway is open to anyone.	Social Relation Type: Interactive Social Gaze: Cultivated Social Lens: Discursive
	Tikanga are abstract/technical objects in the sense of being established cultural protocols/codes. These are regarded as real objects requiring learning through direct experience and investigation	Epistemic Relation Type: Ontic Epistemic Insight: Situational/purist Epistemic Lens: Empirical/Technical
“What’s important is that our own knowledge is fed to our children”	Māori/Iwi discursive knowledge is prioritised. <i>Feeding</i> implies a particular characterisation of learning. Critical principles relate to the prioritisation of this knowledge over general societal knowledge.	Epistemic Relation Type: Discursive Epistemic Insight: Situational/purist Epistemic Lens: Principled
“What’s important is not maths, it is the reo....maths is not endangered it can look after itself”	as above.	Epistemic Relation Type: Discursive Epistemic Insight: Situational/purist Epistemic Lens: Principled
Priority is always given to real cultural events such as pōwhiri and tangi	Participation in authentic cultural events is prioritised. Direct experience with these events is gained.	Epistemic Relation Type: Ontic/Discursive Epistemic Insight: Situational/Purist Epistemic Lens: Empirical/Technical/Principled
The Kura is a genuine cultural organisation that engages as such in real cultural life	as above	Epistemic Relation Type: Ontic/Discursive Epistemic Insight: Situational/Purist Epistemic Lens: Empirical/Technical/Principled
“The standards are done as quickly as possible so that we can get on with what really counts in the Kura, Māori and developing students as Māori people located in a Māori world.”	A decision is made to prioritise Iwi knowledge over official societal knowledge. Critical principles inform the decision.	Epistemic Relation Type: Discursive Epistemic Insight: Doctrinal Epistemic Lens: Principled
Whanaketanga (National standards) have been rejected because they assess children against external, age-related measures.	as above	Epistemic Relation Type: Discursive Epistemic Insight: Doctrinal Epistemic Lens: Principled
There is a very high level of teacher autonomy in the Kura. There are no written guides for teachers and what to cover.	Teachers are expected to deal with the <i>kaupapa nui</i> and be able to distinguish what this means in relation to other knowledges, but in a way that is left undefined and uncontrolled.	Epistemic Relation Type: Ontic Epistemic Insight: Situational Epistemic Lens: Technical

Contextualised Description	Rationale	Specialisation
	Teachers are expected to know students as unique Māori identities and interact with them accordingly.	Social Relation Type: Subjective/Interactive Social Gaze: Born
“When a person’s needs are met, they have everything they need to become who they are, they will be able to do anything they want”	This perspective attends wholly to what the Māori student needs in order to flourish. The flourishing is assumed to be a natural, automatic process.	Social Relation Type: Subjective Social Gaze: Social Social Lens: Social/Biological
“Rather than preparing our children for university and conventional careers we should be preparing them to exist in the world as unique people defined in their own ways”	As above.	Social Relation Type: Subjective Social Gaze: Social Social Lens: Social/Biological
Visitors who cannot speak Māori cannot enter the main areas of the Kura	Any person can, in theory, enter the Kura if they speak Māori and abide by tikanga.	Social relation Type: Interactive Social Gaze: Cultivated Social Lens: Discursive

Table 4.8. The Kura ethos related to specialisation concepts

Specialisation tree and plane.

Figure 4.9 represents the Kura ethos as another multi-specialised regime.

There are strong ontic, empirical epistemic lenses (applying to mātauranga) and relatively much weaker discursive, principled epistemic relations (applying to pāngarau). Overall this is represented on the topological plane as relatively weak epistemic relations because these two specialisations co-exist internally and contribute to the overall Kura ethos.

Social relations are multi-specialised but in a different way. Strong subjective, biological social relations are deemed to apply everywhere in the Kura, although pāngarau regimes are a notable exception. The different social specialisation of pāngarau regimes are thereby indicated as a source of struggle with pāngarau. Weaker interactive, discursive social relations apply to people who are not members of the Kura; they are adopted as a way of relating to non-Māori visitors. Social relations are therefore represented as strong on the topological plane.

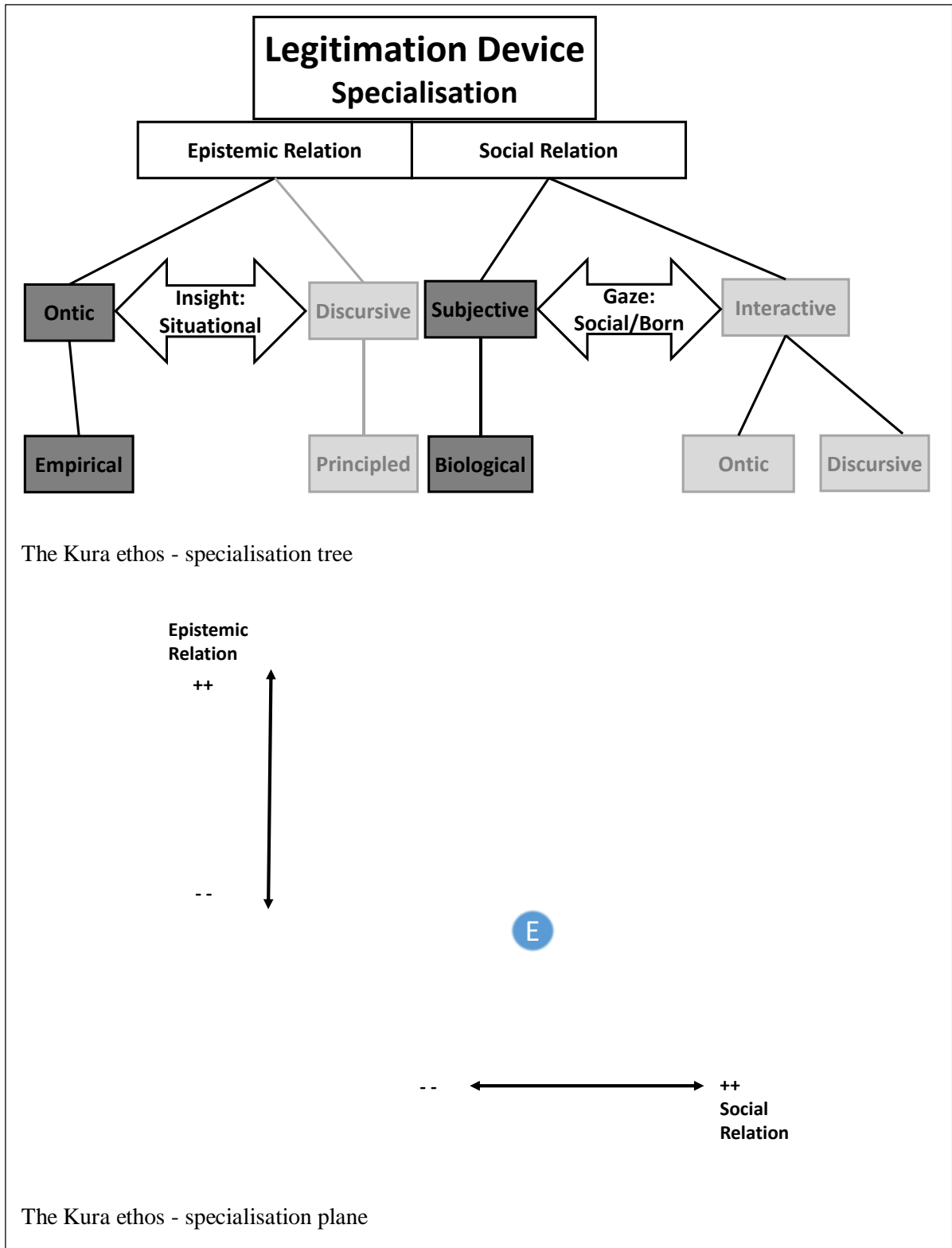


Figure 4.9. The Kura ethos - specialisations of the epistemic and social relation.

Discussion.

The combination of social relations and epistemic relations identified above constitutes the background specialisation code in which all learning activities occur. The strong social relations and weaker epistemic relations is consistent with a conception of the Kura ethos as tending towards a knower-code social field. In such a field, a Māori knower who thinks and acts in Māori ways may train their social/born gaze on any object of study.

Ancestral knowledge and history is learned in the form of waiata (song), pūrākau (story) and mōteatea (story/poetry/chant). The natural world is related to through *atua* (anthropomorphised elements of the natural world). Practices are authentic and engaged with in real time as authentic participants. The cultural events engaged in by students and teachers are non-pedagogised events. They are not learning exercises designed for learning how to participate in an actual event. In this respect, the traditional discourses are learned not for the purpose of knowing the discourses for its own sake; they are learned and developed further (new discourses created) by participation in actual events. This is interpreted as being an ontic epistemic relation. This is a distinctive feature of the Kura ethos which contrasts strongly with what Bernstein would have described as the *imaginary subjects* of recontextualised learning areas (Bernstein, 2000, pp. 32-33).

A notable exception, and highly significant in this thesis, is the position of pāngarau/Te Poutama Tau. The object of study is a distinct, highly defined, de-contextualised world of numbers, organisations of quantities and number relations. Engaging with this object of study is also defined to be *conceptual learning* – learning to grasp generalised patterns and connections between de-contextualised numbers, structured in particular ways (the decimal place value system for example). Pāngarau occurs in *suspended* time; learning, in theory, can take as long as necessary. Temporality is a still-developing part of Legitimation Code Theory but the importance of considering relations to time (real-time/suspended time) is relevant in the case of the Kura ethos and contributes to differences in specialisation between the ethos and pāngarau activities.

The autonomy granted to teachers may be based on a set of assumptions about teachers shared understandings of the Kura ethos. The possibility is created for teachers to adopt a wide variety of different specialisations in their classroom regimes with varying degrees of complementarity and/or contradiction. This creates the possibility of significant

divergence of classroom regimes and a developing tension which may reflect back on the ethos itself.

With respect to pāngarau regimes teachers are free to interpret pāngarau in different ways in an ethos that does not define and strongly control official knowledge and ways of learning it. With mātauranga and te reo Māori (Māori language), a degree of shared understanding might be expected without the need to define and control explicitly. Pāngarau, however, does not enjoy such a shared understanding. The quite different specialisations in each classroom regime are then primarily influenced by individual teacher ideologies.

In a regime which has relatively weak epistemic relations and stronger social relations, learners are made aware of legitimate social relations but must infer or abduct knowledge for themselves. This requires careful interpretation. Through legitimate participation in social relations, knowledge of those relations can be built up by accumulation across experiences and explicit explanation during participation. Specific principles that underpin those relations and guide how participation must happen, mātauranga, are not usually made explicit (at least not in the data). This may be because such mātauranga is in fact esoteric and not made available for everyone. This constitutes a strong knower orientation since the knower must be ready to receive such knowledge, that is, be a very particular kind of knower. Weakness of epistemic relations refers to the definition and control of knowledge, not the nature of the knowledge itself. Mātauranga is a very powerful, abstract form of knowledge but only certain kinds of knower may acquire it; it is accessible through strong social relations not strong epistemic relations.

Considering forms of causality, weak epistemic and stronger social relations tend to support holistic causality in terms of knowledge acquisition but rhythmic forms in terms of social participation. Mātauranga must be abducted from the holistic dialogic context which presents totalities of social relations and entities; legitimate participation in social relations can be learned through participation and rhythmic experience over time in social practices and events. This makes possible multiple interpretations of mātauranga by different people all of which allow them to function successfully in social relations. Over time, divergences of interpretation may occur which result in tension and possible conflict. The practice of wānanga, which governs all meetings at the Kura, involves a free expression of opinion and understandings; wānanga are made necessary to bring together divergent understandings generated in the strong social and weak epistemic conditions of the Kura ethos.

Transfactual relations are derived from the Kura's philosophy. They express such relations as: for the Māori language to survive, total immersion in the language is necessary; Māori knowledge must be prioritised with other knowledge sub-ordinate to it so that Māori culture and language will survive and grow; and, Māori students must be fluent in both Māori and Pākehā worlds so that they may be Māori and earn a living. These relations can be seen to be operational in the background; they are interpreted by the Kura community to produce the particular specialisations of the Kura ethos which institutes forms of holistic and rhythmic causality.

Conclusion.

The Kura ethos has a tendency towards a strong knower-code with a clear emphasis on developing students as unique Māori individuals who are grounded in a Māori reality. This specialisation contradicts commonly held stereotypical, racialised and essentialising views of Māori as operating collectively, not being interested in personal success, and socially oriented (Bidois, 2012). This case example presents a much more nuanced interpretation; whilst all students are expected to be Māori, operate in a Māori ontology and to contribute to their whānau and Iwi, personal excellence is an indispensable part of this. Developing the potential of each student simultaneously develops the capacity of the Iwi as a whole. As students take to new activities and develop capabilities in them, whānau, hapū and Iwi all grow and develop with them. The Kura ethos exemplifies this specialisation; it is not the striving for personal excellence that is at all problematical, it is the reason for that striving. Moreover, this specialisation does not attempt to re-vive a traditional culture and life-style; it is firmly focussed on creating a contemporary Māori way of life that uniquely integrates and re-interprets contemporary knowledge and technologies. The ethos therefore has strong social relations with relatively weak epistemic relations because students are to be established first as Māori and then set on a path towards their own personal form of excellence in potentially any knowledge field. In this way, the Kura ethos emphasises the knower but does not devalue knowledge. As will be discussed in chapter 5, the specialisation of the Kura ethos can be seen to play a significant part in the phenomenon of struggle with pāngarau.

Chapter 5 - Discussion and Conclusions

This chapter integrates all case examples to identify sources of tension between and within specialisations in the context of the Kura and constructs a theoretical causal mechanism for struggle with pāngarau. The discussions of the case examples of chapter 4 inform the following enhanced definitions of knowledge-code and knower-code regimes in the context of the Kura. These definitions underpin the discussion in this chapter.

Knowledge-code regimes involve specialisations and forms of causality which create a social reality as experienced by agents through participating in practices so that their perspectives of dialectical relations *tend to* switch towards discourse about objects of study (not the objects themselves) and the nature of participation (not the nature of participants).

Knower-code regimes involve specialisations and forms of causality which create a social reality as experienced by agents participating in practices so that their perspectives of dialectical relations *tend to* switch towards the objects of study (not discourses about them) and the nature of participants (not the nature of participation).

To be emphasised in these definitions is the phrase *tend to*. This emphasises that forms of causality are not deterministic. Regimes exist in a wide variety of forms as entities in processes of being-in-becoming; although tendencies exist, regimes may still exhibit characteristics not consistent with or completely contrary to those tendencies.

Inter-specialisation Tensions

Figure 5.1 shows a topological representation of all pāngarau specialisations and the Kura ethos specialisation. The topological nature of this representation shows only the relative strengths of specialisation of relations. Although specialisations may appear close to each other on the topological plane, the specialisation type, gaze/insight and lens must also be taken into account. Whaea L's regime and Whaea D's Year 11 regime are very similar in all aspects of the interpretation framework, but Whaea M's dominant regime (MD) differs significantly in the gaze and lens of its epistemic relations and social relations. Maton (2014)

points out that a small difference in lens may generate struggles between actors in social fields that are as intense as major differences between relation types (p. 194). Data from another kura Māori in this study showed a high degree of consistency of specialisation throughout pāngarau regimes and the kura ethos to the level of epistemic lens. Nevertheless, intense clashes were present between regimes (teachers, students and parents) with a principled epistemic lens and those with a procedural epistemic lens.

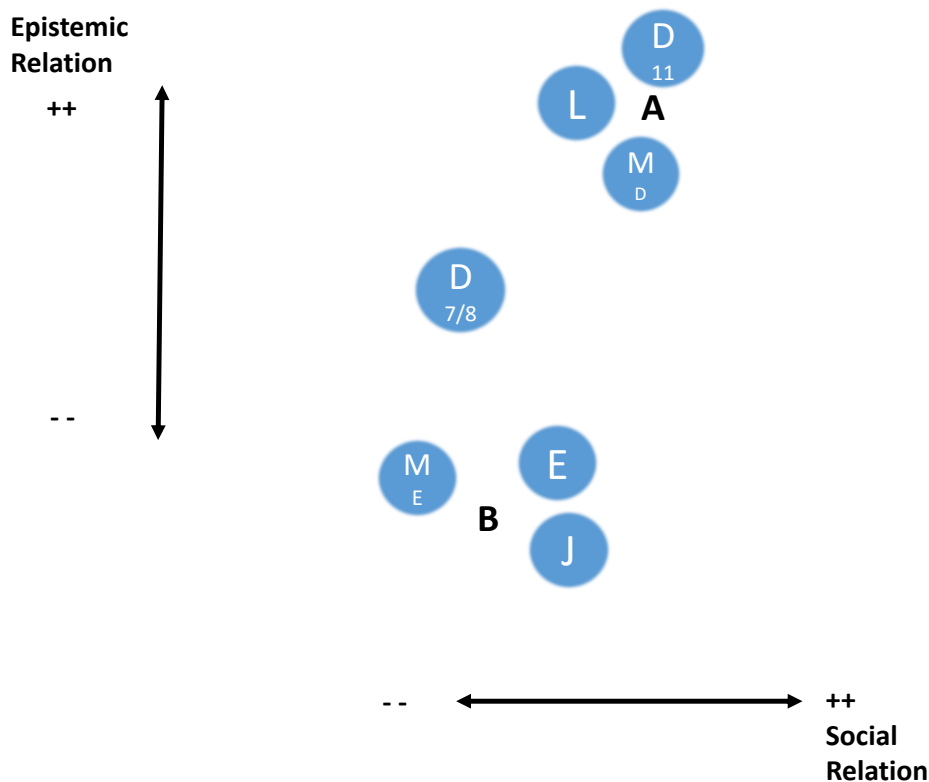


Figure 5.1. Topological representation of all pāngarau specialisations and the Kura ethos specialisation

Figure 5.1 illustrates a polarising effect indicated by cluster A and cluster B. Cluster A represents knowledge-code regimes; cluster B represents knower-code regimes. These clusters indicate potential alliances that may form within the Kura viewing each other with mutually excluding specialisations which tend to increase divergence and tension. They are not necessarily explicit groupings of people who exert their own collective intentional causality. A cluster indicates allied specialisations which may induce collective holistic, rhythmic and transfactual effects regardless of whether those involved are aware of them. Holistically, cluster A and cluster B create confusing and contradictory orientations to

different social realities. Dialectical learning processes in cluster A regimes would abduct a social reality in which knowledge defines the knower; in cluster B regimes a social reality in which knowers define knowledge would be abducted. Students legitimised in one cluster would be more or less subtly de-legitimised in the other creating situations in which the same student is simultaneously legitimate and non-legitimate within the wider context of the Kura.

Regimes are considered to be part of larger constellations. Cluster A regimes are supported by a knowledge-code constellation. Findings in this study indicate that this constellation involves not only strong, discursive epistemic relations and interactive social relations (which are themselves related), but also a range of other entities: a hierarchical knowledge discourse, a problem solving formulation of activity, a mind as container metaphor, a tool metaphor for solution strategies and a well-defined praxeological discourse. In addition, the constellation includes assessment systems, tertiary education systems and the societal division of labour. (Bereiter, 2009; Skovsmose & Valero, 2005; Veel, 2006).

Cluster B regimes are supported by a knower-code constellation. Findings in this study indicate that this constellation involves weaker ontic/discursive epistemic relations and strong subjective social relations (which are themselves related), but also a genealogical knower-structure, a horizontal or towered knowledge discourse, an experiential formulation of activity, mind as an irreducible part of the human person, an *unfolding of potential* metaphor for learning and a collective approach to authentic task achievement. The constellation include relations to Māori spiritual cosmologies and histories, other Iwi, Iwi territories and natural environments/resources, and Māori institutions such as Whare Wānanga, kura Māori organisations, and Iwi confederations (Mead, 2007; Salmond, 1985; Tau, 1999).

It is possible that students and teachers satisfy both legitimisation codes; polarisation indicates a potential/tendency only for students/teachers to migrate to a certain cluster based on a rejection of, or a rejection by, the other cluster. In addition, regimes are never static; within the same classroom, strengths of specialisation change depending on circumstances and context so that the interplay of absences and presences and various dialectical relations cannot be pinned down once and for all.

Whaea D's year 7/8 regime is worthy of note because it occupies middle ground. This regime is of interest because it is multi-specialised and has established a stable rationale between different specialisations. Discursive, principled epistemic relations exist

simultaneously with weaker, but significant, ontic, technical ones. Interactive, discursive social relations exist simultaneously with subjective, social/biological ones. Discursive epistemic relations are aligned with cluster A, ontic epistemic relations with cluster B. Similarly, interactive social relations align with A, subjective relations with cluster B. The multi-specialised nature of this regime refracts the polarisation seen in the whole Kura. It achieves an equilibrium point through the effective management of perspectival switches but this may be unstable as Whaea D herself expresses a preference for a regime more closely aligned with cluster B and may exert intentional agency to bring this about.

All teachers simultaneously experience significant pressure from other teachers, parents and external agencies most significantly national assessment requirements. At the same time, they express their own critiques of, and exert pressure on, other teachers' practices. The basis of legitimation in one regime is the basis of de-legitimation in another; they are at least partially mutually excluding regimes. For example, Whaea L expresses strong anxiety about a lack of Te Poutama Tau/Numeracy data for her students and a low prioritisation of pāngarau in cluster B. Matua J regards other regimes (cluster A) as boring, predictable, regimented and ignoring students' individuality. There are small and large tensions generated between teachers due to this phenomenon - the simultaneous mutual evaluation of each other's practices based on specialisations that legitimate different combinations of the social relation and epistemic relation. This then is one cause of struggle with pāngarau.

Students must make quite large adjustments in order to participate legitimately in different regimes. This aspect of the situation is only touched upon in this thesis but there is some anecdotal evidence that indicates possible student responses. Whaea D's year 11 students express a definite disengagement from their learning. Authority has been transferred to the teacher and the rules and procedures of pāngarau knowledge. In Matua J's regime, students adopt a collective social pattern transferred from the general Kura ethos. Students in Whaea D's year 7/8 regime express a clear relation between the pāngarau learning and how it relates to life; pāngarau problem solving competence transfers to problems in life.

These insights suggest that students adopt the specialisation of the regime in which they learn albeit in their own recontextualised, refracted and/or diffracted forms. This is consistent with the fact that a continuous stream of legitimation and evaluation is given by

each teacher to maintain the specialisation. It would be surprising if students developed a specialisation that was not consistent with the evaluative feedback they receive.

The Kura ethos as ambient specialisation

Viewing the Kura ethos as a specialisation in its own right allows consideration of type, gaze/insight and lens clashes with specialisations in individual pāngarau regimes. Where classroom regimes specialise relations in pāngarau activities, the Kura ethos specialises these relations for whole Kura activities including how individual classroom regimes are regulated in terms of social relations and epistemic relations. The specialisation of the Kura ethos provides the ambient, background conditions in which classroom regimes are formed and must continue to co-exist.

There are important differences between pāngarau regimes and the Kura ethos. Tables 5.1 and 5.2 indicate quite significant differences at all levels of interpretation between most pāngarau regimes and the specialisation of the Kura ethos. Only Matua J has an established regime that resembles the specialisation of the Kura ethos. Whaea M's emergent regime tends towards the Kura ethos but all other regimes have significant differences at all interpretive levels.

Most noticeably different is the ontic, situational specialisation of the epistemic relations of the Kura ethos compared with discursive, purist/doctrinal specialisations in most classroom regimes. This indicates a quite fundamental difference in orientation. The Kura ethos is about engaging with localised, cultural knowledge through real engagement in actual cultural events. The discursive, purist/doctrinal focus of most pāngarau regimes indicates that they attend to a pre-defined, and therefore decontextualised, discourse about pāngarau (derived from the Curriculum and Te Poutama Tau) with strong specialisations about what can be studied and/or how this should be studied. The Kura ethos's epistemic relations are also weak whereas pāngarau epistemic specialisations are strong. The Kura ethos does not strongly define or control pāngarau specialisations so that individual teachers have considerable freedom in establishing their own regimes according to their own ideological/transfactual persuasions.

Regime	Epistemic Relations			
	Type	Insight	Lens	Strength
Kura ethos	Ontic	Situational/ Purist	Empirical	--
D 11	Discursive	Purist	Procedural/ Principled	++
D 7/8	Discursive/ Ontic	Doctrinal/ Purist	Principled/ Technical	+
L	Discursive	Doctrinal	Procedural	++
MD	Discursive	Doctrinal/ Purist	Principled	++
ME	Ontic/ Discursive	Situational/ Purist	Empirical/ Principled	--
J	Discursive/ Ontic	Situational/ Purist	Empirical/ Principled	--

Table 5.1. Summary of all specialisations of epistemic relations in terms of strength, type, insight, lens, and strength.

Regime	Social Relations			
	Type	Gaze	Lens	Strength
Kura ethos	Subjective	Social/Born	Biological	++
D 11	Interactive	Cultivated	Discursive	++
D 7/8	Interactive/ Subjective	Cultivated	Discursive Ontic/ Social/ Biological	+
L	Interactive	Cultivated /Social	Discursive	++
MD	Interactive	Cultivated/Born	Discursive/ Attributional	++
ME	Subjective/ Interactive	Born/Biological	Biological/ Discursive	++
J	Subjective/ Interactive	Born/Biological	Biological/ Discursive	++

Table 5.2. Summary of all specialisations of social relations in terms of strength, type, gaze and lens, and strength.

Tensions are created since teachers, as indicated in individual case studies, draw on a variety of influences to guide the formations of their pāngarau specialisations. In all case examples, the teachers' own school experiences are significant influences. For all teachers, except Matua J, this experience was in English-medium schools. Of interest in this respect is the observation that Matua J is the only graduate of a kura Māori and his pāngarau specialisation is also closest to the Kura ethos. The other main influences are the official resources of the Curriculum and Te Poutama Tau. The main influences on teachers' specialisations in pāngarau then are not usually derived from the Kura ethos. They are instead derived from English-medium experiences and official knowledge. Pāngarau specialisations in the Kura are strongly influenced by a recontextualised pedagogic version of mathematics or, as Bernstein may have said, an imaginary mathematics. The situation is made more complex because pāngarau itself is a recontextualisation of the English-medium pedagogic version of mathematics. Pāngarau in the Kura then can be considered as a recontextualisation of a recontextualisation of mathematics.

All teachers express various degrees of insecurity about mathematics. Teachers tend to rely on the official resources themselves as a source of authority in pāngarau resulting in the use of official resources in a relatively uncritical manner. Throughout the data, teachers express a lack of critical concern about pāngarau, about the pāngarau register and hidden values that may be contained within them. Students are also consistent in their recognition of pāngarau as important in the world and closely connected with being intelligent and successful. In this way, the weak epistemic relations of the Kura ethos create recursive tensions by allowing the development of specialisations in different areas of the Kura with varying degrees of complementarity. This creates on-going strains and tensions with the Kura ethos itself.

The analysis of specialisations in classroom regimes and the Kura ethos portrays a dynamic, dialectical picture in which specialisations are formed in relation to each other and to constellations of systems and totalities external to the Kura. The Kura itself can be considered as a partially closed totality; the institution provides a porous boundary between itself and societal entities. Within the Kura, specialisations jostle with each other generating struggles and tensions. They also react to recontextualisations, diffractions and refractions of external societal totalities which introduce such notions as the universality of mathematics, its inherence in reality and its importance for survival in general society. These recontextualisations are referred to in the analysis of data as transfactual causal statements

which give substance to beliefs underpinning practices. For example, the adoption of a strict levelled knowledge structure and graded activities is underpinned by the transfactual causal statement relating achievement of higher knowledge levels to enhanced prosperity in general society. These transfactual causal relations operating as belief may or may not be valid.

Intra-specialisation Tensions

The case examples describe several ways in which struggle is expressed within individual classroom regimes. Each regime exhibits its own characteristic form of struggle which can be related to the way causality and specialisation operate to create dilemmas for teachers and students.

In Whaea L's regime, struggle is expressed in the practice of *fence-hopping*. Whaea L relaxes epistemic strength in order to emphasise social aspects in response to emotional distress of students. This is followed by an attempt to tighten epistemic relations and re-establish the specialisation. There is an imaginary fence established by the strong specialisation of epistemic relations and social relations that clearly marks a boundary between legitimate and non-legitimate actions. Emotional distress shown by a student invites the temporary crossing of this boundary by Whaea L into the social domain where emotional distress is legitimate. On relaxing conditions, a temporary dismantling of the boundary fence, the student may make a foray into the legitimate area on altered terms which represent a temporary suspension of the usual evaluations of legitimate actions. The contradiction for Whaea L is generated by a simultaneous strong legitimization of epistemic relations of a particular kind and a strongly felt personal concern for students' social and emotional well-being. The strong epistemic relations create the fence between these two concerns which is negotiated in the fence-jumping practice.

In Whaea M's regime, struggle is expressed as a desire to completely change the regime to be more consistent with the general Kura ethos. In her dominant regime, the *ratcheting down* practice can be related to a mismatch of pāngarau and Kura ethos specialisations.

In Matua J's regime, there are strong social relations and weak epistemic relations creating a specialisation very close to that of the Kura ethos. The learning of the

curriculum/Te Poutama Tau forms of pāngarau are left untended to happen incidentally as social activities which incorporate pāngarau elements are participated in. The struggle that this creates is expressed by Matua J's *window dressing* practice. Worksheet exercises or practice exercises are inserted into lessons that explicitly and obviously show students *doing real mathematics*.

Matua J expresses most clearly a phenomenon expressed to varying extents in all case examples. *Being Māori* is confined to pedagogy; pāngarau knowledge itself is non-Māori and cannot be changed. This may be interpreted as a symptom of the struggle for legitimation between the strong knowledge-code of pāngarau and the strong knower-code of the Kura ethos. Pāngarau knowledge is thought to be unassailable; *being Māori* must therefore be confined to social, linguistic and cultural elements embedded in pedagogic practices. This, however, does not resolve struggle because social relations and epistemic relations are related; clashes still exist between social relations emphasising genealogical identity and epistemic relations which induce identities built around knowledge. A hierarchical knowledge discourse imputes greater value to higher knowledge levels; it is very difficult to prevent that value being inherited and incorporated into identities by students operating at higher knowledge levels.

In Whaea D's regimes, there is a distinct regime shift from a moderate/strong multi-specialised regime in the year 7/8 regime to a strong simple relations regime in year 11. Struggle is generated by a closer proximity to high stakes assessment which prompts a tightening of the teacher's grip on knowledge to ensure that necessary knowledge is acquired by students. In the process, subjective social relations and ontic epistemic relations, which may be associated with culturally contextualised Māori knowledge and students, are absented.

The various ways in which struggle is expressed in the different regimes are theorised to arise from attempting to negotiate contradictions between knowledge-code and knower-code orientations inherent in the regimes themselves. These orientations are indicated by the multi-specialised nature of several of the regimes. They have stronger relations which place them in cluster A or cluster B but in certain circumstances, weaker but still significant specialisations come to the fore which are more aligned with the other cluster. This indicates how the regimes are formed in dialectical relations with each other and permeate each other. For example, Matua J adopts a knowledge orientation in his window-dressing practices;

Whaea L jumps to a knower orientation when students are distressed by her procedural knowledge oriented pāngarau practices. Both Matua J and Whaea L justify these perspective switches in terms of satisfying the legitimisation requirements of the other cluster. Whaea D most clearly expresses a perspective switch in relation to the external totality of the national assessment system; knowledge orientation increases with proximity to national assessment.

The Kura ethos is the site of recontextualisation of the totalities of Māori society which centre on the relatedness of people within Iwi (tribes) based on whakapapa (genealogy). Although the data and analysis do not present a synoptic picture of the Kura ethos, the way in which classroom regimes, teachers, students, and recontextualisations of external totalities exist “side-by-side, jostling and elbowing each other”, as theorised in chapter 2, is clearly expressed in an analysis of specialisation. Further analysis of specialisations and other dimensions of the legitimisation device may provide more detailed understandings of how the many elements involved in this dynamic situation are related to each other and to external constellations. Three types of necessity relation between such elements can be identified; *existential constitution*, *existential permeation* and *causal connection*. These correspond to relations of necessary inclusion of one entity in another, necessary proximity of one to another, and production of causal effects by one in another respectively (Bhaskar, 1993, p. 53). Investigating these types of necessity relation is another area of further research.

The Knower/Knowledge Dialectic

The case examples highlight the various ways in which tensions and struggle are expressed and responded to between regimes and within regimes. The last section drew attention to the inherent contradictions that generate these tensions. This section seeks to bring together conclusions made in each case example that relate the various compromise practices to a fundamental knower/knowledge dialectic.

Maton (2014) describes all social fields as *knower-knowledge structures*. This is interpreted to mean that each social field establishes its own setting of the knower/knowledge dialectic legitimising a perspective on the relationship between the knower who knows knowledge and the knowledge that is known by that knower. The legitimised perspective provides the grounds on which practices are built which embody the refracted/diffracted form

of the dialectic experienced by agents. Each specialisation is created by ideological means, which incorporate a variety of influences, to produce a precarious balance of perspectives on pāngarau knowers and their pāngarau knowledge.

For example, in Whaea D's year 7/8 regime there is an even balance between knowers and knowledge. Knowers are recognised as unique individuals in the way the knowledge is learned by them. Whaea D is, however, able to conduct a perspectival shift to recognise the stages of knowledge that each knower has learned. In her year 7/8 class, activities are conducted without obvious, direct knowledge evaluations; social and personal relations are balanced with contextual and conditional evaluations of knowledge. In planning activities, however, Whaea D can switch to a knowledge perspective in order to select appropriate activities which are intended to develop knowledge at higher stages. In Whaea D's year 11 regime, the knowledge that students are learning is consistently foregrounded with no perspective switching occurring. Students, for the purposes of pāngarau and NCEA standards achievement, are seen in terms of their knowledge status only.

Whaea M's dominant regime foregrounds knowledge; her emergent regime foreground knowers. Matua J consistently foregrounds knowers so that any knowledge learned is highly dependent on the social relations of students. Whaea L foregrounds knowledge and sees students in terms of knowledge status.

In each regime, the particular instantiations of dialectical relations between components (social reality, resources, students/teachers, knowledge structures, and practices) contain within them refracted forms of the particular determination of the knower/knowledge dialectic. This determination solidifies the shifting blurred picture of the human person as simultaneously a knower and their knowledge (and other things) to one which can be used as a basis for practices (remembering also that these practices require such a definition). From this dialectical perspective the hierarchical knowledge structure of the pāngarau curriculum, the grading of problems in alignment with curriculum levels, and the definition of pāngarau as problem solving, can all be interpreted as a partial totality that is based on an underlying legitimisation of knowledge rather than the knower. This partial totality exerts holistic causality to induce a knowledge-code in pāngarau classrooms. In the context of the Kura in this study which has a knower-code ethos, pāngarau creates struggle by inducing *bubbles* of knowledge-code regimes within a knower-code ethos.

This interpretation of specialisations and tensions in and between pāngarau regimes as refracted/diffracted knower/knowledge dialectics is shown conceptually in figure 5.2. The Kura ethos plays an important part in the refraction process by creating the conditions in which different classroom regimes may develop disparate specialisations.

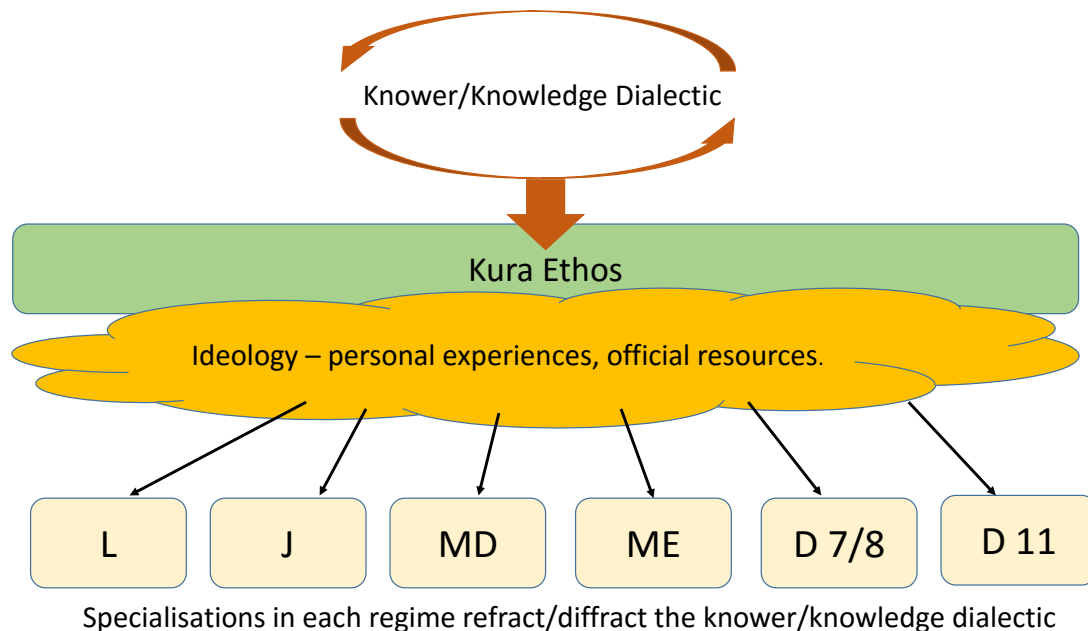


Figure 5.2. Regimes as refractions/diffractions of the knower/knowledge dialectic.

Dialectics Revisited

In this thesis, dialectical relationships are understood to arise from the possibility of attributing multiple meanings simultaneously to intransitive objects. All meanings are abstract and possess a separation from the object which is the intransitive referent of the meaning. This separation between abstract meaning and real referent, (Bernstein's *discursive gap*), is the source of dialectics and their resulting contradictions and tensions.

Because of the possibility of multiple meanings, the establishment of specialisations in social fields is essential in order for knowers to understand how to participate meaningfully in the field. Thus, dialectical relationships are always involved in social life and specialisations are necessary to collapse the range of potential meanings to just those meanings that underpin legitimate participation in practices.

Referring to the common notion that *mathematics is everywhere* and adopting this dialectical perspective, it becomes clear that this statement is simultaneously both true and false. It is true since all objects have multiple meanings, some of which can always be construed as mathematical. It is false since there are other meanings that can be seen in the object, and in relation to certain social practices, that are not mathematical and may contradict the view that the object is mathematical. Specialisations then can be thought as a conditioning of gaze/insight to select particular meanings from a meaning potential. A dialectical learning process is conceptualised as an abductive leap from specialisation-contoured, dialogic contexts to legitimate gazes/insights and meanings. Multiple meanings, specialisations, a dialectical/dialogic concept of learning, and forms of causality are therefore inter-twined in the process of learning and part of the theoretical causal mechanisms for struggle with pāngarau.

The notion that all intransitive entities may have multiple meanings applies equally well to people since a person is also an intransitive entity. Each person may be given a range of possible meanings; the meaning potential for a person needs to be collapsed to a legitimate meaning in a particular social field so that its practices may be defined. The knower/knowledge dialectic is particularly relevant to meaning potentials for people (students) in terms of the fundamental interests of a pedagogic social field – the development of a person's identity and their knowledge. In other social fields with different interests, diffracted/refracted forms of other dialectics may be at play to create struggle.

Summary

This section has discussed in detail the overall findings of the data analysis. The findings have been interpreted as various refractions of an over-arching knower/knowledge dialectic. The section has responded to the first research question by illuminating the characteristics of struggle with pāngarau in the Kura as tensions between and within specialisations which specify the form taken by the various diffractions/refractions of the knower/knowledge dialectic.

In terms of methodology, empirical features have been related to abstract concepts. Some of these concepts are *specialisation*, *ethos* (as collective specialisation), *ideology*, *recontextualisation*, *refraction*, *diffraction*, *legitimation code*, and *knower/knowledge dialectic*. The particular way in which concepts are established in relation to each other in the Kura context constitutes a causal mechanism for struggle with pāngarau.

Each case example also presents complicated interplays and exchanges between absences and presences which contribute to the phenomenon of struggle with pāngarau. Students and teachers switching between knower-code and knowledge-code regimes experience the real absence of legitimised elements of one regime in the other but in individualised and contextualised ways. For example, some students and teachers feel an absence of being Māori in knowledge-code pāngarau regimes but others thrive in them because the absence of societal knowledge felt by these students in knower-code regimes is remedied. Precisely what is being made absent and present is in need of more detailed analysis. Although at a very general level knowledge-code pāngarau makes knower-code mātauranga absent and vice-versa, it is not the case that knowledge-codes are non-Māori and knower-codes Māori. This is far too simplistic. Rather, as discussed in Whaea L's case example, subtle appropriations of cultural icons and knowledge, and *sleights of hand*, substitute pāngarau knowledge-code for mātauranga which may also be organised as knowledge-code but on a different set of organising principles. Subtle, micro-absences/presences are created by these substitutions and cultural appropriations which create dilemmas, deriving from a generalised knower/knowledge dialectic, in the fabric of social activity in the Kura.

The next section will continue this discussion and elaborate a more complete causal mechanism. Developing an understanding of the mechanism operating in the Kura will allow the perspective to be broadened to see the phenomenon of struggle with pāngarau as related to totalities operating in Māori society, general society and in global society. It will also indicate the potential for forms of alienation which may be experienced by both students and teachers.

A Causal Mechanism for Struggle for Pāngarau (with promissory notes)

This section attempts to bring together the findings of data analysis with dialectical realist ontology to construct a causal mechanism for the phenomenon of struggle with pāngarau. This provides a response to the second research question about causes of struggle with pāngarau. This causal mechanism will be incomplete because further substantial empirical research is necessary to illuminate various parts of the mechanism which at this stage can only be indicated by *promissory notes* (Manicas, 2006).

Promissory notes are necessary because of the partial nature of analysis (focussing only on the specialisation dimension of the legitimisation device), the limited nature of collected data (data are from one time period and are not representative of complete regimes), and the fallibility of research in general. This renders the analysis of the nature and relational suspensions of partial totalities incomplete, possibly only attending to a small part of what is necessary. Some significant insights, however, may be gained by considering briefly two totalities which have clear construals in the data. These totalities are *pāngarau* and *mātauranga* (Māori knowledge).

The pāngarau curriculum makes some very clear statements about the universality of mathematical knowledge and attempts to relate mātauranga and pāngarau. Pre-colonisation Māori are portrayed as using mathematical knowledge as an intrinsic part of their traditional life and practices (Te Tāhūhū o te Mātauranga, 2008, p. 40). The curriculum provides clear examples of what Dowling (1998, pp. 1-24) describes as myths of mathematics education which are designed to support the established configurations of mathematics education. For example, Dowling describes the *myth of reference* as the notion that pāngarau is *in everything, everywhere* which legitimises the use of any context for mathematical purposes. Dowling also describes a *myth of emancipation* which asserts that revealing the inherent *mathematical nature* of indigenous practices will connect indigenous students with mathematics, enhance their learning of it, and support the achievement of their aspirations. In this regard, traditional indigenous practices are considered as *frozen* examples of more abstract mathematical practices and are subordinated to them. With these myths in mind, it is possible to see many of the current pāngarau curriculum resources as doing symbolic violence to mātauranga and traditional practices by reconstructing traditional practices as mathematical practices, and pre-colonisation Māori people as mathematicians.

A brief analysis of literature about mātauranga suggests its strong knower-code orientation (Durie, 2004; Marsden, 2003; Mead, 2012; L. T. Mead, 1996; Mika, 2012 ; Patterson, 1992, 1994, 2000; Robinson, 2005; Salmond, 1985, 1998, 2009; Tau, 1999). Mātauranga is portrayed in this literature as a body of ethical and philosophical knowledge concerned with how people exist in the world holistically in relation to all other entities as part of a naturally occurring world beyond human control. In this ontology, people are considered to be intrinsically legitimate and valuable because they are part of the unity of a natural world. Human knowledge is to be derived from the accumulation of past human experiences held by current generations of people. Mātauranga is recontextualised throughout the Kura but is most clearly expressed in the Kura ethos considered as the site for a diffraction/refraction/recontextualisation of this knower-code.

Pāngarau, as a recontextualisation of English-medium mathematics education, retains conventional structural relations and is a strong knowledge-code. It has a hierarchical knowledge discourse expressed in the eight levels of the curriculum. It is formulated metaphorically as the use of mathematical tools to solve problems which gives it a utilitarian complexion aligning well with the myths of mathematics education (Dowling, 1998). Problems, and formal assessments themselves are graded and aligned with curriculum levels so that when a student solves a problem using legitimate mathematical tools, that student may be located at a curriculum level. Pāngarau, as the case examples and discussion demonstrate, is recontextualised differently by each teacher in their pāngarau regimes which exist in uneasy and unstable relations to mātauranga as recontextualised in the Kura ethos.

Constructing a causal mechanism involves identifying the *cogs and wheels* that produce struggle with pāngarau. Components of the causal mechanism must be carefully defined theoretically so as to abstract relevant features of each component (Hedström & Ylikoski, 2010; Hernes, 1998). The mechanism is a transitive and fallible work that must have the theoretical assumptions empirically tested. This may convert the theoretically possible mechanism to a plausible mechanism and eventually to a close approximation of the real mechanism. Hedstrom and Ylikoski also emphasise that while the mechanism should at least partially explain the effect under consideration, it is not necessary for each component to be explained; as Manicas (2006) observes, promissory notes may stand in for components. Promissory notes theorise how the component operates in the mechanism but do not need to explain the component itself.

Gerring (2008) emphasises that the identification and theoretical definition of components in a mechanism is a very difficult task. It potentially involves definition of entities, relations, temporal orderings and forms of causality. This work has already largely been done in previous chapters. The causal mechanism involves complex articulations of a large number of theoretical entities and processes which are shown conceptually as an *exploded diagram* in figure 5.3. Promissory notes, indicated within cloud symbols, are included where further research is required.

A major promissory note which has been partially attended to in the case examples refers to the relations between types and strengths of specialisation, and forms of causality. Case examples have indicated that some regimes tend to emphasise holistic forms of causality rather than rhythmic; other regimes emphasise rhythmic rather than holistic. Dialectical learning is also part of this promissory note. Although its nature has been quite carefully described in this thesis, its relations with forms of causality and specialisation remain unclear. What is clear is that all three are implicated in the collapse of meaning potentials during learning which absent some meanings (and the constellations/totalities supporting them) whilst legitimising others.

Other promissory notes refer to: how student specialisations, and more generally their subjectivities, are related to pāngarau specialisations; how assessment systems and the societal division of labour (economic system) relate to legitimate meanings in pāngarau; how a Māori division of labour/economic system relates to mātauranga; the nature of mathematical knowledge; and the nature of mātauranga. These are very demanding areas of research both theoretically and methodologically and call for major research projects.

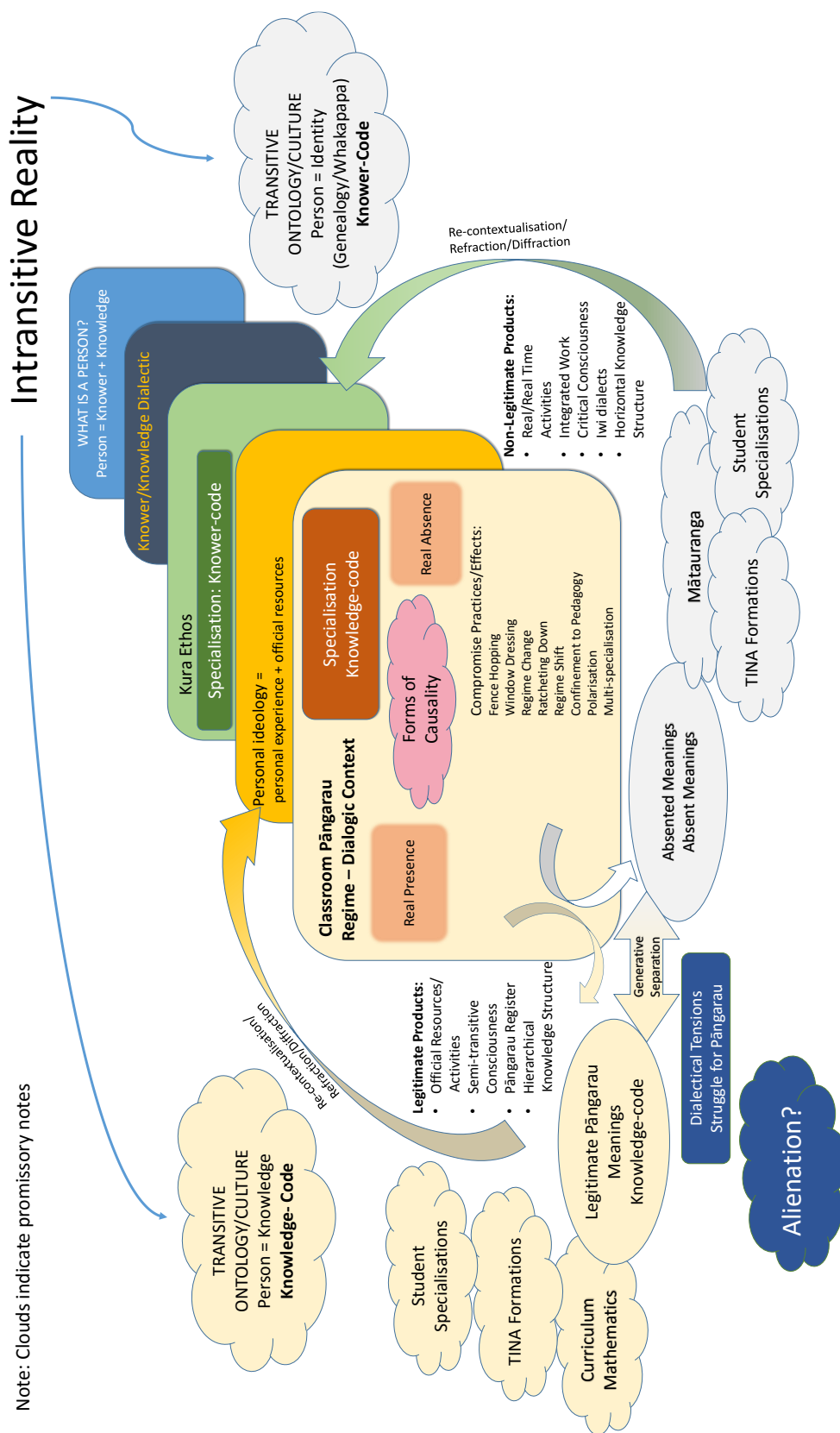


Figure 5.3. Causal mechanism for struggle with pāngarau.

The Description of the Mechanism

(In the following description bold font is used to indicate abstractions necessary in the formation of the mechanism.)

Beginning by considering **people as intransitive real entities**, the mechanism indicates that the knower/knowledge dialectic is refracted/diffracted in different ways to provide a stable definition of people for elements of the social fields/regimes operating in the Kura. Specialisations, resources, practices, forms of causality, teachers and knowledge structures are theorised to be orchestrated (by specialisations and forms of causality) so that the subjectivities of learners are conditioned in a variety of ways. It is important here to understand that *conditioning* in this context includes ways in which the learners themselves exert their own intentionality/agency and respond to the dialogic/dialectical learning context. It is also to be understood that teachers are also sometimes learners. The orchestrations within the social fields of the Kura are related through processes of **recontextualisation**, **refraction** and **diffraction** applied to both general and Māori societal totalities.

The mechanism starts in **intransitive reality** considered to be in a state of unity and infallible. This indicates intransitive reality as being independent of human understanding and not riven by fallibility, dualities and dualisms which are the creations of human geo-cultural-social history. A **person is simultaneously a knower and their knowledge**. This invokes the **knower/ knowledge dialectic** because a dialectical determination must be made about what constitutes a person for the purposes and interest of the Kura and pāngarau. Groups of people over time establish **transitive ontologies/social realities** which provide the basis for their practices. Because different groups of people have different histories, they adopt different settings of the knower/knowledge dialectic. One pole of this dialectic is a **knowledge-code** associated with pāngarau and general New Zealand and Global Society; a **person is equated with official measurements of their knowledge**. Another pole is a **knower-code** associated with mātauranga and Māori society; **a person is equated with their genealogical identity/whakapapa**.

The Kura is a **societal institution** and a **Māori institution**. As a societal institution, it is subject to recontextualising/refracting/diffracting fields in general society. As a Māori institution it is subject to recontextualising/refracting/diffracting fields in Māori society.

Mātauranga is recontextualised within the Kura ethos. Pāngarau is recontextualised within teachers' personal ideologies.

The Kura is composed of 3 levels: the **Kura ethos, personal ideologies** and **classroom pāngarau regimes**. Each level is conceptualised as a structure which has emerged from all the past social activity of all people involved in that level. Classroom pāngarau regimes can be thought of as the emerged product of all of its influences – personal experiences of teachers, students, conditions and official resources, and those of the anonymous writers of such official resources. Personal ideologies similarly are emerged entities (totalities) – a product of all past influences on that person. The Kura ethos is an emerged structure, the product of the activities of all past members of the Kura. In figure 5.3, each level is represented as a structure but it is to be understood that various groups of people, are bound within each level. Transfactual, rhythmic, holistic, and intentional modes of causality operate to actualise events which are experienced empirically/subjectively by teachers and students within each structure.

The three levels of the Kura have **specialisations** and invoke **forms of causality**. The Kura ethos specifies a **collective specialisation**; teachers, as **specialisation managers**, are responsible for the specialisation in the classroom pāngarau regime. Within each pāngarau classroom regime, a knowledge-code specialisation contours the **dialogic context** so that students, as **dialectical learners**, become attuned to the specialisation, responding to forms of causality and exerting their own intentional agencies.

The Kura ethos is a knower-code. Classroom pāngarau regimes are knowledge-codes. Classroom regimes tend to absent knower-code orientations (block, mask or recontextualise the knower-code of the Kura ethos) and create knower-code mātauranga as a **real absence** and pāngarau as a **real presence**. The Kura ethos tends to absent knowledge-codes creating mātauranga as a real presence and pāngarau as a real absence.

In the process of dialectical learning, students become attuned to the specialisation in varying degrees. A **generative separation** may occur with some students becoming strongly oriented to knowledge-code pāngarau; other students, rejecting or being rejected by pāngarau, become strongly oriented to knower-code mātauranga. Strong social relations and epistemic relations create a distinct boundary between legitimate pāngarau products and non-legitimate. This strong boundary marks the origin of generative separation which creates **dialectical tensions** within classroom regimes, between classroom regimes and with the Kura ethos.

These tensions are dialectical because they are based on conflicting determinations of the knower/knowledge dialectic. Struggle in pāngarau then manifests in the Kura as various **compromise practices** which attempt to deal with these conflicting knower/knowledge settings: **fence jumping, window dressing, regime change, ratcheting down, regime shift, confinement of being Māori to pedagogy, polarisation and multi-specialisation.**

The generative separation is strengthened because pāngarau may be thought of as a **TINA formation**. This TINA formation is a wider constellation of general society totalities and structures involving the division of labour, economic systems, assessment systems and various praxeological, ideological and ontological discourses. Pāngarau comes *ready-made* and presented to the Kura in an official form; the curriculum and associated learning/teaching resources are pre-formatted to carry a sedimented representation (in its knowledge structure, resources, language use, praxeology and patterns of activity/pedagogy) of the past geo-history of the development of pāngarau/mathematics education. It institutes strong forms of causality (transfactual, rhythmic, intentional and holistic) which insist on the continuation of pāngarau in its current form.

The many ways in which pāngarau is promoted by the hegemonic projects of individual teachers, students and families, as well as by larger scale societal institutions, collectively forms a hegemonic situation; pāngarau competence is presented as an unavoidable necessity for all. Questions should be asked about the alethic truth or truths that are being masked by this TINA formation. Although this is an area of future research, this thesis suggests that the TINA formation of pāngarau masks the intransitivity of both students, and intransitive reality itself, by insisting that people are valued by their pāngarau knowledge and that intransitive reality is inherently mathematical. In another sense, the TINA formation masks an obvious truth - there are alternatives to pāngarau. Pāngarau, in its current curriculum form, is not necessary for life, only for participation in a particular form of life.

The generative separation involves the creation of a false dichotomy based on the TINA formation of pāngarau and derived from its denial of alethic truths. Students are oriented to the **legitimate products** of conventionalised pāngarau or its **non-legitimate products**. Legitimate products relate to general society totalities instituted as real presences. In so doing, mātauranga and the division of labour in Māori society are made absent. This is a real absence which is conspicuous and causally involved in the production of the above compromise practices.

Alienation *may result* for students and teachers creating fragmented subjectivities. If a strong knowledge-code is inculcated, then identification with societal knowledge may alienate or create a separation of the student from their own whānau, hapū, and Iwi and their whānau, hapū, and Iwi from them. If a strong knower-code is inculcated (a rejection of the knowledge-code pāngarau regime and an identification with mātauranga), the student becomes oriented towards mātauranga; societal knowledge is alienated from the student's life (as indicated in Matua J's comment that academic pāngarau "has no benefit for people like me") and students from communities where such knowledge is vital.

The mechanism is consistent with the theoretical framework developed in chapter 2; components exert causal influences on each other simultaneously. The strengthening or weakening of one entity in a dialectical relation induces a strengthening or weakening in another through dialectical necessity relations. As the Kura ethos asserts a knower-code orientation more strongly in pāngarau, the absence of societal forms of knowledge may be increased. Teachers, students and families may respond to this absence by re-asserting pāngarau in more conventional forms. This increases the tendency for the learning of pāngarau to ebb and flow through the year levels of the Kura over time.

It may also be apparent that as mātauranga and Māori society increase in presence at national and global levels, the Kura ethos will strengthen its knower-code specialisation and be able to resist the ebb and flow of societal knowledge within its classrooms – a dampening effect due to increased presence (causality/power) of Māori economic and cultural systems in general society. Similarly, increased presence of non-Māori knowledge and systems will increase the presence of recontextualised pāngarau (and other knowledges) in classroom regimes and have the potential to undermine the Kura ethos.

Transitive ontologies/cultures form a link between a fundamental determination of the knower/knowledge dialectic and constellations which constitute the recontextualising fields that feed into the Kura at the levels of personal ideology (for pāngarau) and the Kura ethos (for mātauranga). Being transitive, they are fallible and changeable. Weakening/strengthening of a knowledge-code orientation in general society and/or knower-code orientation in Māori society/mātauranga will influence recontextualising processes. These will alter the balance of real presences and real absences with corresponding outcomes for students.

The causal mechanism just described must be understood as fallible and theoretical. Entities, processes and relations are necessarily greatly simplified. In this sense, the causal mechanism theoretically attenuates entities, processes and relations and thereby indicates extreme cases. In any case, social activity always actualises in blurred, combined and overlapping events which are *messy* and require methodologies that recognise this messiness (Law, 2004). Developing a causal mechanism that deliberately attenuates the components in order to present findings intelligibly, whilst also recognising the pitfalls and benefits of doing so is consistent with the blurredness of actual social life. The theoretical framework also expresses this in its depiction of social life as involving real entities jostling each other in open systems in non-deterministic causal mechanisms.

With respect to this jostling and blurredness, Dialectical Critical Realism suggests that causal mechanisms do not predict events but rather create tendencies for events which may or may not be actualised and experienced. Although the mechanism may be operative it is possible that it is not actualised (has no effect via events in empirical experience) because other mechanisms operate concurrently. With this understanding, there will be contexts in which a generative separation between pāngarau regimes and a kura ethos is less pronounced and struggle with pāngarau is weaker or not experienced at all. For example, in the kura Māori featured in the research of Meaney, Trinick and Fairhall (2011), there appears to be a much closer match between the specialisations of pāngarau and the kura ethos. Teachers work more collaboratively to plan pāngarau activities framed by curriculum structures (Maangi, Smith, Melbourne, & Meaney, 2010). Activities incorporate traditional activities and cultural protocols and are oriented towards the three strands of the curriculum: number and algebra, geometry and measurement, and statistics and probability. This kura attempts to achieve a balance when including ethno-mathematical or cultural activities in pāngarau learning which does not devalue the cultural practice or the mathematics curriculum (Trinick, Meaney, & Fairhall, 2015). Struggle with pāngarau in this kura Māori is less pronounced.

Potentials

When thinking about the mechanism and the Kura in this thesis, the starting point for a consideration of potentials is the assumption that the Kura will maintain its knower-code ethos. The recontextualisation of mātauranga Māori expressed in the ethos is the Kura's own well-spring of legitimation, motivation and purpose; without this, the Kura is just another school.

A significant potential consequence for the Kura that is indicated by the causal mechanism is the development of forms of alienation; an alienation of students from their own socio-cultural origins (and an alienation of families from their children), or an alienation of students from society (and an alienation of society from them). Of importance here is that alienation resulting from dialectical contradictions at the ontological level is an issue for everyone. Alienation of Māori from society automatically means an alienation of society from Māori with resulting ills for everyone. Most students, of course, will exist between the two extremes of alienation but this does not detract from the value of an understanding of the mechanism and its alienating tendencies; it is contended that this understanding can support the development of intentionality/transformational praxis which is an essential part of Māori emancipatory efforts (G. H. Smith, 1997, 2000).

Such a perspective challenges the legitimacy of the TINA formation of pāngarau and the notion that pāngarau learning must occur in a knowledge-code regime. The *unthinkable* may be thought by seeing through the TINA formation to the alethic truths it masks. Pāngarau is a transitive theory about aspects of intransitive reality and so a range of other potential meanings and purposes for pāngarau are possible (Skovsmose, 2011). The indeterminate nature of the real referents of pāngarau thus offer the possibility that pāngarau may be redesigned from a knower-code perspective.

This insight suggests that in addition to a knowledge orientation, which may be loosely associated with behaviourist pedagogies, and a learner orientation, which may be loosely associated with constructivist pedagogies, it is possible to consider a *knower orientation*. This third option challenges the tendency to conceptualise knowledge and learner orientations as existing in a dualism; either knowledge orientation or learner orientation must be established. It also challenges the tendency for wholesale decisions to be made for a school or a class on ideological grounds; for example, a school may decide that all

classes will be mixed-ability, or a teacher may decide to use collaborative learning techniques for the whole class.

This knower orientation involves a distribution of pāngarau knowledge based on understandings of the *totality of each student*, not as a learner of curriculum knowledge but as a unique, intransitive entity in themselves. Such a knower orientation makes no necessary demands for kinds of knowledge or pedagogy keeping options open to the adoption of any pedagogy that will achieve the knowers' aims in relation to any body of knowledge. The knowers' aims are generated from their autonomous Māori subjectivity/identity, that is, their totality. This conception of a knower orientation allows scope for a student to engage with regimes with a variety of specialisations be they knowledge-code or knower-code. For example, a student (or, rather, a person) may engage with pāngarau in a knowledge-code regime with strong classification and framing, such as Bourne's radical visible pedagogy perhaps (Bourne, 2004), and with performing arts in a knower-code with weak classification and framing (an invisible pedagogy). Students and teachers operating in this orientation acknowledge and develop understanding about the dialectical relations between nature of knowledge, nature of pedagogy and nature of knower, and the management of perspectival switches involving them. In order to learn something a person will already know that it is theirs to learn and engage in, what are for them, the most appropriate specialisations and pedagogies.

In this perspective, some knowers will learn no formal mathematics, others will become professional mathematicians and both will be equally valued as members of their Iwi. This amounts to a rinsing out of the axiological dye that permeates the hierarchical knowledge discourse of pāngarau. A student who is operating at level 8 of the curriculum is no more or less valuable than a student operating at level 3; the motivation and means for ascending curriculum levels are legitimised in the totalities englobing the knower not the totalities englobing the knowledge structure being ascended.

It is clear that the issue of subjectivity already touched upon in chapter 2, is a central concern. This knower oriented perspective implies a type of subjectivity which operates from an autonomous Māori position, which is the axiological source of goals and purposes, and engages genuinely with all other knowledges and subjectivities. Here, the term *genuinely* is used to convey an engagement that acknowledges and critically interacts with the nature of knowledges and other subjectivities. The current struggle with pāngarau then can also be

interpreted as a struggle to establish such a subjectivity in relation to mathematics. The creation of this subjectivity requires a conscious separation from the *weak master/slave* dialectical relations that currently exist; kura Māori are overly concerned with and confined by meeting the terms and conditions set by pāngarau, which, in its own turn, requires this kind of mild dependency. The establishment of autonomous Māori subjectivities can create space for a subsequent re-engagement with pāngarau on completely different terms. The following inter-related possibilities for transformative action in relation to pāngarau may all be seen as potentially involved in this disengagement/re-engagement process:

- Challenging the discourse of universality and inevitability of pāngarau; seeing through the TINA formation of pāngarau (Bhaskar, 1993; Joseph, 2007);
- Managing perspectival switches on dialectical relations to centralise mātauranga whilst engaging fully with other bodies of knowledge.
- By-passing official recontextualising fields and seeking a direct engagement with and a new recontextualisation of mathematics (Burton, 2004; Freudenthal, 1991). This could involve creating new achievement standards within the current National Certificate of Educational Achievement system.
- Recognising that mathematics knowledge discourse is not strictly hierarchical which provides a potential for it to align with a knower orientation (O'Halloran, 2007). Students can learn some branches of mathematics without reference to others; coverage of all curriculum strands is not required;
- Engaging with authentic tasks, defined as tasks in a Māori axiological system, that have actual consequences and require actions from teachers and students alike - pāngarau competencies of any kind must be used alongside all other types of competency necessary to achieve the task (Frankenstein, 1983, 2009);
- Understanding the relations of mathematics to the nature of the modern world and its role in formatting the world (Skovsmose, 1994, 2011; Skovsmose & Greer, 2012);
- Understanding pāngarau as a laminated structure with a history sedimented within that structure - an authentic engagement with it would require an understanding of its history, sociology, philosophy, relations to other totalities and its knowledge structure (Vu & Dall'Alba, 2013);

Future Research

Figure 5.3 indicates promissory notes by a cloud symbol. Promissory notes are indications of future research possibilities. These have been indicated at various points throughout the thesis. In addition to the research possibilities associated with the transformative developments for pāngarau indicated in the previous section, other possibilities are summarised as investigating how:

- pāngarau is related to wider societal totalities such as assessment systems and the division of labour;
- hierarchical knowledge structures relate to horizontal knowledge structures in terms of the cumulative growth of knowledge (particularly in the case of pāngarau and mātauranga Māori);
- the TINA formation of pāngarau is established and maintained;
- student specialisations/subjectivities relate to their classroom specialisations;
- English-medium curriculum mathematics and pāngarau are related;
- Māori practices can maintain their own status without being re-described in pāngarau terms;
- alienation effects may occur through pāngarau education;
- mātauranga is related to kura ethos;
- forms of causality, specialisation and dialectical learning are related;
- dialectical diffraction/refraction occurs in specific pāngarau contexts;
- researching other dimensions of the legitimisation device provides further insight into struggle with pāngarau.

Conclusion

This chapter has discussed the findings of analysis and interpretation of the empirical data and used these to sketch out a causal mechanism for struggle with pāngarau. The causal mechanism draws attention to the nature of potential alienations for students and teachers in kura Māori. Attempting to re-design pāngarau to be consistent with a knower-code can be considered as part of a re-totalisation or de-alienation process. Kura Māori are considered

here to be part of a re-totalisation project to reconstruct Māori cultural totalities which possess certain internal and external relational configurations built with contemporary knowledge and technologies.

In a dialectical perspective, knower-code pāngarau can be reconfigured to be consistent with a knower-code field but the reverse is also true. Knower-code mātauranga can be recontextualised to be consistent with a knowledge-code field. It is suggested here that this latter development is already underway and has been for some time with the pāngarau curriculum playing its part. The commodification of Māori knowledge, language and culture is already well-developed throughout the New Zealand education system and is represented in a range of graded and levelled qualifications that may be acquired by any type of knower in, for example, Māori studies, Māori language, and Māori performing arts. This creates the possibility, which is completely legitimate in knowledge-code general society, that some Europeans, for example, become competent in Māori language and may teach Māori language to Māori children. In a knower-code, this situation can create powerful absences for Māori of genealogy, identity, and history, that is, an absence of aspects of mātauranga.

The struggle between knowledge-code and knower-code orientations is recognised by most, if not all, indigenous groups. Shiva (2000) explains how indigenous peoples have had their knowledges appropriated; the horizontal plurality of indigenous knowledges which are considered all equal and valid, are assessed and re-packaged to fit a hierarchy of *western knowledge* to become a vertical ordering of unequal knowledges. Cajete (2012) describes the experiences of Native Americans in education in similar terms to the Māori experience; schooling is primarily to prepare students for placement in the economic system whereas an indigenous approach would be relational and concerned with the ethical ecology of indigenous learning which regards people as part of a wider and sacred universal whole. In a move that resonates with the knower orientation outlined previously, Cajete imagines a future for Native American education which conceptualises tribal knowledge, philosophies and concepts of learning as the vehicle for learning contemporary western knowledge.

Ultimately, the source of struggle with pāngarau can be located at the cultural/transitive ontology level understood to consist of sets of different dialectical determinations of intransitive entities; in the context of this thesis, these determinations are about what constitutes a person. Pāngarau reaches into this ontological level and refracts a

geo-historical cultural decision to regard people as collections of what they know locating them, and forming their human identities, in relation to a constellation of transitive knowledge. The Kura ethos reaches into this ontological level and refracts a geo-historical cultural decision to regard people as a product of genealogy and locates them in a constellation of genealogically related people and their knowledges.

Many of the issues dealt with in the pāngarau literature discussed in chapter 1 can be re-interpreted as relating to the knower/knowledge dialect and the causal mechanism. The *trojan horse effect* (Barton & Fairhall, 1995) may be seen as a clash between knowledge-code pāngarau and knower-code mātauranga. Similarly, issues of language change may be interpreted as changes of language in response to a need to participate in knowledge-code social fields. Ethnomathematical concerns about absencing of cultural forms of mathematics (Barton, 2008) also relate to knowledge-code practices replacing knower-code. The ways in which the kura Māori featured in the research of Meaney, Trinick and Fairhall meets challenges and achieves equity are attempts to deal with contradictions induced by conflicting settings of the knower/knowledge dialectic (Meaney et al., 2011, 2013). The attempts to identify unique Māori pedagogies in pāngarau are somewhat unsuccessful; the uniqueness is located in the use of te reo Māori, and the identity and personal characteristics of the teacher (Meaney et al., 2007b). From the perspective of this thesis, this is unsurprising because pedagogies are considered to be dialectically related to the totalities in which pāngarau is embedded which exert powerful holistic causal effects on pedagogy. As noted in the case example of Matua J, the confinement of *being Maori* to pedagogy, and more particularly to the inter-personal, social aspects of pedagogy, is considered here to be a causal effect of the mechanism elaborated in this thesis.

As indicated at various points in the thesis, the issue of relations between ethnomathematical practices and pāngarau is an important topic for further investigation. The thesis has pointed to re-contextualisation issues in which ethnomathematical practices are re-defined as mathematical. This is clearly related to the powerful status of mathematics and its essentialising of reality as mathematical; mathematicians turn particular insights/gazes on all activities and see mathematics manifested in them (Dowling, 1998, 2009). In this regard, the establishment of a knower orientation is a resistance to Māori children being re-described, and re-constructed, in curriculum mathematics terms.

The thesis has not explicitly focussed on issues of power relations or coloniser/colonised relations seeing them more as embedded in forms of causality expressed in ever-changing webs of dialectical relations. It may have been the case in the past that coloniser/colonised relations were explicit but in contemporary New Zealand the situation is much less clear. Interpreting the contemporary scene in terms of the theoretical framework recognises that an explicit coloniser/colonised relation may have been diffracted and refracted amongst innumerable dialectical relations in the small and large contexts of contemporary Māori society. Contextualised instantiations of dialectical relations such as participant/participation, resource/resource use, and legitimisation/evaluation dialectics would contain within them refracted coloniser/colonised relations. As already noted, this is especially apparent in the TINA formation of pāngarau which is seen as instituting weak master-slave type relations in the Kura. Investigating how micro-dialectical relations embody (sediment) previous coloniser/colonised relations presents a broad area for future research.

People are both knowers and their knowledge simultaneously. Dealing with societal determinations of this dialectic presents a major challenge for kura Māori. Seeking knower-code groundings for the learning of pāngarau is an area of potential for the future but also a contentious area because it challenges many entrenched positions supporting pāngarau in its current form. People within the kura Māori education system have already joined with the TINA formation of pāngarau, supporting it, building their professional identities around it, and earning a living from it. Even so, considering a knower orientation shows promise in being able to reconcile the necessary prioritisation of mātauranga Māori as knower-code over mathematics education as knowledge-code. This requires a nuanced, deep and broad understanding of potential Māori embodiments of knower-code which in their details maintain a knower orientation (not a learner orientation) whilst also understanding, respecting and engaging critically with the specific knowledge characteristics of particular bodies of knowledge. The evidence in the case examples of this thesis indicates that the journey in this direction has already begun in the organic contexts of the Kura.

Throughout the data collected in this thesis, there are many examples of teachers and students expressing this knower orientation in a variety of explicit and implicit ways. In a particularly apposite comment, a Year 11 student who had decided not to continue with pāngarau in Year 12 and 13 gave the following explanation for “knocking it out”. The comment expresses both a prioritisation of Māori axiological concerns and a critical, positive engagement with mathematics. It also provides a very fitting final paragraph of the thesis.

I can pick pāngarau up any time when I need it and know that it won't be a struggle...that's why I am knocking it out...so I can concentrate on te reo Māori [Māori language] and doing kapa haka [Māori performing arts] where I can express myself...and I am going to learn about my marae [tribal settlement and people] from my Koro and Kuia [elders] ...they won't be around for very much longer and I want to learn from them.

References

- Al-Amoudi, I. (2007). Redrawing Foucault's Social Ontology. *Organization*, 14(4), 543-563.
doi: 10.1177/1350508407078052
- Alston, W. P. (2002). Introduction. In W. P. Alston (Ed.), *Realism and antirealism* (pp. 1-13).
Ithaca, NY: Cornell University Press.
- Apple, M. W. (2006). *Educating the "right" way: Markets, standards, God, and inequality*.
New York: Routledge.
- Archer, M. S. (1988). *Culture and agency: The place of culture in social theory*. Cambridge:
Cambridge University Press.
- Archer, M. S. (1995). *Realist social theory: The morphogenetic approach*. Cambridge:
Cambridge University Press.
- Argyris, C., & Schon, D. (1974). *Theory in practice: Increasing professional effectiveness*.
San Francisco: Jossey-Bass.
- Arnot, M., & Reay, D. (2004). The framing of pedagogic encounters: Regulating the social
order in classroom learning. In J. Muller, B. Davies, & A. Morais (Eds.), *Reading
Bernstein, researching Bernstein* (pp. 137-150). London, New York:
RoutledgeFalmer.
- Atkinson, P. (1985). *Language, structure and reproduction: An introduction to the sociology
of Basil Bernstein*. London: Routledge.
- Bakhtin, M. M. (1984). *Problems of Dostoevsky's poetics* (C. Emerson, Trans.). Minneapolis:
University of Minnesota Press.
- Barton, B. (1999). Ethnomathematics and philosophy. *ZDM*, 2, 54-58. doi: 10.1007/s11858-
999-0009-7

- Barton, B. (2004). Mathematics and mathematical practices: Where to draw the line? *For the Learning of Mathematics*, 24(1), 22-24.
- Barton, B. (2009). *The language of mathematics: Telling mathematical tales*. Boston, MA: Springer Science+Business Media, LLC.
- Barton, B. (Ed.). (1989). *Te kupenga: First steps towards bicultural mathematics*. Auckland: MECA: Mathematics Education Centre for All.
- Barton, B., & Fairhall, U. (1995). Is mathematics a trojan horse? Mathematics in Māori education. In B. Barton & U. Fairhall (Eds.), *Mathematics in Māori education*. (pp. 1-12). Auckland: The University of Auckland.
- Barton, B., Fairhall, U., & Trinick, T. (1998). Tikanga reo tātai: Issues in the development of a Māori mathematics register. *For the Learning of Mathematics*, 18(1), 3-9.
- Becker, H. S. (2008). How to find out how to do qualitative research. Retrieved from: <http://home.earthlink.net/~hsbecker/articles/NSF.html>
- Bennett, A. (2008). The mother of all "isms": Organising political science around causal mechanisms. In R. Groff (Ed.), *Re-vitalising causality: Realism about causality in philosophy an social science* (pp. 205-220). Abingdon, New York: Routledge.
- Bereiter, C. (1985). Toward a solution of the learning paradox. *Review of Educational Research*, 55(2), 201-226. doi: 10.3102/00346543055002201
- Bereiter, C. (2009). *Education and mind in the knowledge age*. Mahwah, NJ: Routledge.
- Berger, P., & Luckmann, T. (1967). *The social construction of reality*. London: Allen Lane.
- Bernstein, B. (1971). On the classification and framing of educational knowledge. In M. F. D. Young (Ed.), *Knowledge and control: New directions for the sociology of education* (pp. 47-69). London: Routledge.

- Bernstein, B. (1981). Codes, modalities and the process of cultural reproduction: A model. *Language and Society*, 10, 327-363.
- Bernstein, B. (1999). Vertical and Horizontal Discourse: An essay. *British Journal of Sociology of Education*, 20(2), 157-173. doi: 10.1080/01425699995380
- Bernstein, B. (2000). *Pedagogy, symbolic control and identity*. Oxford: Roman and Littlefield Publishers.
- Berry, K. S. (2006). Research as bricolage. In K. G. Tobin & J. L. Kincheloe (Eds.), *Doing educational research - A handbook* (pp. 87-115). Rotterdam: Sense Publishers.
- Berryman, M. (2013). Te kotahitanga: Culturally responsive and relational pedagogies for teachers and students. In S. Katene & M. Mulholland (Eds.), *Future challenges for Māori: He kōrero anamata* (pp. 125-137). Wellington, NZ: Huia Publishers.
- Bevan-Brown, J. (1998). By Māori, for māori, about Māori - Is that enough? In T. P. Hauora (Ed.), *Te oru rangahau - Māori research and development conference proceedings 7-9 July, 1998* (pp. 231-246). Palmerston North, New Zealand: Massey University.
- Bhaskar, R. (1975). *A realist theory of science*. London: Verso Books.
- Bhaskar, R. (1979). *The possibility of naturalism*. Brighton: Wheatsheaf.
- Bhaskar, R. (1982). Emergence, explanation, and emancipation. In P. F. Secord (Ed.), *Explaining human behaviour: Consciousness, human action and social structure* (pp. 275-311). Beverly Hills, London, New Delhi: Sage.
- Bhaskar, R. (1993). *Dialectic: The pulse of freedom*. London, New York: Verso.
- Bhaskar, R. (1997). On the ontological status of ideas. *Journal for the Theory of Social Behaviour*, 27(2-3), 139-147. doi: 10.1111/1468-5914.00031
- Bhaskar, R. (2002). *From science to emancipation: Alienation and the actuality of enlightenment*. New Delhi, Thousand Oaks, London: Sage Publications.

- Bhaskar, R. (2010). *The formation of critical realism: a personal perspective* London ;New York: Routledge.
- Bhaskar, R. (2011). *Reflections on metareality: Transcendence, emancipation and everyday life*. London: Routledge.
- Bhaskar, R. (2012). *The philosophy of metareality: Creativity, love and freedom*. London: Routledge.
- Bidois, V. (2012). *Destablising the binary: Reframing cultural identity. Postcolonial reflections in Aotearoa New Zealand*. (Doctoral dissertation), University of Otago, Dunedin, NZ. Retrieved from <https://ourarchive.otago.ac.nz/handle/10523/2467>
- Billig, M. (1991). *Ideology and opinions*. London: Sage.
- Billig, M., Condor, S., Edwards, D., Gane, M., & Middleton, D. R. (1988). *Ideological dilemmas*. London Sage.
- Bishop, R. (1996). *Collaborative research stories: Whakawhanaungatanga*. Palmerston North NZ: The Dunmore Press.
- Bishop, R. (2003). *Te kōtahitanga: The experiences of year 9 and 10 Māori students in mainstream classrooms*. Wellington, N.Z.: New Zealand Ministry of Education, Research Division.
- Bishop, R. (2007a). *Te kōtahitanga: Improving the educational achievement of Māori students in mainstream education: Phase 2: Towards a whole school approach*. Wellington, N.Z.: New Zealand Ministry of Education.
- Bishop, R. (2007b). *Te kōtahitanga: Phase 3: Whanaungatanga, establishing a culturally responsive pedagogy of relations in mainstream secondary school classrooms*. Wellington, N.Z.: Ministry of Education, Research Division.
- Bishop, R., & Berryman, M. (2006). *Culture speaks: Cultural relationships and classroom learning*. Wellington, N.Z.: Huia.

- Bologh, R. W. (1979). *Dialectical phenomenology: Marx's method*. London: Routledge and keegan Paul Ltd.
- Boudon, R. (1998). Social mechanisms without black boxes. In P. Hedstrom & R. Swedburg (Eds.), *Social mechanisms: An analytical approach to social theory* (pp. 172-204). Cambridge: Cambridge University Press.
- Bourdieu, P. (1989). Social space and symbolic power. *Sociological Theory*, 7(1), 14-25. doi: 10.2307/202060
- Bourdieu, P. (1990). *The logic of practice*. Cambridge: Polity Press.
- Bourdieu, P. (2000). *Distinction: a social critique of the judgement of taste*. Cambridge, Mass: Harvard University Press.
- Bourne, J. (2004). Framing talk: Towards a 'radical visible pedagogy'. In J. Muller, B. Davies, & A. Marais (Eds.), *Reading Bernstein, researching Bernstein* (pp. 61-74). London, New York: RoutledgeFalmer.
- Brown, S. I. (2001). *Reconstructing school mathematics: Problems with problems and the real world*. New York: Peter Lang Publishing Inc.
- Brown, T. (2008). Lacan, subjectivity and the task of mathematics education research. *Educational Studies in Mathematics*, 68(3), 227-245. doi: 10.2307/40284523
- Bunge, M. (2014). *Chasing reality: Strife over realism*. Toronto: University of Toronto Press.
- Burton, L. (2004). *Mathematicians as enquirers*. New York: Springer-Verlag.
- Cajete, G. (2012). Comtemporany indigenous education: Thoughts for American Indian education in a 21st-century world. In S. Mukhopadhyay & W.-M. Roth (Eds.), *Alternative forms of knowing (in) mathematics: Celebrations of diversity of mathematical practices* (pp. 33-53). Rotterdam: Sense Publishers.

- Carvahlo, L., Dong, A., & Maton, K. (2009). Legitimizing design: A sociology of knowledge account of the field. *Design Studies*, 30(5), 483-502. doi: 10.1016/j.destud.2008.11.005
- Chen, R. (2010). *Knowledge and knowers in on-line learning : Investigating the effects of online flexible learning on student sojourners*. (Doctoral dissertation), University of Wollongong, Wollongong, Australia. Retrieved from <http://ro.uow.edu.au/cgi/viewcontent.cgi?article=4099&context=theses>
- Chomsky, N. (1965). *Aspects of theory of syntax*. Cambridge, Mass.: MIT Press.
- Chouliaraki, L., & Fairclough, N. (1999). *Discourse in late modernity: Rethinking critical discourse analysis*. Edinburgh: Edinburgh University Press.
- Christensen, I. (1996). Māori mathematics. *He pukenga korero : a journal of Māori studies*, 1(2), 42-47.
- Christensen, I. (2004). *Te reo pāngarau*. Te Whanganui a Tara: Te Tāhūhū o te Mātauranga.
- Christensen, I. (2010). *Te reo pāngarau*. Te Whanganui a Tara: Te Tāhūhū o te Mātauranga.
- Christensen, O. R., Stentoft, D., & Valero, P. (2008). Power distribution in the network of mathematics education practices. In K. Nolan & E. De Freitas (Eds.), *Opening the research text: Critical insights and in(ter)ventions into mathematics education* (pp. 131-147). New York: Springer.
- Coffey, A. (1999). *The ethnographic self*. London: SAGE Publications Ltd.
- Cole, M. (1998). *Cultural psychology: A once and future discipline*. Cambridge, Mass.: The Belknap Press.
- Collier, A. (1989). *Scientific realism and socialist thought*. Hemel Hempstead: Harvester Wheatsheaf.

- Collier, A. (1994). *Critical realism: An introduction to Roy Bhaskar's philosophy*. London: Verso.
- Collier, A. (1998). Stratified explanation and Marx's conception of history. In M. S. Archer, R. Bhaskar, T. Lawson, A. Collier, & A. Norrie (Eds.), *Critical realism: Essential readings* (pp. 258-282). London, New York: Routledge.
- Cruickshank, J. (2004). A tale of two ontologies: an immanent critique of critical realism. *The Sociological Review*, 52(4), 567-585. doi: 10.1111/j.1467-954X.2004.00496.x
- Cunningham, C. (1998). A framework for addressing Māori knowledge in research, science and technology. In T. P. Hauora (Ed.), *Te oru rangahau Māori research and development conference proceedings 7-9 July 1998* (pp. 387-398). Palmerston North, New Zealand: Massey University.
- D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics*, 5(1), 44-48.
- D'Ambrosio, U. (1990). The role of mathematics education in building a democratic and just society. *For the Learning of Mathematics*, 10(3), 20-23.
- Damasio, A. (1999). *The feeling of what happens: Body and emotion in the making of consciousness*. Orlando, FL: Harcourt, Inc.
- Damasio, A. (2003). *Looking for Spinoza: Joy, sorrow and the feeling brain*. Orlando, FL: Harcourt, Inc.
- Danermark, B., Ekstrom, M., Jakobsen, L., Karlsson, J. C., & Bhaskar, R. (2002). *Explaining society: An introduction to critical realism in the social sciences*. Abingdon, Oxon: Routledge.
- Davis, P. J., Hersh, R., & Marchisotto, E. A. (2011). *The Mathematical Experience*. Secaucus: Birkhauser Boston Inc.

- Deer, C. (2012). Doxa. In M. Grenfell (Ed.), *Pierre Bourdieu: Key concepts* (pp. 114-125). Durham: Acumen Publishing Limited.
- Dehaene, S. (2014). *Consciousness and the brain*. New York: Viking.
- Denzin, N. K. (2009). *The research act: A theoretical introduction to sociological methods*. Somerset: Aldine Transaction.
- Douglas, M. (1986). *How institutions think*. New York: Syracuse University Press.
- Dowling, P. (1998). *The sociology of mathematics education*. London: Falmer Press.
- Dowling, P. (2009). *Sociology as method: Departures from the forensics of culture, text and knowledge*. Rotterdam: Sense Publishers.
- Dowling, P. (2013). Social activity method (SAM): A fractal language for mathematics. *Mathematics Education Research Journal*, 25(3), 317-340. doi: 10.1007/s13394-013-0073-8
- Durie, M. (2003). *Ngā kāhui pou: Launching māori futures*. Wellington, NZ: Huia Publishers.
- Durie, M. (2004). *Exploring the interface between science and indigenous knowledge*. Paper presented at the 5th APEX Research and Development Leaders Forum, Christchurch, New Zealand. Retrieved from <http://www.massey.ac.nz/massey/fms/Te%20Mata%20O%20Te%20Tau/Publications%20-%20Mason/M%20Durie%20Exploring%20the%20interface%20Between%20Science%20and%20Indigenous%20knowledge.pdf?CE92AA6ED9817AF4E35467C91584A8A9>
- Durie, M. (2011). *Ngā tini whetū: Navigating māori futures*. Wellington, NZ: Huia Publishers.

- Durie, M. (2012). Kaupapa māori: Shifting the social. *New Zealand Journal of Educational Studies*, 47(2), 21-30.
- Eden, S., L. (2007). *A systemic functional grammar of Chinese*. London: Bloomsbury Academic
- Edwards, D., & Mercer, N. (1987). *Common knowledge: The development of understanding in the classroom*. London: Methuen.
- Eisenhart, M. A. (2008). Generalizing from qualitative inquiry. In K. Ercikan & W.-M. Roth (Eds.), *Generalizing from educational research: Beyond qualitative and quantitative polarization* (pp. 51-66). New York: Routledge.
- Eketone, A. (2008). Theoretical underpinnings of kaupapa Māori directed practice. *MAI Review*, 1. Retrieved from: www.review.mai.ac.nz
- Elder-Vass, D. (2005). Emergence and the realist account of cause. *Journal of Critical Realism*, 4(2), 315-338. doi: 10.1163/157251305774356667
- Elder-Vass, D. (2011). *The causal power of social structures: Emergence, structure and agency*. Cambridge: Cambridge University Press.
- Elder-Vass, D. (2014). Redescription, reduction, and emergence: A response to Tobias Hansson Wahlberg. *Philosophy of the Social Sciences*, 44(6), 792-797. doi: 10.1177/0048393113515386
- Elvin, K. (1988). *Nga mauranga: The bilingual mathematics network*. Wellington, N.Z.: Curriculum Development Division, New Zealand Department of Education.
- Ensor, P., & Galant, J. (2005). Knowledge and pedagogy: Sociological research in mathematics education in South Africa. In R. Vithal, J. Adler, & C. Keitel (Eds.), *Researching mathematics education in South Africa* (pp. 281-307). Cape Town: HSRC Press.

- Ernest, P. (1991). *The philosophy of mathematics education*. London, New York: Falmer Press.
- Ernest, P. (2014). Certainty in mathematics: Is there a problem? *Philosophy of Mathematics Education Journal* No. 28 (October 2014). Retrieved from: <http://people.exeter.ac.uk/PErnest/pome28/index.html>
- Fairclough, N., Jessop, B., & Sayer, A. (2004). Critical realism and semologic. In J. M. Roberts & J. Joseph (Eds.), *Realism, Discourse and Deconstruction* (pp. 23-43). London: Routledge.
- Forgas, J. P. (2001). Feeling and thinking: Summary and integration. In J. P. Forgas (Ed.), *Feeling and thinking: The role of affect in social cognition* (pp. 387-407). Cambridge: Cambridge University Press.
- Francois, K., & Van Kerkhove, B. (2010). Ethnomathematics and the philosophy of mathematics (education). In B. Lowe & T. Muller (Eds.), *Philosophy of mathematics: Sociological aspects and mathematical practice*. (pp. 121-154). London: College Publications.
- Frankenstein, M. (1983). Critical mathematics education: An application of Paulo Freire's epistemology. *Journal of Education*, 165(4), 315-339. Retrieved from: www.jstor.org/stable/42772808
- Frankenstein, M. (2009). Developing a critical mathematical numeracy through real real-life word problems. In L. Verschaffel, B. Greer, W. Van Dooren, & S. Mukhopadhyay (Eds.), *Words and worlds: Modelling verbal descriptions of situations* (pp. 111-130). Rotterdam: Sense Publishers.
- Freire, P. (1972). *Pedagogy of the oppressed*. Harmondsworth, Middlesex: Penguin.
- Freire, P. (1985). *The politics of education*. London: MacMillan.
- Freudenthal, H. (1991). *Revisiting mathematics education: China lectures*. Dordrecht: Kluwer Academic Publishers.

- Geertz, C. (1973). *The interpretation of cultures*. New York: Basic Books.
- Gellner, E. (1992). *Postmodernism, reason and religion*. London, New York: Routledge.
- Gerdes, P. (2001). Ethnomathematics as a new research field, illustrated by studies of mathematical ideas in african history. In J. J. Saldana (Ed.), *Science and cultural diversity. Filling a gap in the history of science*, (pp. 11–36). Mexico: Cuadernos de Quipu.
- Gerring, J. (2008). The mechanistic worldview: Thinking inside the box. *British Journal of Political Science*, 38(1), 161-179. doi: 10.1017/S0007123408000082
- Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. Cambridge: Polity Press.
- Glover, D., & Coleman, M. (2005). School culture, climate and ethos: Interchangeable or distinctive concepts. *Journal of In-service Education*, 31(2), 251-272. doi: 10.1080/13674580500200359
- Grenfell, M. (2012). Interest. In M. Grenfell (Ed.), *Pierre Bourdieu: Key concepts* (pp. 151-169). Durham: Acumen Publishing Limited.
- Groff, R. (2004). *Critical realism, post-positivism and the possibility of knowledge*. London, New York: Routledge.
- Gutiérrez, R. (2008). What is “nepantla” and how can it help physics education researchers conceptualize knowledge for teaching? *AIP Conference Proceedings*, 1064(1), 23-25. doi: 10.1063/1.3021263
- Gutiérrez, R. (2009). Embracing the inherent tensions in teaching mathematics from an equity stance. *Democracy & Education*, 18, 9-16.
- Gutiérrez, R. (2012). Context matters: How should we conceptualize equity in mathematics education? In B. Herbel-Eisenmann, J. Choppin, D. Wagner, & D. Pimm (Eds.),

Equity in Discourse for Mathematics Education (Vol. 55, pp. 17-33): Springer Netherlands.

Gutiérrez, R. (2013). The sociopolitical turn in mathematics education. *Journal for Research in Mathematics Education*, 44(1), 37-68. doi: 10.5951/jresmetheduc.44.1.0037

Gutstein, E. (2005). *Reading and writing the world with mathematics: Toward a pedagogy for social justice*. Hoboken: Routledge.

Hadamard, J. (2007). *An essay in psychology of invention in the mathematical field*. Alcester: Read Books.

Halliday, M. A. K. (2004). *An introduction to functional grammar* London: Arnold.

Hammersley, M. (2006). Ethnography: problems and prospects. *Ethnography and Education*, 1(1), 3-14. doi: 10.1177/0952695110384442

Harre, R. (2009). Saving critical realism. *Journal for the Theory of Social Behaviour* 39(2), 129-143. doi: 10.1111/j.1468-5914.2009.00403.x

Hartwig, M. (2007). *Dictionary of critical realism*. New York: Routledge.

Hasan, R. (2010). The ontogenesis of decontextualised language: Some achievements of classification and framing. In A. Morais, I. Neves, B. Davies, & H. Daniels (Eds.), *Towards a sociology of pedagogy: The contribution of Basil Bernstein to research* (pp. 47-81). New York: Peter Lang.

Hāwera, N. (2011). *Ngā whanaketanga pāngarau rūmaki Māori: Pāngarau research project, report to the Ministry of Education*. Wellington, NZ: New Zealand Ministry of Education Retrieved from www.educationcounts.govt.nz/publications.

Hāwera, N., & Taylor, M. (2013). Children's views about geometry tasks in Māori-medium schools: Meeting ngā whanaketanga rūmaki Māori pāngarau (national standards in mathematics). *SET*, 2013(3), 37-46.

- Hedstrom, P., & Swedburg, R. (1998). Social mechanisms: An introductory essay. In P. Hedstrom & R. Swedburg (Eds.), *Social mechanisms: An analytical approach to social theory* (pp. 1-32). Cambridge: Cambridge University Press.
- Hedström, P., & Ylikoski, P. (2010). Causal mechanisms in the social sciences. *Annual Review of Sociology*, 36(1), 49-67. doi: 10.1146/annurev.soc.012809.102632
- Hernes, G. (1998). Real virtuality. In P. Hedstrom & R. Swedburg (Eds.), *Social mechanisms: An analytical approach to social theory* (pp. 74-102). Cambridge: Cambridge University Press.
- Howard, S., & Maton, K. (2011). Theorising knowledge practices: a missing piece of the educational technology puzzle. *Research in Learning Technology*, 19(3), 191-206.
- Hunter, J. (2006). The numeracy project: Foundations and development. *ACE papers*, (17). Retrieved from: <http://www.education.auckland.ac.nz/en/about/research/research-at-faculty/research-publications/ace-papers/ace-issue17.html>
- Jablonka, E., Wagner, D., & Walshaw, M. (2013). Theories for studying social, political and cultural dimensions of mathematics education. In M. A. K. Clements, A. J. Bishop, C. Keitel, J. Kilpatrick, & F. K. S. Leung (Eds.), *Third International Handbook of Mathematics Education* (pp. 41-67). New York and London: Springer Science+Business Media B.V.
- Jackson, A. Y., & Mazzei, L. A. (2012). *Thinking with theory in qualitative research: Viewing data across multiple perspectives*. New York: Routledge.
- Jones, A. (2012). Dangerous liaisons: Pākehā, kaupapa Māori, and educational research. *New Zealand Journal of Educational Studies*, 47(2), 100-112.
- Jones, A., Marshall, J., Matthews, K. M., Smith, G. H., & Smith, L. T. (1995). *Myths and realities: Schooling in New Zealand*. Palmerston North, NZ: The Dunmore Press Ltd.

- Jorgensen, R., & Wagner, D. (2013). Mathematics education with/for indigenous peoples. *Mathematics Education Research Journal*, 25(1), 1-3. doi: 10.1007/s13394-013-0070-y
- Joseph, J. (2007). *Hegemony: A realist analysis*. London: Routledge.
- Kearney, M. (1984). *Worldview*. Novato, CA: Chandler and Sharp Publishers.
- Keitel, C. (2005). Reflections on mathematics research in South Africa. In R. Vithal, J. Adler, & C. Keitel (Eds.), *Researching mathematics education in South Africa* (pp. 329-345). Cape Town: HSRC Press.
- Kemp, S., & Holmwood, J. (2003). Realism, regularity and social explanation. *Journal for the Theory of Social Behaviour*, 33(2), 165-187. doi: 10.1111/1468-5914.00212
- Kidman, J., Chiung-Fen, Y., & Abrams, E. (2013). Indigenous students' experiences of the hidden curriculum in science education: A cross-national study in New Zealand and Taiwan. *International Journal of Science and Mathematics Education*, 11(1), 43-64. doi: 10.1007/s10763-012-9365-9
- Kilpert, L., & Shay, S. (2012). Kindling fires: examining the potential for cumulative learning in a journalism curriculum. *Teaching in Higher Education*, 18(1), 40-52. doi: 10.1080/13562517.2012.678326
- Kincheloe, J. L., & Berry, K. S. (2004). *Rigour and complexity in educational research: conceptualizing the bricolage* Maidenhead: Open University Press.
- Kitcher, P. (1985). *The nature of mathematical knowledge*. New York: Oxford University Press.
- Kivinen, O., & Piironen, T. (2006). On the limits of a realist conception of knowledge: A pragmatist critique of Archerian realism. *The Sociological Review*, 54(2), 224-241. doi: 10.1111/j.1467-954X.2006.00611.x
- Kline, M. (1980). *Mathematics: The loss of certainty*. Oxford: Oxford University Press.

- Kreuger, R. (1987). *Focus groups: A guide for applied research*. Thousand Oaks, CA: Sage.
- Lakatos, I. (1980). Infinite regress and the foundations of mathematics. In J. Worrall & G. Currie (Eds.), *Mathematics, science and epistemology: Volume 2, philosophical papers* (pp. 3-24). Cambridge: Cambridge University Press.
- Lakoff, G., & Nuñez, R. E. (2000). *Where mathematics comes from: How the embodied mind brings mathematics into being*. New York: Basic Books.
- Lather, P. (2008). (Post) feminist methodology: Getting lost, or a scientificity we can bear to learn from. In N. K. Denzin & M. D. Giardina (Eds.), *Qualitative inquiry and the politics of evidence* (pp. 182 - 195). Thousand Oaks: Sage
- Law, J. (2004). *After method*. London: Routledge.
- Lawson, T. (1998). *Economics and reality*. London: Routledge.
- LeCompte, M. D., & Goetz, J. P. (1982). Problems of reliability and validity in ethnographic research. *Review of Educational Research*, 52(1), 31-60. Retrieved from: <http://rer.sagepub.com/content/52/1.toc>
- Lee, J. B. J. (2006). *Ako: Pūrākau of Māori secondary teachers*. (Doctoral dissertation), University of Auckland, Auckland, New Zealand. Retrieved from www.kaupapamaori.com/assets/lee_J/leej2008_phd.pdf
- Lee, J. B. J. (2009). Decolonising Māori narratives: Pūrākau as a method. *MAI Review*, 2, Article 3. Retrieved from: <http://www.review.mai.ac.nz>
- Lerman, S. (1998). Cultural perspectives on mathematics and mathematics teaching and learning. In F. Seeger, J. Voigt, & U. Waschescio (Eds.), *The culture of the mathematics classroom* (pp. 290-308). Cambridge: Cambridge University Press.
- Lerman, S. (2001). Cultural, discursive psychology: A sociocultural approach to studying the teaching and learning of mathematics. *Educational Studies in Mathematics*, 46(1-3), 87-113. doi: 10.1023/A:1014031004832

- Lerman, S. (2006). Theories of mathematics education: Is plurality a problem? *Zentralblatt für Didaktik der Mathematik*, 38(1), 8-13. doi: 10.1007/BF02655902
- Lerman, S., & Tsatsaroni, A. (1998). *Why children fail and what the field of mathematics education can do about it: The role of sociology*. Paper presented at the First International Mathematics Education and Society Conference (MEAS 1), University of Nottingham, UK. Retrieved from:
www.nottingham.ac.uk/csme/meas/plenaries/lerman.html
- Lerman, S., & Zevenbergen, R. (2004). The socio-political context of the mathematics classroom: Using Bernstein's framework to understand classroom communications. In P. Valero & R. Zevenbergen (Eds.), *Researching the socio-political dimensions of mathematics education: Issues of power in theory and methodology* (pp. 27-43). Dordrecht: Kluwer Academic Publishers.
- Lincoln, Y. S., & Guba, E. (1985). *Naturalistic inquiry*. Beverley Hills, CA: Sage.
- Lipka, J., Wong, M., & Andrew-Ihrke, D. (2013). Alaska native indigenous knowledge: Opportunities for learning mathematics. *Mathematics Education Research Journal*, 25(1), 129-150. doi: 10.1007/s13394-012-0061-4
- Lukacs, G. (1971). *History and class consciousness*. Cambridge: M.I.T. Press.
- Lynch, R. A. (2011). Foucault's theory of power. In D. Taylor (Ed.), *Michel Foucault: Key concepts* (pp. 13-27). New York: Routledge.
- Maangi, H., Smith, H., Melbourne, P., & Meaney, T. (2010). Pēnei i au te āhua? Is this me? Teaching young children mathematics in a kura kaupapa Māori. In R. Averill & R. Harvey (Eds.), *Teaching primary school mathematics and statistics: Evidence-based practice* (pp. 223-237). Wellington, NZ: NZCER Press.
- Macfarlane, A. H. (2004). *Kia Hiwa Rā! Listen to culture - Māori students' plea to educators*. Wellington, New Zealand: New Zealand Council for Educational Research.

- Macfarlane, A. H., Glynn, T., Grace, W., Penetito, W., & Bateman, S. (2008). Indigenous epistemology in a national curriculum framework. *Ethnicities*, 8(1), 102-126. doi: 10.1177/1468796807087021
- Macken-Horarik, M. (2011). Building a knowledge structure for English: Reflections on the challenges of coherence, cumulative learning, portability and face validity. *Australian Journal of Education*, 55(3), 197-213. doi: 10.1177/000494411105500303
- Manicas, P. T. (2006). *A realist philosophy of social science: Explanation and understanding*. Cambridge, UK: Cambridge University Press.
- Manicas, P. T. (2009). Realist metatheory and qualitative methods. *Sociological Analysis*, 3(1), 31-46.
- Marsden, M. (2003). *The woven universe: Selected writings of Rev. Māori Marsden*. Otaki, N.Z. : Estate of Rev. Māori Marsden.
- Marshall, J., Coxon, E., Jenkins, K., & Jones, A. (2000). *Politics, policy, pedagogy: Education in Aotearoa/New Zealand*. Palmerston North, NZ: The Dunmore Press Ltd.
- Martin, D. B. (2007). Beyond missionaries or cannibals: Who should teach mathematics to African American children? *High School Journal*, 91(1), 6-28.
- Martin, D. B. (2009). Does race matter? *Teaching Children Mathematics*, 16(3), 134-139.
- Martin, D. B. (2012). Learning mathematics while black. *Educational Foundations*, 26(1/2), 47-66.
- Martin, D. B. (2013). Race, racial projects, and mathematics education. *Journal for Research in Mathematics Education*, 44(1), 316-333. doi: 10.5951/jresematheduc.44.1.0316
- Martin, J. R., & White, P. R. R. (2007). *The Language of evaluation*. New York: Palgrave Macmillan.

- Martins, N. (2011). An evolutionary approach to emergence and social causation. *Journal of Critical Realism*, 10(2), 192-218. doi: 10.1558/jcr.v10i2.192
- Maton, K. (2005). A question of autonomy: Bourdieu's field approach and higher education policy. *Journal of Education Policy*, 20(6), 687-704. doi: 10.1080/02680930500238861
- Maton, K. (2006). On knowledge structures and knower structures. In R. Moore, M. Arnot, J. Beck, & H. Daniels (Eds.), *Knowledge, power and educational reform: Applying the sociology of Basil Bernstein* (pp. 44-59). New York: Routledge.
- Maton, K. (2009). Cumulative and segmented learning: Exploring the role of curriculum structures in knowledge-building. *British Journal of Sociology of Education*, 30(1), 43-57. doi: 10.1080/01425690802514342
- Maton, K. (2013). Making semantic waves: A key to cumulative knowledge-building. *Linguistics and Education*, 24(1), 8-22. doi: 10.1016/j.linged.2012.11.005
- Maton, K. (2014). *Knowledge and knowers: towards a realist sociology of education*. Abingdon, Oxon: Routledge.
- Maton, K. (2015). *Knowledge-building: Educational studies in Legitimation Code Theory*. London: Routledge.
- Matruglio, E., Maton, K., & Martin, J. R. (2013). Time travel: The role of temporality in enabling semantic waves in secondary school teaching. *Linguistics and Education*, 24(1), 38-49. doi: 10.1016/j.linged.2012.11.007
- Matthiessen, C. M. I. M., Teruya, K., & Lam, M. (2010). *Key terms in systemic functional linguistics*. London: Continuum.
- Maxwell, J. A. (2005). *Qualitative research design: an interactive approach*. Thousand Oaks, CA: Sage.

- Maxwell, J. A. (2008). The value of a realist understanding of causality for qualitative research. In N. K. Denzin & M. D. Giardina (Eds.), *Qualitative inquiry and the politics of evidence* (pp. 163-182). Walnut Creek, CA: Left Coast Press Inc.
- Maxwell, J. A. (2012). *A realist approach for qualitative research*. Thousand Oaks: Sage Publications Inc.
- May, T. (2004). Reflexivity and social science: A contradiction in terms? In B. Carter & C. New (Eds.), *Making realism work: Realist social theory and empirical research* (pp. 171–188). London: Routledge.
- McKinley, E. A. (1995). *A power/knowledge nexus: writing a science curriculum in Māori*. (Unpublished master's thesis), University of Waikato, Hamilton, New Zealand.
- McKinley, E. A., Stewart, G. M., & Richards, P. (2004). Māori students in science and mathematics. *SET*, 2004(3), 9 -14.
- McMurphy-Pilkington, C. (2004). *Pāngarau: Māori medium mathematics curriculum: empowerment or a new hegemonic accord?* (Doctoral dissertation), University of Auckland, Auckland, New Zealand. Retrieved from <https://researchspace.auckland.ac.nz/handle/2292/3306>
- McMurphy-Pilkington, C. (2008). Indigenous people: Emancipatory possibilities in curriculum development *Canadian Journal of Education/Revue canadienne de l'éducation*, 31(3), 614-663.
- McMurphy-Pilkington, C., & Trinick, T. (2002). Horse power or empowerment? Mathematics curriculum for Maori: Trojan horse revisited. In B. Barton, K. C. Irwin, M. Pfannkuch, & M. O. J. Thomas (Eds.), *Mathematics education in the South Pacific (Proceedings of the 25th annual conference of the Mathematics Education Research Group of Australasia)* (pp. 465-472). Adelaide, SA: MERGA.
- McMurphy-Pilkington, C., Trinick, T., & Meaney, T. (2013). Mathematics curriculum development and indigenous language revitalisation: contested spaces. *Mathematics Education Research Journal*, 25, 341-360. doi: 10.1007/s13394-013-0074-7

- Mead, H. M. (1996). *Tāwhaki: the deeds of a demigod*. Auckland, New Zealand: Reed Publishing (NZ) Ltd.
- Mead, H. M. (2007). *Tikanga Māori: Living by Māori values*. Wellington: Huia Publishers.
- Mead, H. M. (2012). Understanding mātauranga Māori. In T. Black, D. Bean, W. Collings, & W. Nuku (Eds.), *Conversations on mātauranga Māori* (pp. 9-15). Wellington: NZQA.
- Mead, H. M., & Groves, N. (2004). *Ngā pēpeha a ngā tīpuna: The sayings of the ancestors*. Wellington: Victoria University Press.
- Mead, L. T. (1996). *Ngā aho o te kākahu mātauranga: The multiple layers of struggle by Māori in education (Doctoral dissertation)*. Auckland University, Auckland, New Zealand. Retrieved from <https://researchspace.auckland.ac.nz/handle/2292/942>
- Meaney, T., Fairhall, U., & Trinick, T. (2007a). Acquiring the mathematics register in te reo Māori. In J. Watson & K. Beswick (Eds.), *Mathematics: Essential research, essential practice, volume 1 (Proceedings of the 30th annual conference of the Mathematics Education Research Group of Australasia)* (pp. 493-502). Adelaide, SA: MERGA.
- Meaney, T., Fairhall, U., & Trinick, T. (2007b). *Te reo tātaitai: Developing rich mathematical language in Māori immersion classrooms*. Wellington NZ: Teaching and Learning Initiative Research Reports. Retrieved from www.tlri.org.nz/sites/default/files/projects/9230_finalreport.pdf.
- Meaney, T., Fairhall, U., & Trinick, T. (2008). The role of language in ethnomathematics. *The Journal of Mathematics and Culture*, 3(1), 52-65. Retrieved from: <http://nasgem.rpi.edu/pl/journal-mathematics-culture-volume-3-number-1>
- Meaney, T., McMurchy-Pilkington, C., & Trinick, T. (2008). Mathematics education and indigenous students. In H. Forgasz, A. Barkatsas, A. J. Bishop, B. Clarke, S. Keast, W. Tiong Seah, & P. Sullivan (Eds.), *Research in mathematics education in Australasia 2004-2007* (pp. 119-141). Rotterdam: Sense Publishers.

- Meaney, T., McMurchy-Pilkington, C., & Trinick, T. (2012). Indigenous students and the learning of mathematics. In B. Perry, T. Lowrie, T. Logan, A. MacDonald, & J. Greenlees (Eds.), *Research in mathematics education in Australasia 2008-2011* (pp. 67-89). Rotterdam: Sense Publishers.
- Meaney, T., Trinick, T., & Fairhall, U. (2011). *Collaborating to meet language challenges in indigenous mathematics classrooms*. Dordrecht: Springer.
- Meaney, T., Trinick, T., & Fairhall, U. (2013). One size does NOT fit all: Achieving equity in Māori mathematics classrooms. *Journal for Research in Mathematics Education*, 44(1), 235-263. doi: 10.5951/jresmetheduc.44.1.0235
- Mercier, O. R., Douglas, M., Rickard, D., Stewart, O., Morrison, S., & Apiata, D. (2014). Project mātauranga-Our science on-screen. In H. Murphy, C. Buchanan, W. Nuku, & B. Ngaia (Eds.), *Enhancing mātauranga Māori and global indigenous knowledge* (pp. 69-87). Wellington: NZQA.
- Merriam, S. B. (1995). What can you tell from an N of 1? Issues of validity and reliability in qualitative research. *PAACE Journal of Lifelong Learning*, 4, 51-60. Retrieved from: <http://www.iup.edu/ace/publications/>
- Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.
- Merriam, S. B. (2002). *Qualitative research in practice: Examples for discussion and analysis*. San Francisco: Jossey-Bass.
- Mika, C. T. H. (2012). Overcoming ‘being’ in favour of knowledge: The fixing effect of ‘mātauranga’. *Educational Philosophy and Theory*, 44(10), 1080-1092.
- Moore, R., & Muller, J. (2002). The growth of knowledge and the discursive gap. *British Journal of Sociology of Education*, 23(4), 627-637. doi: 10.2307/1393318
- Morais, A. (2002). Basil Bernstein at the micro level of the classroom. *British Journal of Sociology of Education*, 23(4), 559-569. doi: 10.1080/0142569022000038413

- Morgan, D. L. (1996). Focus groups. *Annual Review of Sociology*, 22, 129-152. doi: 10.1146/annurev.soc.22.1.129
- Morrison, M. (2015). *Reconstructing reality: Models, mathematics, and simulations*. New York: Oxford University Press.
- Moss, G. (2001). Bernstein's languages of description: Some generative principles. *International Journal of Social Research Methodology*, 4(1), 17-19. doi: 10.1016/S0898-5898(99)00017-0
- Nash, R. (2005). Explanation and quantification in educational research: The arguments of critical and scientific realism. *British Educational Research Journal*, 31(2), 185-204. doi: 10.1080/0141192052000340206
- Nellhaus, T. (1998). Signs, social ontology, and critical realism. *Journal for the Theory of Social Behaviour*, 28(1), 1-24. doi: 10.1111/1468-5914.00060
- New Zealand Ministry of Education. (2009). *Ka hikitia – Managing for success. The Māori education strategy - 2008-2012*. Wellington NZ: New Zealand Ministry of Education/Te Tāhūhū o te Mātauranga.
- New Zealand Ministry of Education. (2013). *Ka hikitia: Accelerating success 2013-2017*. Wellington, NZ: New Zealand Ministry of Education Retrieved from <http://www.education.govt.nz/ministry-of-education/overall-strategies-and-policies/the-maori-education-strategy-ka-hikitia-accelerating-success-20132017>.
- Norrie, A. (2010). *Dialectic and difference: Dialectical critical realism and the grounds of justice*. New York: Routledge.
- Nutti, Y. (2013). Indigenous teachers' experiences of the implementation of culture-based mathematics activities in a Sámi school. *Mathematics Education Research Journal*, 25(1), 57-72. doi: 10.1007/s13394-013-0067-6
- O'Halloran, K. L. (2007). Mathematical and scientific forms of knowledge: A systemic functional multimodal grammatical approach. In F. Christie & J. R. Martin (Eds.),

Language, Knowledge and Pedagogy: Functional Linguistic and Sociological Perspectives. (pp. 205-236). London, New York: Continuum.

Ollman, B. (2003). *Dance of the dialectic: Steps in Marx's method*. Baltimore: University of Illinois Press.

Outhwaite, W. (1998). Realism and social science. In M. S. Archer, R. Bhaskar, T. Lawson, A. Collier, & A. Norrie (Eds.), *Critical realism: Essential readings* (pp. 282-297). London, New York: Routledge.

Pais, A., & Valero, P. (2012). Researching research: Mathematics education in the political. *Educational Studies in Mathematics*, 80(1/2), 9-24. doi: 10.2307/41485964

Patterson, J. (1992). *Exploring Māori values*. Melbourne: Cengage Learning Australia.

Patterson, J. (1994). Maori environmental virtues. *Environmental Ethics*, 16(4), 397-409. doi: 10.5840/enviroethics19941645

Patterson, J. (2000). *People of the land- A pacific philosophy*. Palmerston North: Dunmore Press.

Penetito, W. (2010). *What's Māori about Māori education?* Wellington, NZ: Victoria University Press.

Pihama, L., Cram, F., & Walker, S. (2002). Creating methodological space: A literature review of kaupapa Māori research. *Canadian Journal of Native Education*, 26(1), 30-43. Retrieved from: <http://search.proquest.com/docview/230302719?accountid=14782>

Power, S., & Whitty, G. (2002). Bernstein and the middle class. *British Journal of Sociology of Education*, 23(4), 595-606. doi: 10.2307/1393315

Putnam, H. (1999). *The threefold cord: Mind, body and world*. New York: Columbia University Press.

- Rata, E. (2011). *The unintended outcomes of institutionalising ethnicity: The case of Māori education in New Zealand*. Unpublished manuscript. Department of Education. Cambridge University. Retrieved from <https://www.educ.cam.ac.uk/research/academicgroups/.../Rata1-2.pdf>
- Rata, E. (2012). Theoretical claims and empirical evidence in Māori education discourse *Educational Philosophy and Theory*, 44 (10), 1060-1072. doi: 10.1111/j.1469-5812.2011.00755.x
- Remillard, J. T., & Heck, D. (2014). Conceptualizing the curriculum enactment process in mathematics education. *ZDM*, 46(5), 705-718. doi: 10.1007/s11858-014-0600-4
- Rieder, B. (2012). The refraction chamber: Twitter as sphere and network. *First Monday*, 17(11), 1-17. doi: 10.5210/fm.v17i11.4199
- Roberts, J. M. (2014). Critical realism, dialectics, and qualitative research methods. *Journal for the Theory of Social Behaviour*, 44(1), 1-23. doi: 10.1111/jtsb.12056
- Roberts, J. M., & Sanders, T. (2005). Before, during and after: Realism, reflexivity and ethnography. *The Sociological Review*, 53(2), 294-313. doi: 10.1111/j.1467-954X.2005.00515.x
- Robinson, S. T. (2005). *Tohunga: The revival - Ancient knowledge for the modern era*. Auckland: Raupo Publishing (NZ) Ltd.
- Roth, W.-M. (2009). *Dialogism*. Rotterdam: Sense Publishers.
- Roth, W.-M. (2014). *Curriculum*-in-the-making*. New York: Peter Lang.
- Salmond, A. (1985). Māori epistemologies. In J. Overing (Ed.), *Reason and morality* (pp. 240-265). London, New York: Tavistock Publications.
- Salmond, A. (1998). *Between worlds: Early exchanges between Māori and Europeans, 1773-1815*. Honolulu: University of Hawai'i Press.

- Salmond, A. (2009). *Hui: A study of Māori ceremonial gatherings*. Auckland: Raupo Publishing (NZ) Ltd.
- Sayer, A. (1992). *Method in social science: A realist approach*. London, New York: Routledge.
- Sayer, A. (2012). *Realism and social science*. London: Sage.
- Schatzki, T. R. (2002). *The site of the social: A philosophical account of the constitution of social life and change*. University Park, PA: Pennsylvania State University Press.
- Schatzki, T. R. (2012). *The timespace of human activity: On performance, society, and history as indeterminate teleological events*. Lanham, MD: Lexington Books.
- Schwandt, T. A. (1998). *Qualitative inquiry: A dictionary of terms*. Thousand Oaks, CA: Sage.
- Schwartz, E. (2002). Using dramaturgy in educational research. In J. L. Kincheloe & S. R. Steinberg (Eds.), *Students as researchers: Creating classrooms that matter* (pp. 113-134). London: Falmer Press.
- Scott, D. (2010). *Education, epistemology and critical realism*. London ;New York: Routledge.
- Sewell, W. H. (1992). A Theory of structure: Duality, agency, and transformation. *American Journal of Sociology*, 98(1), 1-29. doi: 10.1086/229967
- Sherif, B. (2001). The ambiguity of boundaries in the fieldwork experience: Establishing rapport and negotiating insider/outsider status. *Qualitative Inquiry*, 7(4), 436-447. doi: 10.1177/107780040100700403
- Shiva, V. (2000). Forward: Cultural diversity and the politics of knowledge. In G. J. Sefa Dei, B. L. Hall, & D. Goldin Rosenberg (Eds.), *Indigenous knowledges in global contexts* (pp. vii-xi). Toronto: University of Toronto Press.

- Sissons, J. (2005). *First peoples: indigenous cultures and their futures*. London: Reaktion Books.
- Skovsmose, O. (1994). *Towards a philosophy of critical mathematics education*. Dordrecht: Springer.
- Skovsmose, O. (2009). *In doubt - About language, mathematics, knowledge and life-worlds*. Rotterdam: Sense Publishers.
- Skovsmose, O. (2011). *An invitation to critical mathematics education*. Rotterdam: Sense Publishers.
- Skovsmose, O., & Greer, B. (Eds.). (2012). *Opening the cage: Critique and politics of mathematics education*. Rotterdam: Sense Publishers.
- Skovsmose, O., & Valero, P. (2005). Mathematics education and social justice: Facing the paradoxes of the informational society. *Utbildning & Demokrati*, 14(2), 57-71.
Retrieved from: <http://www.oru.se/English/Research/Research-Environments/Research-environment/HS/Education-and-Democracy/Education--Democracy/>
- Smith, G. H. (1990). The politics of reforming Māori education: The transforming potential of kura kaupapa Māori. In H. Lauder & C. Wylie (Eds.), *Towards successful schooling* (pp. 73-89). Basingstoke, UK: The Falmer Press.
- Smith, G. H. (1997). *The Development of Kaupapa Māori: Theory and Praxis*. (Unpublished doctoral dissertation), University of Auckland, Auckland, NZ.
- Smith, G. H. (2000). Māori education: Revolution and transformative action. *Canadian Journal of Native Education*, 24(1), 57-72. Retrieved from: <http://search.proquest.com/helicon.vuw.ac.nz/docview/230301010?accountid=14782>
- Smith, G. H. (2003). *Indigenous struggle for the transformation of education and schooling*. Key note address to the Alaskan Federation of Natives (AFN) Convention.

Anchorage, Alaska. Retrieved from

https://faculty.washington.edu/pembina/all_articles/Smith_G2003.pdf

- Smith, G. H. (2008). Mai i te māramatanga ki te putanga mai o tahuritanga: From conscientisation to transformation. In J. Andrzejewski, M. Baltodano, & L. Symcox (Eds.), *Social justice, peace and environmental education*. (pp. 19-28). London: Routledge.
- Smith, G. H. (2012). Kaupapa Māori: The dangers of domestication. *New Zealand Journal of Educational Studies*, 47(2), 10-21.
- Smith, L. T. (1999). *Decolonizing methodologies: research and indigenous peoples*. Dunedin, N.Z.: University of Otago Press.
- Smith, L. T. (2005). On tricky ground: Researching the native in the age of uncertainty. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (pp. 85-107). Thousand Oaks: Sage.
- St. Pierre, E. A. (2013). The posts continue: Becoming. *International Journal of Qualitative Studies in Education*, 26(6), 646-657. doi: 10.1080/09518398.2013.788754
- Stein, M. K., Remillard, J. T., & Smith, M. (2007). How curriculum influences student learning. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning: a project of the National Council of Teachers of Mathematics* (pp. 319 - 371). Charlotte, NC: Information Age Pub.
- Stewart, G. M. (2007). *Kaupapa māori science*. (Doctoral dissertation), Waikato University Hamilton, New Zealand. Retrieved from <http://hdl.handle.net/10289/2598>
- Stewart, G. M. (2010). *Good science? The growing gap between power and education*. Rotterdam: Sense Publishers.
- Stewart, G. M. (2012). Achievements, orthodoxies and science in kaupapa Māori schooling. *New Zealand Journal of Educational Studies*, 47(2), 51-63.

- Stinson, D. (2008). Negotiating sociocultural discourses: The counter-storytelling of academically (and mathematically) successful African American male students. *American Educational Research Journal*, 45(4), 975-1010.
- Stinson, D. (2011). When the 'burden of acting white' is not a burden: School success and African American male students. *Urban Review*, 43(1), 43-65. doi: 10.1007/s11256-009-0145-y
- Stinson, D. (2013). Negotiating the “white male math myth”: African American male students and success in school mathematics. *Journal for Research in Mathematics Education*, 44(1), 69-99. doi: 10.5951/jresmetheduc.44.1.0069
- Stinson, D., & Bullock, E. (2012). Critical postmodern theory in mathematics education research: A praxis of uncertainty. *Educational Studies in Mathematics*, 80(1/2), 41-55. doi: 10.1007/s10649-012-9386-x
- Stones, R. (2005). *Structuration theory*. Basingstoke, UK: Palgrave Macmillan.
- Straehler-Pohl, H., & Gellert, U. (2013). Towards a Bernsteinian language of description for mathematics classroom discourse. *British Journal of Sociology of Education*, 34(3), 313-332. doi: 10.1080/01425692.2012.714250
- Sullivan, P., Jorgensen, R., Boaler, J., & Lerman, S. (2013). Transposing reform pedagogy into new contexts: Complex instruction in remote Australia. *Mathematics Education Research Journal*, 25(1), 173-184. doi: 10.1007/s13394-013-0069-4
- Taiwhati, M., Toia, R., Te Maro, P., McRae, H., & McKenzie, T. (2010). Takina te kawa: Setting the research engagement methodology in Aotearoa/New Zealand. *Australian Journal of Indigenous Education*, 39, 110-117.
- Tau, T. M. (1999). Mātauranga māori as epistemology. *Te Pouhere Kōrero: an organisation of Māori historians*, 1(1), 10-23. Retrieved from: <http://tepouherekorero.org.nz/>
- Te Maro, P., Averill, R., & Higgins, J. (2007). Evaluation of support for pāngarau teachers working in wharekura. *Findings from the New Zealand Numeracy Development*

Projects 2007, 49-61. Retrieved from: <http://nzmaths.co.nz/findings-nz-numeracy-development-projects-2007>

Te Maro, P., Averill, R., Higgins, J., & Tweed, B. (2008). Fostering the growth of teacher networks within professional development: Kaiako wharekura working in pāngarau. *Te Poutama Tau Evaluations 2008*, 34-47. Retrieved from: <http://nzmaths.co.nz/te-poutama-tau-evaluation-report-2008-research-findings-p-ngarau-years-1-10>

Te Maro, P., & Higgins, J. (2009). The role of leadership in promoting the teaching of pāngarau in wharekura. *Findings from the New Zealand Numeracy Development Projects 2009*, 169-179. Retrieved from: <http://nzmaths.co.nz/findings-nz-numeracy-development-projects-2009>

Te Puni Kōkiri. (1993). *Pāngarau: Māori mathematics and education*. Wellington NZ: Te Puni Kōkiri.

Te Tāhūhū o te Mātauranga. (2008). *Te marautanga o Aotearoa*. Te Whanganui ā-Tara, Aotearoa: Te Pou Taki Kōrero.

Te Tāhūhū o te Mātauranga. (2010). *Whanaketanga: Pāngarau. He aratohu mā te pouako*. Te Whanganui ā-Tara, Aotearoa: Te Pou Taki Kōrero.

Te Tāhūhū o te Mātauranga/New Zealand Ministry of Education. (1996). *Pāngarau i roto i te marautanga o Aotearoa*. Whanganui a-Tara/Wellington New Zealand: Te Pou Taki Kōrero/Learning Media Ltd.

Te Tāhūhū o te Mātauranga/New Zealand Ministry of Education. (2008). *Te Marautanga o Aotearoa*. Whanganui a Tara/Wellington New Zealand: Te Pou Taki Korero/Learning Media Ltd.

Thomas, G., & Tagg, A. (2004). *Exploring issues in mathematics education: An evaluation of the early numeracy project 2003*. Wellington, New Zealand: New Zealand Ministry of Education.

- Trinick, T., Meaney, T., & Fairhall, U. (2015). E haere ana koe ki hea? Spatial thinking: Traditional Māori systems and the language of spatial orientation. In R. Averill (Ed.), *Mathematics and statistics in the middle years: Evidence and practice* (pp. 146-162). Wellington, NZ: NZCER Press.
- Trinick, T., & Parangi, M. (2006). Te Poutama Tau: Te whakaako pāngarau - Wharekura. *Te Poutama Tau Evaluations 2006*, 25-54. Retrieved from: <http://nzmaths.co.nz/sites/default/files/Numeracy/References/eval-tpt2006.pdf>
- Trinick, T., & Stevenson, B. (2005). An evaluation of Te Poutama Tau 2004. *Findings from the New Zealand Numeracy Development Projects 2004*, 80-88. Retrieved from: <http://nzmaths.co.nz/node/1618>
- Trinick, T., & Stevenson, B. (2006). An evaluation of Te Poutama Tau 2005. *Findings from the New Zealand Numeracy Development Projects 2005*, 103-115. Retrieved from: <http://nzmaths.co.nz/node/1615>
- Trinick, T., & Stevenson, B. (2007). Te Poutama Tau 2006: Trends and patterns. *Findings from the New Zealand Numeracy Development Projects 2006*, 44-54. Retrieved from: <http://nzmaths.co.nz/node/1614>
- Trinick, T., & Stevenson, B. (2008). Te ara poutama: An evaluation of Te Poutama Tau 2007. *Findings from the New Zealand Numeracy Development Projects 2007*, 2-12. Retrieved from: <http://nzmaths.co.nz/findings-nz-numeracy-development-projects-2007>
- Trinick, T., & Stevenson, B. (2009a). Evaluation of Te Poutama Tau: Māori medium numeracy project 2003-2009. *Findings from the New Zealand Numeracy Development Projects 2009*, 72-87. Retrieved from: <http://nzmaths.co.nz/findings-nz-numeracy-development-projects-2009>
- Trinick, T., & Stevenson, B. (2009b). Longitudinal patterns of performance: Te Poutama Tau. *Te Poutama Tau Evaluations 2008*, 1-13. Retrieved from:

<http://nzmaths.co.nz/te-poutama-tau-evaluation-report-2008-research-findings-p-ngarau-years-1-10>

- Trinick, T., & Stevenson, B. (2009c). Te Poutama Tau student performance in asTTle. *Te Poutama Tau Evaluations 2008*, 13-22. Retrieved from: <http://nzmaths.co.nz/te-poutama-tau-evaluation-report-2008-research-findings-p-ngarau-years-1-10>
- Tumoana Williams, L. R., & Ormonde, A. (2010). What is research? *MAI Review*, 3. Retrieved from: <http://www.review.mai.ac.nz/index.php/MR/issue/view/17>
- Van Dijk, T. A. (2008). *Discourse and context*. Cambridge: Cambridge University Press.
- Van Dijk, T. A. (2009). *Society and discourse*. Cambridge: Cambridge University Press.
- van Oers, B. (2002). Fruits of polyphony: A commentary on a multiperspective analysis of mathematical discourse. *The Journal of the Learning Sciences*, 11(2/3), 359-363. doi: 10.1080/10508406.2002.9672143
- Veel, R. (2006). Language, knowledge and authority in school mathematics. In F. Christie (Ed.), *Pedagogy and the shaping of consciousness: Linguistic and social processes* (pp. 185-287). London, New York: Continuum.
- Verschaffel, L., Greer, B., Van Dooren, W., & Mukhopadhyay, S. (Eds.). (2009). *Words and worlds: Modelling verbal descriptions of situations*. Rotterdam: Sense Publishers.
- von Glasersfeld, E. (2002). *Radical constructivism: A way of knowing and learning*. London: RoutledgeFarmer.
- Vu, T. T., & Dall'Alba, G. (2013). Authentic assessment for student learning: An ontological conceptualisation. *Educational Philosophy and Theory*, 46(7), 778-791. doi: 10.1080/00131857.2013.795110
- Wahlberg, T. H. (2014). Elder-Vass on the causal power of social structures. *Philosophy of the Social Sciences*, 44(6), 774-791. doi: 10.1177/0048393113500213

- Walshaw, M. (2004). The pedagogical relation in postmodern times: Learning with Lacan. In M. Walshaw (Ed.), *Mathematics education within the postmodern* (pp. 121-141). Greenwich, Conn.: Information Age Publishing.
- Walshaw, M. (2013). Post-structuralism and ethical practical action: Issues of identity and power. *Journal for Research in Mathematics Education*, 44(1), 100-118. doi: 10.5951/jresmetheduc.44.1.0100
- Walshaw, M., & Brown, T. (2012). Affective productions of mathematical experience. *Educational Studies in Mathematics*, 80(1/2), 185-199. doi: 10.1007/s10649-011-9370-x
- Wang, H., Harkess, C., & Parkin, M. (2007). *Senior secondary students' achievement at Maori-medium schools 2004 – 2006*. Wellington, NZ: New Zealand Ministry of Education Retrieved from http://www.educationcounts.govt.nz/publications/schooling/ncea_factsheets/14593.
- Wertsch, J. V. (1998). *Mind as action*. New York: Oxford University Press.
- Wilder, R. L. (1981). *Mathematics as a cultural system*. Oxford, New York: Pergamon Press.
- Willis, P. E. (1977). *Learning to labour: How working class kids get working class jobs* Farnborough, UK: Saxon House.
- Yin, R. K. (2009). *Case study research: Design and methods*. Thousand Oaks, CA: Sage Publications Limited.
- Young, M. F. D. (2013). Is knowledge under attack (audio podcast). <https://archive.org/details/EducationForumNo34IsKnowledgeUnderAttack>.
- Young, M. F. D., Lambert, D., Roberts, C., & Roberts, M. (2014). *Knowledge and the future school: Curriculum and social justice*. London: Bloomsbury.

Appendices

Appendix A - Māori Words used in the Thesis

Māori Word	English approximation
ako	learning/teaching
Aotearoa	New Zealand
atua	anthropomorphised element of the world
haka	posture dance
hapū	sub-tribe
hau kainga	people of the home
He Tau Anō te Tau	curriculum mathematics resource books
hui	meeting
ira/ira atua	dot, spot or particle/fractal of the gods
Iwi	tribe
kai	food/eat
kaiako	teacher
kaitakawaenga	advisor
kaitiaki	custodian
kapa Haka	group performance of waiata and haka
kaumatua	Māori elder
kaupapa	purpose/theme
kia kaha!	be staunch/strong!
kohanga reo	Māori pre-school
kōrero	talk
Koro	familiar term for older male (grandfather)
koroua	a male elder, grandfather, granduncle
kuia	a female elder, grandmother, grandauntie
kura	school
(the) Kura	the school involved in this thesis.
kura Māori	Māori School
kura tuatahi	Māori primary school
mana	prestige/status
manaakitanga	care
Manu Kōrero	speech competition
manu tukutuku	traditional kite
Māori	indigenous first people of Aotearoa
marae	a traditional meeting area, buildings and genealogically associated people.
mātauranga	knowledge
matua	father/male teacher
Māui	demi-God: disorderly
mokopuna	grandchild
mōteatea	song/poem embodying cultural knowledge
Ngā Whanaketanga	National Standards for Primary Schools
ngaro	lost
nui	big
Pākehā	European New Zealander
pāngarau	curriculum mathematics education
pou	carved post in wharenui
pōwhiri	welcome ceremony

Māori Word	English approximation
pūrākau	legend/myth/story embodying cultural knowledge
rākau	tree
rangatiratanga	autonomy
rangona	heard
rāranga	flax weaving
reo	language
reo pāngarau	curriculum mathematics register in Māori
tamaiti	child
tamariki	children
tangihanga	funeral
tātai	scheme/calculate
Tāwhaki	demi-God: orderly
Te Poutama Tau	New Zealand Numeracy Project
Te Puni Kōkiri	government agency to support Māori
te reo Māori	the Māori language
Te Tāhūhū o te Mātauranga	New Zealand Ministry of Education
teina	younger sibling/person
tikanga	protocol
tuakana	older sibling/person
tukutuku	symbolic pattern displayed in wharenui.
tumuaki	school principal
waiata	song
waiata-a-ringa	song with actions
wairua	human spirit
waka	canoe/automobile
whaea	mother/female teacher
whakapapa	ancestry/genealogy
whakataukī	proverb
whānau	family
whanaungatanga	family-like relationships
wharenui	Iwi/hapū ancestral meeting house
whare wānanga	Māori university
wharekura	Māori secondary school

Appendix B - Participant Information Sheets and Consent Forms

Note: The information sheets and consent form for teacher participants only are included here. Information sheets and consent forms for students and parents/care-givers are essentially the same but re-worded slightly to use language appropriate for the readers.



Tātai kōrero i ngaro, tātai kōrero e rangona.

Some voices are lost, but others are heard

Teacher Participant Information Sheet

Investigating Engagement with Mathematics Curriculum Resources in te reo Māori.

Tēnā koutou ko ngā Mātua, ko ngā Tauira, ngā Kaiako, ngā tāngata katoa e tautoko ana i te mahi ako i te Kura <insert name>. Kei te mihi whānui atu mātou ko Te Kura Māori o te Whare Wānanga o te Ūpoko o te Ika a Māui ki a koutou katoa.

Ko Brian Tweed tēnei e mihi atu nei me āku mihi whakatairanga ake anō.

My name is Brian Tweed. I am a PhD student at Te Kura Māori, Victoria University of Wellington. I would like to conduct a research project at your Kura as part of a PhD degree. I invite you to join me in this research project.

I would like to investigate how recent curriculum and professional development resources published in te reo Māori are impacting on the teaching and learning of mathematics in your Kura. The benefit of this research is to support future production of resources, to support teachers in their use of them and ultimately to support the development on Māori medium mathematics.

Victoria University requires that all research involving people be reviewed by the Research Ethics Committee and be given ethics approval.

You are not expected to do anything different for this research. During your usual work routines, I plan to

- interview you to give you the opportunity to explain how you use resources for up to three learning objectives. These interviews will be audio recorded. This may involve several interviews during the course of 2012.
- copy examples of your planning documents and other resources that you produce to support your planned activities.
- video record you working together with small groups of students as they work on your activities,
- ask your students about their own thoughts and perspectives on the activities and take copies of their work.

The above data collection is planned for up to three different learning objectives and may take place any time during 2012.

In my report for the project, no individuals or the Kura will be identified. Confidentiality will be guaranteed. All findings will be reported in aggregated form so that no individuals or the Kura will be able to be identified.

As a research participant your privacy and confidentiality will be protected. Video footage and audio recordings taken during observations in the classroom, interviews and focus groups will be confidential and all such material will be safely stored in a password protected computer file with myself as the researcher having sole access. All physical materials collected (for example, student written work) will be kept in a locked filing cabinet with only the researcher having access.

The data collected for this research project will be used in the final thesis and may be used in other publications (e.g. publication of papers in educational journals). The findings of the research will be offered to you for viewing after completion of the data analysis (late 2013).

All data collected during the data collection phase of the research will be held for a period of 5 years after the completion of the research. All data will then be destroyed.

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

- decline to answer any question
- withdraw from the study at any time during the data collection phase and withdraw any contributions you have made up to that point
- ask any questions about the study at any time
- provide information on the understanding that your name will not be used unless you give permission to the researcher
- be given access to the project findings and report
- check the accuracy of any of your own data recorded by the researcher
- ask for any recording device to be switched off at any time.

Contacts:

Researcher

Brian Tweed, Te Kura Māori, Victoria University of Wellington, Faculty of Education,
Donald Street, Karori, Wellington

E-mail: matangahapai@gmail.com

Phone: 0274226024

Supervisor

Dr Joanna Higgins, Victoria University of Wellington, Faculty of Education, Donald Street
Karori, Wellington

E-mail: Joanna.Higgins@vuw.ac.nz

Phone: 04 463 9576

Heio anō tāu he whakapā mai hei whakamārama atu anō

Nāku noa i roto i te wairua tautoko

Nā Brian Tweed



Tātai kōrero i ngaro, tātai kōrero e rangona.

Some voices are lost, but others are heard

Investigating Engagement with Mathematics Curriculum Resources in te reo Māori.

Teacher Consent Form

I have read the information sheet and have had details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I can withdraw at any time along with any individual contributions that I have made.

I agree to participate in the study under the conditions set out in the information sheet.

I would like a summary of the research findings. (Delete this if not required)

Signature

Date:

Full Name:

Appendix C - Interview Question Guide

First interview/focus group – overall vision.

Cluster 1 – Experience and Current Practice.

How does your past pāngarau experience influence current practice? / What are your pāngarau lessons like?

Who has influenced you most? Who helps you most?

How would you describe your current pāngarau practice?

What would your perfect pāngarau lessons would be like?

What is your major aim as a teacher (of any subject)? What is your aim as a student?

Cluster 2 – Nature of Pāngarau.

Is pāngarau important? Why?

What is the relevance of academic/disciplinary mathematics?

Where does pāngarau come from?

What is the nature of pāngarau?

Is pāngarau a creative activity? What makes it creative/not creative?

What is pāngarau for?

Cluster 3 – Pāngarau Resources.

What are your thoughts about the pāngarau register?

Where have pāngarau resources come from?

What learning theories are involved?

What are the good and bad features of resources?

How do you use them? How do resources influence your lessons?

Cluster 4 – Māori content of Resources.

Do the resources support the Kura?

Are the pāngarau resources Māori?

What is the role of the New Zealand Ministry of Education and the Government in the production of pāngarau resources?

Second interview/focus Group – internal components.

Cluster 1 – People.

How do you become good at pāngarau?

Can anyone be good at pāngarau?

Can anyone be a mathematician?

What is the best way to learn pāngarau?

What are mathematicians like?

Do you think you will use pāngarau when you leave the Kura?

Do you use pāngarau outside of the Kura?

If you gave advice to a friend about how to get good at pāngarau, what would you say?

Cluster 2 – Knowledge.

Is pāngarau hard? Why?

What do you need to know to be good at pāngarau?

Is the way the curriculum structures knowledge the only way?

What is it structured like that?

Could you learn pāngarau knowledge in a different order to that suggested in the curriculum?

Why does Te Poutama Tau emphasise strategy and knowledge?

Why is multiplicative thinking at stage 7 and 8 of the Te Poutama Tau framework?

Cluster 3 – Value.

If a person is good at pāngarau (and not other things) will they get a good job?

If a person is good at art (and not other things) will they get a good job?

Could the Kura not do pāngarau at all?

Is mathematics in English-medium different to pāngarau?

Does pāngarau make you brainy? Why?

Is being brainy a good thing?

What would be impossible if pāngarau didn't exist?

Were Māori ancestors good at pāngarau?

Cluster 4 – Video data.

Why did you do the activity?

How did you know that the activity was appropriate?

Where did it come from?

Why was it designed like that?

What was the aim of it?

What was the context? Why was it used?

What did you do in the activity? Why?

What did you learn by doing it?

Was it successful? How do you know?

If you did it again what would you change?

How does it relate to other activities?

How does it relate to the Kura as a whole?