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The doing of curriculum mathematics: the case of an Indigenous Māori school in Aotearoa/New Zealand

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ABSTRACT

This article discusses a research project in which curriculum mathematics education in an Indigenous Māori school in Aotearoa/New Zealand was conceptualised as a site of struggle. A bricolage of concepts from the sociology of education and Māori knowledge was used to interpret ethnographic data from this school. Findings suggest that struggle derives from two conflicting ontological commitments about the nature of a person. Curriculum mathematics education carried with it a commitment to the person as a collection of official knowledge and associated interactional modes. The ethos of the school carried a commitment to the person as genealogically embedded unique being. Centring Māori ontological commitments, knowledge and people as the source of legitimation suggests the possibility that such schools could use Indigenous ontologies and their associated epistemologies to generate their own terms of engagement with, and Indigenous knowledge of, the discipline of mathematics itself.

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Introduction

This article is not about the nature of mathematics, ethnomathematics, improving the achievement of Indigenous students, or effective pedagogy for Indigenous students. It is about the ontological work that curriculum mathematics education does in an Indigenous Māori school (kura Māori¹).

Curriculum mathematics education is understood to be an assemblage of inter-connected entities that mutually support, justify and permeate each other. This assemblage consists of the New Zealand national curricula, education law and policy, dominant educational discourses, educational research, professional development provisions, modes of administration/evaluation and communities of people. There are two national curricula, the New Zealand Curriculum (for English medium schools) and Te Marautanga o Aotearoa (for Māori medium schools). These are not translations of each other but, for mathematics education, both have virtually identical content.

The Māori students and teachers in this study did not struggle with the doing of curriculum mathematics. Struggle manifested in relation to what this doing of curriculum

mathematics meant for the nature of the school itself. Inspired by Foucault's saying 'what [people] don't know is what what they do does' (Dreyfus and Rabinow 1983, 187), the struggle is about what the doing of curriculum mathematics education does.

Māori struggle with curriculum mathematics education has been the focus of a small number of researchers in Aotearoa/New Zealand. Barton and Fairhall (1995) likened curriculum mathematics education to a trojan horse offered gift-like whilst being toxic for the conceptual basis of Indigenous cultures. McMurchy-Pilkington and Trinick (2002) returned to the notion of the trojan horse and found that curriculum mathematics is 'still ethnocentric and still techno-rational' and about 'preparing Māori for the job market' (p. 471). McMurchy-Pilkington (2008), signalling the need for Māori to have full control over the nature of curriculum, concludes that 'the state must work with Māori and make structural changes, giving them more control over the resources, decisions, and meaning' (p. 634). In recognising the delicate balancing act that Māori must engage with when enacting mandated national curricula, McMurchy-Pilkington, Trinick, and Meaney (2013), explain how Māori have been able to exploit the spaces in the structures imposed by government to move towards the achievement of their own aspirations. The research detailed in this article shows that the trojan horse is still present and that the toxicity is in part about the legitimisation of ontological commitments that are contradictory to Indigenous ontological commitments.

Struggle with mathematics education is experienced wherever Indigenous peoples must earn a living in a non-Indigenous dominant society. For example, in Australia, Matthews et al. (2005) assert that change is required in the power relations and tacitly held stereotypical assumptions to value Indigenous cultures and ways of knowing. In Alaska, the work of Lipka, Wong, and Andrew-Ihrke (2013) seeks to build on Indigenous knowledge to support Indigenous students learning of curriculum mathematics. In the Canadian context, Nicol (2018) contemplates a critical pedagogy of place to connect Indigenous students with curriculum mathematics in ways that also challenge settler colonial legitimacy. Nicol suggests a different understanding of place as connecting 'human, non-human and more-than-human relational worlds'. Nicol is suggesting a different ontological commitment for what is understood as 'place' which in turn would suggest a different mathematics education.

In the US, McCarty and Lee (2014) emphasise the need for a critical, culturally sustaining pedagogy which demands 'relentless commitment to community-based accountability' (p. 119). Although not related to curriculum mathematics education, the call for this kind of accountability is aligned closely with the position taken in this article – that power and resources be returned to Indigenous communities so that they may form their own engagement with mathematics.

Indigenous knowledge, culture, practices and artefacts tend to be regarded as resources for the learning of curriculum mathematics. This tendency, which Paris and Alim (2017) identify as employing 'asset pedagogies', imputes an inherent mathematical nature to such Indigenous 'assets'. As Te Maro (2019) emphasises, this recasting of Indigenous culture as inherently mathematical is more about assimilation into mainstream society and the support of Indigenous students to learn curriculum mathematics than valuing Indigenous culture and people. Te Maro reverses the usual perspective that Indigenous knowledge be used as an asset for curriculum mathematics. In her dialectical view,

indigeneity will not be seen in mathematical terms, but mathematics will be seen in Indigenous terms.

The Aotearoa/New Zealand context

Over the last 70 years, Māori have moved from a rural lifestyle in traditional homelands, to an urban one. Now, over 80% of Māori now live in towns and cities. One quarter of all Māori live in Auckland, New Zealand's largest city, and one sixth in Australia (Haami 2018). Most Māori children are educated in English speaking, urban schools (referred to in this article as English-medium schools).

In the 1970s, concern by Māori about the survival of Māori language, culture and land, resulted in a number of actions which signalled the emergence of a 'Māori renaissance'. A pivotal factor in this renaissance is the Treaty of Waitangi. This treaty, signed in 1840, was an agreement between the British Crown, now the New Zealand Government, and most, but not all, Māori tribal groups. It guaranteed control by Māori over all of their cultural and material resources.

The Treaty has provided the basis on which settlements have been negotiated to partially compensate Māori for historical and continuing injustices. It has also provided political leverage to establish re-vitalisation projects such as economic and social welfare projects, Māori television and radio stations, language re-vitalisation projects, and the establishment of Māori early childhood centres, primary and secondary schools, and universities (Smith 2011, 2003; Durie 1999, 2007).

As part of this renaissance, a relatively small number of children now attend kura Māori based on Indigenous Māori philosophies with Māori language as the exclusive language of instruction and communication. Research about the doing of curriculum mathematics education mandated by a national curriculum in one such kura Māori (henceforth **the** kura Māori) is reported on in this article. The kura Māori involved is a small school with approximately 120 students spanning the full age range from 5 to 18 years old. At the time of data collection, there were 7 full-time classroom teachers. The kura is situated in the centre of a medium sized town.

The ethics of non-Indigenous researchers in Indigenous contexts

No researcher can research in Indigenous contexts without having strong connections with the communities involved. It is appropriate then to begin with an explanation of how the author is connected with the community of the kura Māori.

The author has been closely associated with kura Māori and their communities for 25 years. He has taught, as a fluent speaker of te reo Māori (Māori language), in kura Māori and universities, and initiated professional learning opportunities for Māori teachers in mathematics and science (Te Maro, Averil, Higgins, and Tweed 2008). He has worked in several kura Māori as a teacher of mathematics and as a mathematics advisor to kura Māori. In this experience, the phenomenon of struggle with curriculum mathematics education has been experienced from 'both sides of the fence'; as a teacher trying to implement the curriculum in his own classroom, and, as a professional development provider, supporting

teachers to implement curriculum mathematics. By marriage, he is connected to the Iwi (tribe) Ngāti Porou and has gradually grown to a point where he is able to carry out significant roles in upholding tikanga Māori (cultural practices and protocols) ((Tweed 2019). He is also still a teacher and whānau (wider family) member at the kura Māori involved in this research. This long association and commitment to te ao Māori (the Māori world) through work, family, personal and social life, it is suggested, places this non-Māori researcher appropriately for research in this Māori community in which he has been invited to stay.

The creation of this article

This article draws on the author's PhD study (Tweed 2016). The PhD study was conducted in alignment with the University's human ethics regulations (details available on request).

As already mentioned, the author has had a long association with the kura Māori in the research. This was necessary before any research could be contemplated. To establish the possibility of research in the community of the kura, representations following appropriate cultural protocols were made. This included informal discussions with teachers (who were also colleagues), the principal, and a formal presentation to the whānau (family) of the kura. The whānau of the kura includes all children and their extended families. The ethos of the kura is that the whānau has overall authority for the kura and matters relating to it. In order for the research to be possible, consent was obtained from the whānau. The agreement of the whānau marks the formal beginning of the work that has ultimately led to the writing of this article.

In a similar way, outlined later in the methodology section, as research progressed and data analysed, findings were presented and discussed with participants and whānau members throughout the project. Submission of the final thesis was done with the assurance that all participants and the whānau supported the submission. Participants in the research were also present to witness the oral defence of the thesis.²

Single authorship by non-Indigenous writers in general should rightly be questioned. In this case, the context is such that the whānau has entrusted the communication of this research to the author. Prompted by the peer review of the article, the author sought further confirmation of this by approaching the whānau again for their consent to continue with the publication. This involved a further deliberation by the whānau resulting in a reaffirmation of the article.

There is a cultural boundary to be crossed here. In the sense that the author is the individual who has written the article, sole authorship stands. In a different sense, a sense assumed by the whānau, the author is not an outsider but a member of the whānau and the messages of the article are those of the collective. After this final agreement of the whānau, the principal commented

Nō te whānau koe...e whakapono ana te whānau katoa ki a koe

You are part of the whānau...we all believe in you.

Whānau support is given for the writing of the article but also a distinctly Indigenous responsibility is conferred. As a member of the school whānau, the author is subject to particular ethical responsibilities which, over and above the usual University based

responsibilities, involve responding to the current manifestations of oppression and equity resulting from our colonial history and is committed to a life-long involvement in social life.

Kaupapa Māori theory

Kaupapa Māori theory has emerged as a theoretical framework grounded in Māori language, cultural practices and worldview and usually emphasises that research in Māori contexts should be by Māori, with Māori and for Māori and using Māori language and worldviews (Bevan-Brown 1998; Pihama, Tiakiwai, and Southey 2015). Strictly speaking the research outlined in this article cannot be kaupapa Māori research since the author is not Māori. Strongly Māori-centric may be more apt as a description since Māori people and their aspirations are centralised and this frames the questions and challenges generated. From this position, the author challenges mainstream educators to critically reflect on their/our own positions and act on these reflections.

Bricolage: creating the analytical framework

The analytical bricolage combines conceptual elements from the sociology of education with concepts from mātauranga Māori. Bricolage is understood here as a conceptual weaving across the boundaries of these two domains, recognising the ‘discursive gap’ between them and requiring deep knowledge of both (Lee 2009). This involves developing innovative ‘tools’ to do such weaving and interdisciplinary work which are intimately related to the research context and the researcher themselves and the history in which the research is sedimented (Kincheloe 2005). The framework that emerged in this research reflects the kura Māori, a commitment to Māori emancipation and the particular stances that the researcher inevitably carries.

Concepts from mātauranga Māori/Māori knowledge

Māori knowledge is based on an understanding of people as an intrinsic part of the natural world – there is no subject-object separation which characterises western knowledge systems. Williams (2016) exemplifies the nature of this perspective in his description of the navigation techniques of Kupe who captained the first Polynesian waka (ocean going canoe) to reach Aotearoa (New Zealand) in around 800 AD. Kupe navigated as an integral part of the natural environment in which he travelled by using stars, cloud formations, the paths followed by whales, and the flight paths of birds. In this form of knowledge, as Te Ahukaramu Charles Royal (2009) eloquently explains,

the objective and subjective worlds are ultimately ‘one’ ... The sense of deep connection with the world and thus the deep interconnectedness of all things is revealed and experienced through ‘creative participation’, ‘participatory epistemology’. (p. 114).

Royal also provides a continuum that describes contemporary Māori knowledge from a pole of ‘internalised knowing’ (tohu – Kupe’s science) to ‘explicit, codified knowledge’ (mātauranga). In between these poles are a series of stages which both characterise different states of knowledge/people and constitute ways of generating knowledge

(epistemological actions). Importantly, in this continuum, knowledge and the people are inextricably inter-connected as befits the Māori holistic view of reality. From a Māori perspective, people must participate for knowledge to exist – the centrality of people is always maintained in an intimate weaving of people and knowledge.

Concepts from the sociology of education

The overarching sociological concept informing the analytical framework is that of legitimation as conceptualised in the work of Karl Maton in his development of Legitimation Code Theory (LCT) (Maton 2014). LCT builds upon Basil Bernstein's concept of the pedagogic device (Bernstein 2000) to generalise it as the legitimation device. It also draws on Pierre Bourdieu's field theory. Legitimation in a particular social field implies that a legitimate person, one who conforms sufficiently to the basis of legitimation (the 'legitimation code'), has access to the resources of the field and has opportunities to achieve status within it. A person formed through social practices to conform to a legitimation code will develop a form of consciousness or identity compatible with it. This understanding has clear derivation from Bourdieu's concepts of capital and habitus (Bourdieu 2006).

The approach taken here is based upon the understanding that the legitimation device sets the ontological conditions for practices in a social field. Ontology here is a set of commitments about what the world is like. These commitments both legitimise practices and are re-inscribed each time practices are enacted. Analysis of practices using LCT can clarify ontological commitments which must be present for the practices to make sense.

LCT recognises a number of dimensions of the legitimation device. The dimension most relevant in this research is termed 'specialisation'. This refers to how the practices of a social field create a specialisation of the subjectivity of participants (Maton 2014). This relevant question here is 'how do the practices experienced in a social field shape participants towards a specific kind of legitimate person?'. If we see this legitimate person as an ontological commitment, the connection between practices and ontology is present and analytically available.

In Maton's approach, using specialisation to analyse practices in a social field involves the estimation of relative strengths and the nature of the relation with knowledge (the epistemic relation) and between people (the social relation). Maton further characterises the epistemic relation as being either 'discursive' (involving engagement with an existing official discourse) or 'ontic' (involving direct engagement with an object of study). The social relation is characterised as 'subjective' (based on gender, ethnicity, or class for example) or interactive (based on modes/norms of social interaction). In educational fields, this focus on the epistemic and social relations is especially appropriate since such fields are structured around the acquisition of particular kinds of knowledge by particular kinds of people (knowers) in particular ways.

Concepts to weave sociology and mātauranga

Both Royal's treatment of Māori knowledge and Maton's concept of specialisation recognise that social fields/life involve an intertwining of knowledge and people (knowers). Maton explicitly refers to this as a knower-knowledge structure (Maton 2000).

This understanding of social fields as a weaving of knowledge and knowers provides the bricolage concept allowing the connection between mātauranga Māori and a sociology of education to be made. A further deepening of this concept is possible by recognising each configuration of knowers and knowledge as a ‘setting’ of a knower/knowledge dialectic influenced by the workings of power within each social field (Tweed 2016). The overarching bricolage concept/tool then becomes one which connects the particular way that knowers and knowledge are related in a social field to the power of the society that englobes it. In certain social fields, power can be seen to ‘fix’ this dialectic to legitimise a certain configuration of knowledge and knowers. Attention is then directed at the configuration of the kind of knowledge that is to be known and the kind of knower who knows that knowledge and the source of power that maintains this configuration.

The phenomenon of struggle is understood not in phenomenological terms (how people experience the phenomenon from a first-person perspective), but from the perspective of practice. Practices are conceptualised as sequences of actions which occur regularly as part of the accepted regime of a social field. In this view, practices give a window into the underlying ontological commitments of the field since practices are only conceivable and purposeful if ontological commitments are already in place to give meaning to what is regularly done.

Practices cover a range of possibilities; from overt patterns of actions, to verbal instructions that are repeated at certain times, to beliefs that are stated and restated in explicit or internal conversations.

The analytical framework

Whilst the framework presented here draws on the work of Maton and Royal, it is not a direct application of either; it is a re-contextualisation of both.

Maton’s epistemic relation is recontextualised as an identification of explicit, codified knowledge/mātauranga (discursive) or internalised knowing/tohu (ontic). The match between codified knowledge and Maton’s discursive relation is close but not exact. The particular understanding of tohu, however, is quite different to Maton’s ontic relation; there is overlap in the notion of direct experience of ‘objects of study’, but in Māori terms the subject-object separation is dissolved; tohu/ontic becomes a direct interaction with and participation in real events which results in personalised, internalised knowledge (which may later be externalised and codified).

The social relation, implicit in Royal’s proposals, is made explicit with the help of Maton’s work. In Māori terms, the centralisation of the knower in relation to any knowledge is a given and so for Royal there is no need to elaborate. Maton’s social relation is helpful here as a tool to cater for the presence of curriculum mathematics and can be re-contextualised in Māori terms as whai tikanga noa³/interactive or whakapapa⁴/subjective. [Figure 1](#) illustrates how these four settings of the epistemic and social relations form the four quadrants of an analysis table.

The use of this analytical framework involves a careful examination of empirical data to map each social practice onto one or more of the four quadrants.

Social Relation / Epistemic Relation	Whakapapa/ Subjective	Whai tikanga noa/ Interactive
Mātauranga/ Discursive		
Tohu/ Ontic		

Figure 1. Analysis table for the epistemic relation and social relation/ the fixing of the knower/knowledge dialectic.

Methodology

Data collection methods included semi-structured interviews, focus groups, video recordings, and field notes. Data was collected from each mathematics classroom and in the school as a whole (the ‘ethos’).

As an ethnographic study by a researcher who is also part of the Indigenous community involved, data collection and interpretation require a collaborative approach. The nature of working as part of a Māori community leaves no room for privacy in research. The thinking and findings were communicated to participants through a process of wānanga – meetings in which ideas and knowledge are discussed as equals with no distinction between researcher and participants.

As analysis proceeded, a picture was created about the dominant specialisation in each field under study. This lifts attention from the nature of what was said and done to an overall holistic judgement about the dominant specialisation in each social field. The dominant specialisation then indicates how each field legitimates people and allows inferences to be made about the ontological commitments of these fields and connections to societal power.

Findings

There were four major, inter-related findings at the level of the social field:

- i. a significant difference between dominant specialisation in mathematics classes and the kura ethos,
- ii. a school-wide polarisation effect,
- iii. tensions in the subjective experiences of student and teachers, and
- iv. the presence of ‘mediating’ practices.

In this section, in keeping with the focus on dominant specialisations, trends are described rather than detailed examples empirical data. For further detailed discussions and examples of empirical data see Tweed (2016, 2021).

Different dominant specialisations

There was a significant difference between the dominant specialisations in mathematics classes and in the school as a whole (the ‘kura ethos’).

Mathematics classes tended to create an epistemic relation that was mātauranga/discursive. This meant that students needed to demonstrate certain levels of official mathematical knowledge and competencies as defined in the official discourse of curriculum mathematics. At the same time, mathematics lessons tended to create a social relation that was strongly whai tikanga noa/interactive. This meant that students had to behave and interact with each other and with the teacher in defined ways which were consistent with the epistemic relation. To be legitimate in curriculum mathematics, students and teachers needed to internalise both the codified/discursive ways of knowing, speaking and symbolic representation of mathematics education, and the concomitant ways of behaving and interacting. Another way of saying this is that official knowledge conditioned/organised student consciousness/identity. Table 1 gives some examples of how empirical data from mathematics classes were related to epistemic and social relations.

In contrast, the kura ethos tended to a tohu/ontic epistemic relation and a whakapapa/subjective social relation. Engagement with knowledge (tohu/internalised knowing/ontic epistemic relation) tended to be through real events such as participation in Iwi-based

Table 1. Mapping of empirical data to social relation and epistemic relation in mathematics classes.

Empirical data	Interpretation – connecting to relations	Mapping to relation
The teacher has already decided on the learning objective, which emphasises the strategy to be taught and being able to explain the strategy. (Observation from video data)	The objective defines mathematical activity as: problem/solution strategy/ explanation This is a strong genre originating in the national curriculum.	Epistemic Relation: mātauranga/ Discursive
The lesson is very strongly framed by the official resources. (Observation from video data)	The discourses contained in official resources are transplanted wholesale into the classroom discourse.	Epistemic Relation: mātauranga/ Discursive
“Māui is not welcomed in mathematics” (Interview data)	Māui is a mythical figure known as a trickster and challenger of authority. The ideal student is one who interacts with people and knowledge in a controlled and conventional manner.	Social Relation: Whai tikanga noa/Interactive
“there is nothing wrong with building the child’s emotional wellbeing, but the reality is that maths is in everything... this building has to do with maths ... the school is run on maths really I think” (Interview data)	Mathematics knowledge is said to be intrinsic to everything and is essential for children to learn. Mathematics over-arches other knowledges to do with social and spiritual understandings.	Epistemic Relation: mātauranga/ Discursive
“Mathematics learning is the overcoming of a challenge which is intrinsically good for the child” (Interview data)	The child needs to develop the attributes and ways of interacting that place them favourably to meet mathematical challenges.	Social Relation: Whai tikanga noa/Interactive
Learning in mathematics means knowing strategies and explaining them to others – a public display is usually required. (Observation from video data)	Students must learn to give public displays in a legitimate way by interacting with people, resources and language appropriately.	Social Relation: Whai tikanga noa/Interactive

events and political or environmental activity. In this relation gaining knowledge means doing something real for your Iwi through direct action and navigation within events themselves as they happen. The social relation tended to be whakapapa/subjective; legitimisation was not based on interaction, but rather on being Māori and, ultimately being human. Students and teachers were automatically legitimate due to their possession of genealogical ties to Māori ancestors and location in a constellation of people (the Iwi (tribe), Māori society and humanity in general) with behaviours and knowledge considered as the many and varied natural qualities of the unique person ‘created’ through genealogy. Another way to say this is that whakapapa(genealogy) conditioned/organised knowledge. Table 2 gives examples of how elements of empirical data about the ethos were related to epistemic and social relations.

School-wide polarisation

A particular strength of the methodology is the ability to represent the whole school ethos and all mathematics classes at the level of the social field in a single diagram (Figure 2). This showed a distinct polarisation between fields. It was also found that some mathematics classes changed or alternated between quadrants in relation to changing circumstances.

In one case, teacher C conducted a localised ‘revolution’ and systematically changed from a strong knowledge position to strong knower position over the course of the period of data collection. Teacher C explained how students examined number patterns in tukutuku panels (traditional geometric designs that express cultural understandings) and how the cultural purpose of doing tukutuku had been lost.

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

This comment exemplifies the motivation to move away from the mathematised version of a cultural activity to an authentic one sourced in cultural knowledge.

In another case, teacher A who taught in both primary and secondary sections of the school alternated between knower and knowledge positions. In primary classes, teacher A encapsulates a knower orientation in this way.

no matter what the standard of mathematics of each student there is always a benefit that comes from their work, it's really about acknowledging the students own mana [authority] in their work ...if they are part of a community, a whānau, a hapū [larger kinship group], they have some skills, someone else has other skills and through sharing everyone's skills will get better.

In secondary classes, teacher A explains that lessons are

...guided by the [assessment] standard and so I want to make sure that the students follow the steps that the marker of the assessment wants to see...

and elaborates that at this level

Table 2. Mapping of empirical data to social relation and epistemic relation in the school ethos.

Empirical data	Interpretation – connecting to relations	Specialisation of Epistemic/ Social relation
Family involvement in the running of the school and in making important decisions is considered to be a vital and unique component of the School ethos (Field notes)	Being a member of a family with genealogical ties to the lwi and therefore the School is prioritised.	Social Relation Type: Whakapapa/Subjective
School meetings have a wānanga (collaborative meeting based on Māori protocols) style with all participants able to have their say on any matter. (Field notes)	Participation in hui requires competence in the interactional principles of wānanga and inclusion is based on being a family member.	Social Relation Type: Whakapapa/Subjective And Whai tikanga noa/ Interactive
Students are positioned as kaitiaki/guardians of their lands and natural resources, of Māori language and of Māori identity. (Field notes)	Students are seen as located in the lwi/Tribe and in the lands of the lwi. Their roles are pre-determined because of who they are.	Social Relation Type: Whakapapa/Subjective
They are involved in real protests when injustice is thought to occur in terms of pollution of water and land or discrimination against Māori people. These protests involve marches to parliament, interviews on TV and radio and direct action through appropriate Māori protocols to restore polluted land and water. (Field notes)	Real issues are engaged with as they happen. Efforts are directed towards real solutions.	Epistemic relation type: Tohu/Ontic
Groups of students take turns in leading a set of spiritual invocations that are ritually chanted by everyone. (Field notes)	The words and form of the invocations are important as is learning them experientially by chanting in unison. The purpose of the invocations is to establish the 'right' spiritual and emotional conditions within each person so that they are positioned well for the work ahead.	Epistemic Relation Type: mātauranga/Discursive (learning the form of the invocations) Tohu/Ontic (acting on the person in that moment)
The school will suspend all operations and engage en masse with real events such as formal welcoming ceremonies, funerals, cultural celebrations, marking of traditional season changes which follow Southern hemisphere natural cycles. (not those imported from the Northern hemisphere) (Field notes)	Students are expected to learn about cultural protocols by direct experience of them. The actual environment of New Zealand as a Pacific island and located in the Southern hemisphere with Southern star patterns and seasonal patterns governs environmentally oriented cultural protocols	Epistemic relation type: Tohu/Ontic and Mātauranga/Discursive
Discipline is always with a restorative intention – that unacceptable behaviour or breeches of protocols be thought about, discussed and correct observance of tikanga and behaviours be re-established. (Field notes)	Correct interaction with cultural protocols and establishment of the valid identity of students is prioritised. Students as valuable, Māori people, must be developed and treasured not diminished through punishment.	Social Relation Type: Whakapapa/Subjective

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 for example .it's not about learning the formulas, it's about using their prior knowledge to select the correct one.

Primary classes have a strong focus on the students and what they themselves do. Secondary classes have a strong focus on students grasping relationships between concepts, the requirements of assessment and the formal language of curriculum mathematics.

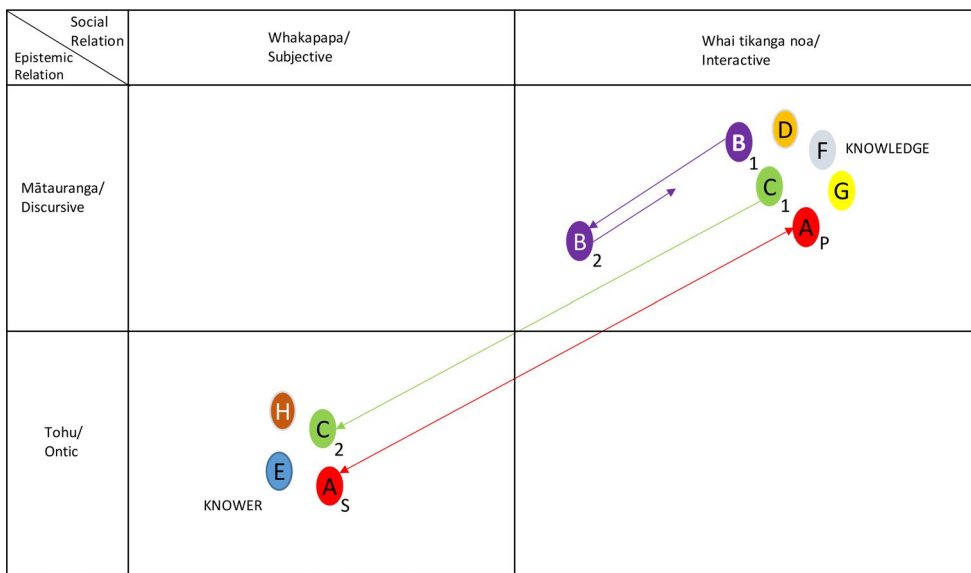


Figure 2. Polarisation effect into knowledge-oriented fields and knower-oriented fields. Movements between quadrants indicated by arrows.

Figure 2 shows all mathematics classes and the school ethos on a single diagram divided into four quadrants which show possible dominant specialisations. Determination of the dominant specialisation was arrived at through an estimation of the time spent in practices that actively supported the specialisation, and the evaluative ‘charge’ that practices carried. This latter determination was achieved using a Systemic Functional Linguistics informed framework provided by Martin and White (2007). Figure 2 does not indicate precise evaluations of the strength of relations. It is intended to indicate only that data analysis identified a clear distinction between dominant specialisations and the formation of two distinct ‘poles’.

Figure 2 represents eight mathematics classes, involving 7 teachers, and the School ethos. Three of the mathematics classes (Teachers D, F and G) remained at the knowledge pole throughout the period of data collection. Teacher H remained at the knower pole. Two of the mathematics classes (Teachers B and C) created new regimes and another (Teacher A) alternated between poles for the two different classes that they taught. Teacher C moved from position C1 to position C2 during data collection. Teacher B moved from position B1 to position B2 and then began to return to position B1. Teacher A alternated between positions AP (the teacher’s primary level class) and position AS (the teacher’s secondary level class).

It is important to note here that only the dominant specialisation in any field is shown in Figure 1. Analysis also showed that at various times, other specialisations came to the fore. Although, the top left and bottom right quadrants appear blank, this is because only the dominant specialisations are shown and only for curriculum mathematics classes and the kura Ethos.

Tensions in subjective experiences

Teachers who advocated for a strong knowledge-oriented regime in mathematics classes tended to judge unfavourably the practices of knower-oriented teachers who were ‘not really doing mathematics’. This was always associated with the contention that students were being ‘let down’ because they were not being prepared for life and work in general society (in which they would have to make a living). On the other hand, knower-oriented teachers viewed the practices of their knowledge-oriented colleagues unfavourably because they were perceived as being incompatible with the philosophy of the school and subjugating students to the demands of an external, non-Māori system.

Teachers who moved towards a knower-oriented regime in their mathematics lessons did so because they saw the connection of curriculum mathematics knowledge to the subjectivity of students as objectionable and incompatible with the philosophy of the school. These teachers wanted to foreground the students themselves, their passions, interests and their cultural location. For example, teacher C objects to standardized assessment because the idea that “a child should show predefined attainments at a certain age when the curriculum doesn’t have any idea about the child and the world they live in...that is a real affront to the child.”

In this connection, Teacher H centralises the identity of students commenting that students should

know who they are and have a strong sense of identity...it is important that they have all the necessary elements in place so that they are whole and know the structure of a person...their identity and origins.

and offers the powerful observation that

other teachers are trying to be the ideal mathematics teacher, use the curriculum resources and get the students to do what is expected...this makes it all predictable, boring and routine....people might look at my lessons and see the students yelling, excited and moving around, standing on chairs maybe in some kind of game and they think there’s no mathematics going on...but it’s there...it might not be what you are used to seeing.

Students and teachers also felt tensions as they moved between mathematics classes and other areas of the school, from knower to knowledge poles. Generally, this was felt as they moved into mathematics classes where they felt less agency and less control over what they had to do and how to achieve success. As one student put it, “in mathematics you are not allowed to have your own ideas...not like in art or oratory where whatever you come up with is accepted”.

‘Mediating’ practices

Mediating practices manged switches between different specialisations for a variety of reasons.

In those classes with strong knowledge code relations, a switch to a knower code was enacted when students displayed anxiety, anger or other emotion in the mathematics work. This mediating practice involved a temporary suspension of the mathematics work to attend to the feelings of the students. Once any anxieties were allayed, the mathematics was returned to.

Another mediating practice involved an acceptance of a kind of alienation from the actual content of the curriculum and the pedagogies used to teach it. Typically, this involved a belief that curriculum content was external and decided by others (non-Māori) whilst being Māori was confined to how teachers and students related and worked together whilst learning content.

A final mediating practice was to introduce activities that were observable as ‘mathematical’ in nature. As an example, students and teachers may have been engaged in game-like activities that combined multiple aspects of language learning, Māori knowledge and mathematical ideas. This would be followed by a change to a calculation worksheet that an observer would recognise as clearly ‘doing curriculum mathematics’.

Discussion

Switching between the specialisation of mathematics classes and that of the school ethos had the effect of legitimating both students and teachers in the ethos while delegitimizing them in mathematics classes. In the specialisation of the ethos there was a commitment to the person as a genealogically endowed unique being with access to collective knowledge through whakapapa. In mathematics classes the specialisation carried a commitment to an individualised ‘person as knowledge’. These two specialisations are contradictory. Being secure as member of a collective through whakapapa is upset by a demand to have complete knowledge as an individual. Having status through individual prowess in mathematics is upset in regimes where this prowess is viewed as a collective resource.

The second set of field-level findings, polarisation and specialisation change, give insight into the effects of the switching between specialisations on overall inter-class relations. The polarisation effect appeared to be due at the interpersonal level to differing ideological commitments held by individual teachers themselves. The judgementalism of both knower and knowledge-oriented teachers, backed up on the one hand by the power of the New Zealand curriculum and reference to the need to survive in mainstream society, and on the other by a commitment to being Māori and reference to the legitimacy of Māori knowledge and rights as the Indigenous people of Aotearoa, was sufficient to maintain the polarisation effect. This set up a precarious tension which resulted in teachers switching sides and sometimes leaving the school altogether.

In the case of teacher A, who oscillated between the two poles, proximity to high stakes national assessment tasks was a clear factor. In the secondary section of the school, mātauranga/whai tikanga noa (discursive/interactive) specialisation dominated as a response to the perceived need to gain the knowledge deemed necessary to succeed in the national assessment tasks. In the primary section of the school, tohu/whakapapa (ontic/subjective) specialisation gave much more scope for error, direct experimentation, and even opting out of mathematics altogether.

Switching between knower and knowledge orientations created tensions for students and teachers forcing the enactment of various practices which temporarily switched from the dominant to the subordinate specialisation. These ‘mediating’ practices temporarily mitigated the struggle caused by different specialisations in mathematics classes and the

school ethos but only at the level of social practice – the contradictions at the ontological level remained.

These findings suggest that despite the school being founded on Indigenous language, culture and philosophy, curriculum mathematics education was still a powerful intervention on behalf of national, majority culture power external to this foundation.

The data identifies three main ways in which this intervention is enabled: the personal, pre-existing ideologies of teachers, students and families, the ‘assemblage’ of the curriculum mathematics education, and the national qualification system. The data illustrates how these ‘conduits’ into the school carry with them an ontological commitment to the ‘person as knowledge’ creating instabilities which were generated through polarisation, specialisation switching, whole class change, subjective tensions, held precariously together through mediating practices.

Conclusion

The analysis has identified how curriculum mathematics education as an assemblage creates a distinct cultural disjunction within the kura Māori. Understanding educational social fields as configurations of knowledge and people (knowers) existing in a dialectical inter-twining, the two distinct specialisations can be further understood as ‘settings’ of a knower/knowledge dialectic. These two settings reflect the power relations between majority culture, English-medium society and Māori society. Māori society which englobes the majority of the practices in the kura creates through its own legitimisation device a particular setting of the knower/knowledge dialectic. This foregrounds the knower in terms of whakapapa/genealogy constellation and organises knowledge of all kinds according to this constellation. Majority culture society which controls the economy, and all of society’s major institutions and resources, is able to intervene in this legitimisation, exerting power through the assemblage of curriculum mathematics education to create a shifting of the knower/knowledge dialectic to foreground the knowledge and modes of interactions of people. In this scheme, a constellation of external knowledge (the hierarchy of curriculum levels) organises people. This explains why the switching between specialisations in the kura Māori causes struggle; it is not just a simple case of students getting used to different teaching styles in different learning areas as would be the case in an English-medium school. In these schools, the effects of doing curriculum mathematics education become muffled or invisible because the specialisation of the school ethos is very likely to be the same as that of mathematics classes.

For the kura Māori, in contrast, such a switch of specialisation is tantamount to a direct undermining of the power and status of Māori society that has been regained to some small degree over the last 40 years. In Māori terms, the intervention at the level of legitimisation, becomes felt as a loss of control and self-determination; it has a colonising effect despite the best intentions of mainstream educators.

The mandating of curriculum mathematics education for all students in Aotearoa/New Zealand is the single most relevant issue here. This creates a false dichotomy; follow curriculum mathematics or Māori knowledge as a basis for future lives. From this is generated a range of effects: distinctly different and contradictory specialisations in mathematics

classes, dominant and subordinate specialisations within the same classes, schoolwide polarisation, subjective tensions for students and teachers and the creation of mediating practices which must be brought into play to cope with these alienating effects.

Currently, educational discourse in Aotearoa is dominated by notions of culturally relevant, responsive and sustaining pedagogies, which, in various ways, seek a middle ground between curriculum mathematics and Indigenous knowledge. The perspective developed in this article suggests that these pedagogies, in the end, must always prioritise the achievement of high levels of proficiency in curriculum mathematics and cross the boundary from knower to knowledge orientation at some point. In other words, the pathway leads eventually to an ontological commitment to the person as knowledge. To avoid this end result, a radical re-imagining of what mathematics education in kura Māori might be like is called for.

Bernstein's concepts of the re-contextualising field and discursive gap provide insight here (Bernstein 2000). The recontextualising fields (pedagogic and official) and the discursive gap are seen as a space in which the 'unthinkable' may be thought. At present, a dominant official re-contextualising field, the working domain of curriculum mathematics education, represses the possibilities for a different and direct engagement between Māori people, mātauranga Māori and the discipline of mathematics. Thinking the unthinkable here means the creation of a pedagogic recontextualising field which centralises Māori ontological commitments as the of a direct engagement with the discipline of mathematics.

Beginning with the ontological commitments of the Māori world, an epistemological project to generate Indigenous knowledge about disciplinary mathematics is possible. One such epistemology has already been outlined by Royal (2009) whose thinking informed the analytical bricolage in this research. The major obstacle, it seems, is the hegemony of mainstream society which, currently, insists that all citizens participate in a single economic/cultural system and take on subjectivities compatible with it. The Covid 19 pandemic has given us a different perspective on this hegemony and, perhaps, exposed its failings and arbitrariness. We can expect further shocks to this hegemony in the future. It is hoped that that thinking the unthinkable will be possible and Indigenous Māori ontologies and epistemologies form the foundations of a different form of mathematics education. The Treaty of Waitangi and the United Nations Declaration on the Rights of Indigenous People establish the right of Māori to create this mathematics education.

Notes

1. kura Māori can mean one Māori school or several – the context must be read to know which meaning applies.
2. Documentation in relation to this is available through the University ethics system and by contacting the author directly.
3. Whai tikanga noa tries to convey the sense of students following rules of interaction for their own sake, at the behavioural level.
4. Whakapapa refers to the genealogical location of a person. In Māori ontological terms, however, everything has a whakapapa, not just people.

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