



Fine Lines: Mātauranga Māori and Science Classrooms

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Abstract

Science teachers in Aotearoa New Zealand are under pressure to incorporate mātauranga Māori in their classrooms, yet most know little about it and there is dissent about its place in science education. If mātauranga Māori is not science, then why should science teachers teach it? What does the principle of ‘mana ōrite mō te mātauranga Māori’ mean in science teaching? In this article, three science educators of varying experiences and backgrounds join forces to reflect, separately and together, on the challenges raised by the question of including mātauranga Māori in science classrooms. Using the increasingly popular method of self-study in science education research, most of the length of this article consists of three named sections from each co-author. This article is not designed for beginning readers of the debates about Māori knowledge in science education, which are longstanding and intransigent, and familiarity with the background and relevant literature will be assumed. The aim of the article is not to come up with the ‘right’ answer but to reflect on our learning journeys, inspired by the question of including mātauranga Māori in science education.

Keywords Cultural responsiveness · Knowledge systems · Mātauranga Māori · Nature of science · Science education

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Introduction

As three science educators, we consider the question of including mātauranga Māori in school science classrooms. Using self-study in science education research, a method that is growing in popularity, this article centres on three named sections, one by each co-author, exploring our various positionalities and changing ideas about Māori knowledge in science classrooms. The aim is not to come up with the ‘right’ answer to this (or any) question, but to reflect on our learning journeys inspired by this question.

The longstanding debate in Aotearoa New Zealand between science and mātauranga Māori (Dickison, 1994; Lomax, 1996; McKinley, 1995; Smith, 1995) is a local version of a wider global debate between science and Indigenous knowledge. In Aotearoa New Zealand, this debate centres on science education and, in particular, the subject Science in secondary schooling, which is under pressure to change along with all learning areas of the curriculum to be more inclusive of things Māori (Stewart, 2005, 2023). Until recently, subject Science could claim immunity from this pressure by saying that science is a-cultural, but in the wake of Kaupapa Māori schooling, the mātauranga Māori concept entered the educational landscape (Mead & E-tangata, 2022). Questions about how science interfaces with Māori knowledge became more acute in science systems, and the policy principle of ‘mana ōrite mō te mātauranga Māori’ in schools heated up this debate to boiling point, as discussed below.

This article is not designed for a beginning reader on this topic, with insufficient space to recapitulate the relevant literatures including multicultural science education research, represented by the classic landmark 2001 special issue of the top global journal, *Science Education* (Lewis & Aikenhead, 2001). That issue presented the underlying knowledge problem of universalism (i.e. there is only one knowledge system) vs. relativism (i.e. there can be multiple knowledge systems), while also considering the difficult issue of equity in science education for Indigenous and other ‘non-elite’ student groups in national school populations. Terminology and technology are subject to continuous change, but the basic educational problems remain the same as they were in 2001, and for decades before that. School science qualifications are gained by a small cohort of mainly elite students, as defined by parental wealth, and this basic pattern holds consistently across time and across countries with Western-style schooling, including the CANZUS group of settler-Indigenous ex-British colonies, namely Canada, Australia, New Zealand and the United States (Gover, 2015). The first author’s papers cited in this article draw on those research literatures (Stewart, 2021b).

Mātauranga in the science classroom is also a question for curriculum theory, a field in part inaugurated by the groundbreaking book *Knowledge and Control* by Michael F. D. Young (1971), which posited that what is taught in schools is influenced by political power. Three decades later, Young recanted his critique of the influence of political power on school curriculum in his second-most famous book, *Bringing knowledge back in: From social constructivism to social realism in the sociology of education* (Young, 2008). Given Young’s influence on current debates about so-called ‘knowledge-rich’ curriculum in Aotearoa New Zealand, it seems useful to apply his ideas to the question of Māori knowledge in science classrooms (Stew-

art, 2021c). In an article published five years after his second book, Young (2013) reflected on the field and his thinking about curriculum and knowledge, leaving three key insights about school curriculum to keep in mind:

- Curricula are not given but always embody prevailing power relations.
- Curriculum theory needs a theory of knowledge.
- No curriculum can, on its own, reduce educational inequalities. (Young, 2013)

Whatever we may think about curriculum and pedagogy, it is difficult to avoid the fact that senior secondary school qualifications in Science are needed for a student to enrol in a Bachelor of Science degree, which is the first step towards becoming a working scientist in standard international systems.

The third point is important for Aotearoa New Zealand, where the school curriculum has long been expected to overcome the effects of societal wealth inequity including ethnic wealth inequity, which is clearly impossible. As long as there are school qualifications at the end of the secondary school journey, students will be measured according to their individual success in learning at school.

Reading Māori curriculum debates against these three key insights suggests Māori knowledge can support and enrich traditional curriculum frameworks. Yet there is a fine line but huge difference between ‘replacing’ curriculum knowledge with Māori knowledge, and ‘enriching’ curriculum with Māori knowledge. Meanwhile it bears noting, according to Young’s third principle above, that bicultural education policies cannot, on their own, do anything to reduce Māori educational inequity at a statistical level. Such policies may open the door to learning for Māori students but cannot assure their success, nor transform national Māori outcomes in school science qualifications.

Our title in this article continues this notion of fine lines between different positions in the debate in science education, sharpened by the policy of ‘mana orite mō te mātauranga Māori.’ There is a fine line between ‘appreciation’ and ‘appropriation’ of mātauranga Māori in any area of education, nowhere more so than science education. Likewise, there is a fine line but vast difference between the concept of mātauranga Māori as a system of knowledge and the claim that mātauranga Māori is science; and between the idea that mātauranga Māori has much to offer science and the notion that a Māori science curriculum can be based on mātauranga Māori. It seems to us that much of what gets written on this topic dances across these fine lines.

At the global level, the tantalizing idea that Indigenous knowledge has much to offer science has been advanced for years and is still continuing to grow in popularity. This idea underpins the various models for this relationship found in the literature, including Two-eyed Seeing (Bartlett et al., 2012) a concept taken from the First Nations cultures of Canada, or the model of He Awa Whiria (Braided Rivers) by Angus Macfarlane (Macfarlane et al., 2024). The mana orite principle is another expression of this idea (see next paragraph). In the other camp, scholars styling themselves as ‘defenders of science’ are pushing the idea that Indigenous knowledge is damaging or dangerous to science. Evidence cited for this strong claim is the interest shown in knowledge systems other than science, including the very principle of ‘mana orite mō te mātauranga Māori.’ In other words, based on the same situation,

one side is claiming that mātauranga Māori *can help* science, the other side that mātauranga Māori *is harming* science. These opposing ideas cannot be described using the ‘fine lines’ image since they are in such contrast.

The Principle of ‘Mana Ōrite mō te Mātauranga Māori’

The term ‘mana ōrite’ comes from a model for bicultural Māori-Pākehā relationships in culturally responsive classroom practice (Berryman et al., 2018). Mana is an attribute of persons, a central concept of Māori philosophy with no equivalent in the English language, hence the word ‘mana’ is appropriated intact into New Zealand English. Ōrite is a traditional word meaning ‘alike’ that has been fixed to mean ‘equal’ in applications such as the language of mathematics education. The term ‘mana ōrite’ is therefore usually explained as meaning ‘equal mana’ but the slippery nature of both ideas in this term—mana, which is bestowed by whakapapa, and ōrite, a non-numerical concept—make it a trip line in policy terms.

According to the authoritative Māori scholar Hirini Moko Mead, mātauranga Māori potentially includes *all* knowledge, including traditional knowledge that has been lost since colonisation, and Western knowledge that Māori have adopted (Mead & E-tangata, 2022). The notion of ‘mana ōrite mō te mātauranga Māori’ applies across the curriculum, but has caused the most consternation in subject Science, where some commentators have claimed it means ‘teaching equal amounts of science and mātauranga Māori’ in the Secondary Science classroom. If mātauranga Māori is defined as including ‘all’ knowledge, this blurs the distinction between science and mātauranga, so when we teach science, we can claim that we are also teaching mātauranga Māori.

It helps to remember that to apply the concept of ‘mana’ to knowledge is a metaphorical device. In this sense, the purpose and value of the principle of ‘mana ōrite mō te mātauranga Māori’ is a call to end the denigration of Māori knowledge that has been part and parcel of the longstanding policy of assimilation of Māori ever since the 1840 signing of Te Tiriti o Waitangi. With this more critical understanding, the notion of ‘mana ōrite mō te mātauranga Māori’ in science education is better rendered in English as ‘respectful relations between science and mātauranga Māori.’ More is said about this differential interpretation in the sections that follow.

Beneath the sound and fury, it’s important to remember why we are having this debate in science education. The underlying aim is to improve the teaching and learning of science, so that more students achieve better outcomes in school science and go on to become working scientists. Policy drivers impacting on schooling in Aotearoa New Zealand are multiple and often in tension, if not contradictory. The underlying policy driver is equity; one of the most important equity questions concerns Māori, and subject Science is the worst-case scenario for Māori education (Stewart, 2017). Māori science education is far from a simple problem and becomes more complex the more one knows about it. Thus, newcomers and those at distance (often including decision-makers and holders of power) consistently seriously underestimate the difficulty of ameliorating Māori lack of achievement in science education.

As a way of moving our thinking forward, below we turn to self-study, a recent methodology science education research (Bullock & Russell, 2012). Another term

that describes our approach is co-autoethnography (Coia & Taylor, 2009). Regardless of terminology, this article results from a deeply collaborative enterprise that is important for researching our own teacher practice because ‘we are more than teachers; we are defined by others; and we are defined by our relationships with others’ (from Coia & Taylor, 2009, p. 8).

This self-study produces three named reflections, below, one by each author. We are three science education colleagues who have met occasionally over the past few years to discuss the question of including mātauranga Māori in science classrooms, in which we are all interested. Our widely varying positionalities provide an opportunity to write separately about science education and mātauranga Māori in these three reflections (below). Each of us has different strengths: Angelo as a former scientist and current secondary science teacher, Sally as a primary science teacher, educator and researcher, and (first author) Georgina as a Māori science education expert. Our three narratives below preserve our distinct voices and perspectives, bookended by this introduction beforehand and the discussion and conclusion afterwards. The aim of this article is not to come up with the ‘right’ answer but to reflect on our learning journeys, inspired by the knotty question of including mātauranga Māori in science education. We hope our paper will be useful for school science teachers, and others as well.

Navigating Many Tides to New Cultural Spaces as a New Zealander

Angelo: I grew up in a small town in the north of Italy surrounded by my extended family. Most of my childhood was spent with my grandparents, who told me stories about our local environment, how to observe natural patterns, changes and signals that could predict the weather and a good year ahead. These experiences made me extremely interested in science and understanding how the world works. In the Italian education system, the choice of secondary school depends on the subjects one wants to study. For me, it was a science-heavy curriculum with Chemistry and Biology, both practice and theory. At university, I joined a Biotechnology course so I could further my interest in studying science in a more medical-related field. I wanted to proceed with further studies abroad, so I moved to the UK and enrolled in a MSc in Neuroscience at University College London, followed by a PhD in Neurophysiology, studying how neurons communicate. After finishing my studies, I lived in a few different countries doing research and teaching undergraduate students, through which I came to realise the international homogeneity of science research.

After migrating to Aotearoa New Zealand in 2020, I realised that my passion for teaching science had grown bigger than the research work that dominated my day-to-day job. This led me to change my career and become a secondary teacher of junior Science and senior Chemistry, completing a classroom-based Postgraduate Diploma in Secondary Teaching with Ako Mātātupu | TeachFirst.

My postdoctoral research made me realise that science is universal, allowing a common language to be applied in different contexts and societies. Becoming a research scientist involved a process of self-discovery, and I bring this mind-shifting approach to teaching young people in Aotearoa New Zealand. I feel very fortunate

to have followed my scientific journey through academia and to be able to pass on what I have learned to my students. It is important to inspire new generations to be passionate about science, as my grandparents did for me.

During my first year as a teacher in a large secondary school in Auckland, I had to learn how NCEA (the National Certificate of Educational Achievement) worked, including the 2019 updates of Level 1 Science (Ministry of Education, 2021). One new principle was ‘mana ōrite mō te mātauranga Māori’ (equal mana for Māori knowledge). Mātauranga Māori was completely unknown to me, so I asked colleagues and people around me for help to find out what we were supposed to teach and what our students were meant to learn.

Through email correspondence and online meetings, I built a connection with Georgina, and after a year or so we co-wrote a short commentary about the (short-lived) introduction of Māori words into the titles of some NCEA Science Level 1 standards (Stewart & Tedoldi, 2021). These conversations helped me develop a better understanding of mātauranga Māori and gave me confidence to try in-class discussions and teaching about it.

As I became more aware of the importance of mātauranga Māori, however, I began to find it harder to believe that I could teach it meaningfully, so as to uphold centuries of knowledge and mana. Increasingly, I questioned how teachers could give mātauranga Māori equal mana and space in our teaching, given how little most teachers know or understand about it.

This uncomfortable feeling motivated me to want to know what my own students felt about Māori knowledge within the science curriculum, so I ran surveys with them before and after teaching a unit about fungi that involved mātauranga Māori. To my surprise, the students weren’t interested in learning about Māori knowledge in their science classes and couldn’t see the connection. Most saw no reason for learning about mātauranga Māori because they ‘couldn’t use it at university.’

These surveys made me think about assessing mātauranga Māori, which hadn’t previously occurred to me. NCEA has both internal and external assessments that test students’ learning in the standards they are taught. If mātauranga Māori was now part of NCEA Level 1 Science, then it should be assessed. But how can teachers assess something about which they have no in-depth understanding? We might teach a unit on Matariki and assess student learning on the material we presented, but does this give equal mana to mātauranga Māori? These questions created an internal shift and uncomfortable sense as they made me realise that mātauranga Māori cannot be taught in an equal manner or significance to science. Non-Māori teachers, both Pākehā and migrant teachers, need to be aware of this sense of discomfort, as it guides us to give mana to mātauranga Māori and respect its importance and connection to te ao Māori. One of my Ako Mātātupu teachers remarked:

As non-Māori teaching our taura [students] about mātauranga Māori it’s important that you always feel uncomfortable. That feeling is a way for yourself to understand that you are aware of the importance and mana of mātauranga Māori and that you are doing everything you can to uphold it. The day that you do not feel that uncomfortable feeling is the day that your mind has been colonised again. (W. Nathan, pers. comm.)

A national debate arose among science teachers who were questioning the relevance of teaching mātauranga Māori in the science curriculum. A fracture emerged, with many teachers saying that mātauranga Māori doesn't have a place in science and that it cannot be taught as science. For once, I agreed with them: mātauranga Māori is not meant to be part of science as it is not and was never meant to be science. Mātauranga Māori can be seen as an alternative way of collecting evidence and creating knowledge, a way to use different approaches to reach conclusions; it is a way to teach students to be inquisitive by using observations and patterns to reach conclusions. However, this is a very simplistic way of seeing mātauranga Māori, and, I would argue, not a way to give it equal mana. On the contrary, this way of teaching can be seen as diminishing its mana while also making it easier for teachers to embrace its teaching, even the ones who find it difficult to see why we teach it within the science curriculum. Changing the name used may make it easier for teachers to accept, but at the cost of reducing its mana.

Over the past five years, my attitude to teaching mātauranga Māori has changed and I am still to find a meaningful way to teach it. I started with a very strong commitment to teaching it and have since moved to a position of being unsure that it can be taught in a meaningful way, and whether a person like me, with no connection to te ao Māori or deep understanding of mātauranga Māori, *should* be teaching it, at least without strong constant support. I recently celebrated my commitment to Aotearoa New Zealand when I attended my citizenship ceremony, so I look forward to continuing to bring my growing understanding of mātauranga Māori to inform my classroom practice as a science teacher, for the benefit of my students.

I think it is extremely important to be self-reflective and to question everything we teach and do when it comes to mātauranga Māori. I wonder how my grandparents would feel if their stories, which they learned by word of mouth from their ancestors, were taught by a person from outside, who was not part of our upbringing. Someone lacking connection to the cultural depth of these stories could easily make mistakes that would diminish the significance of their meanings. Likewise, in my own academic career, the more I come to know and understand about a specific subject, the more complex it comes to seem, as I grow more aware of all the other interconnected parts. As I have learned more about mātauranga Māori, I have become more wary of including it in my science classroom, and my sense has grown that this may be the best way to recognise its mana.

Finding and Weaving Strands of Mātauranga Māori into My Practice

Sally: I am Pākehā with origins in the United Kingdom. My paternal grandfather's ancestors emigrated from Yorkshire in the early 1800s, first to Nova Scotia and then on to Aotearoa New Zealand to Waipu Cove where they established a family farm in Whangateau, just north of Auckland. Similarly, my paternal grandmother came from a farming family who lived in the Hauraki Plains. My maternal grandmother emigrated from Scotland when she was 15 years old, and my maternal grandfather's family came from Ireland. I have lived all but 17 months in a suburb of Auckland.

Teaching is my second career. I went to teachers' college to train as a teacher after my children were born. My motivation came from being a parent helper for reading in my son's class and thinking – I can do this! I've now been in education for 35 years, 12 years as a classroom teacher and the remainder as a teacher educator in a tertiary institution.

Reflecting on my journey, I see it having three distinct periods as my understanding and knowledge of te ao Māori grows. This ongoing growth in my understanding and knowledge would not have been possible without my conversations with Georgina. She continues to generously share her knowledge and challenge my perceptions, making me reflect on my assumptions and worldviews about mātauranga Māori and science education.

Dormant Seeds

My journey began when I began training as a teacher. In my first year we did a course called Māori Studies. It was held at the College's marae, and I remember two things about it, one being that we spent a lot of time singing waiata. The other memory is of having to keep a scrapbook of newspaper articles related to things Māori. We had to cut articles out and paste them into a book and write a caption. To this day, I'm still unsure of the purpose of this assessment task but I handed in my scrapbook that I had assiduously filled and passed the course.

The other vivid memory comes from the second year of my teacher training. I remember lecturers enthusiastically introducing a week they called Ngā Kākano. They encouraged student teachers to incorporate 'taha Māori' as it was known then, into our ideas about teaching. I was easily 'sold' on this idea since I found my Languages lecturer's enthusiasm infectious. Ngā Kākano was a week-long focus across the courses. In Languages there was a focus on Māori books, and I remember learning stick games in PE and waiata in Music.

I then took this learning out on my fourth practicum placement with a Year 4–5 class. In reading and writing, I shared a picture book about kiwi and how they became flightless birds. I introduced this book as a 'Māori myth' and wanted the children to then write and illustrate their own myth to explain why pūkeko had such long toes on their feet. I also taught art lessons where the children drew kōwhaiwhai patterns that they used as borders to decorate their writing. On my return to teachers' college and another year of training, I cannot recall any other mention of 'taha Māori'.

For most of my primary classroom teaching, mātauranga Māori was absent. I cannot recall any encouragement for me, or me taking the initiative to include mātauranga Māori in my classroom programmes. This dearth continued into my second and third positions at intermediate schools. In my last position at another intermediate school, I recall there was a school kapa haka group that was led extremely enthusiastically by a Korean boy who was in my class. I also recall the principal of this school, who was a fluent te reo speaker, stating that he was opposed to people speaking te reo unless they could pronounce it correctly. I still remember my puzzlement, thinking that surely it was better that reo Māori was spoken and used, even if it wasn't pronounced correctly?

I then moved into teacher education as a science educator at a teachers' college, which was then subsumed into a local university. For several years, I did incorporate acknowledgements of 'taha Māori' in my teaching but they were sparse. I used Māori 'myths' that could complement science topics; for example, when teaching students how to teach about volcanoes I introduced them to Kātarina Mataira's book *The Warrior Mountains*, which tells the story of the positioning of the volcanoes found in the central North Island. When teaching about plants, I helped students to learn about native plants by having them go on a scavenger hunt around the grounds, armed with a scientific classification key to identify native trees. I also encouraged students to learn the Māori names of these native trees and how they were used by Māori and Pākehā using matching activities.

When I began my teacher education career, I also started postgraduate study. In a science education course, there was a small component that explored 'Māori science' that was accompanied by a few journal articles. We were persuaded to think that there was no 'Māori science' because Māori did not employ scientific inquiry to construct their ideas. But no name was given to Māori knowledge about the environment. Nor was any value bestowed upon Māori knowledge. I unthinkingly accepted this position. At that point I was far more fascinated by my introduction to the nature of science, Mertonian norms and how science was interconnected with society and our everyday lives.

Unsettling

Several years into my teacher education career, my ideas about using food when teaching science were challenged by a few students. They lodged an official complaint stating that my use of food was both wasteful and disrespectful of Māori culture. I was using common household items including edible items (vinegar, baking soda, jelly crystals, a potato, a lemon) to teach about physical and chemical changes, along with dissolving. I recall feeling surprised and confused, wondering why the students had raised this issue. Couldn't they see that using common food items was connecting science to their everyday lives? These items are chemical substances found in homes and an entirely normal way of teaching chemistry in primary schools.

I consulted Georgina (my then-colleague) who explained how she thinks about using food in science classrooms in ways that do not disrespect Māori worldviews. I developed a slide (see below) that I now use with every class of student teachers in Science and Technology to allay any concerns about waste or respect. Note the Māori words/concepts in the final dot point below. The heading and points on the slide are:

Using Food in Science and Technology Education Classes (Slide)

- Explain clearly to children not to put materials used in practical work on their skin or in their mouths unless the teacher specifically instructs them to do so.
- Ensure separation of materials and equipment used for teaching and learning, both physically and in purpose, from other materials/equipment, e.g. lunch items,

food utensils, etc.

- Explain the distinction between food/utensils used for eating and those used for learning tools.
- Food and drink are noa, not tapu, so it is unnecessary or inappropriate to karakia before using edible items in science/technology lessons.

In my conversations with Georgina, I was introduced to the idea that Māori had their particular ways of explaining the world. These explanations are the so-called ‘Māori myths and legends,’ which Georgina chose to call ‘nature narratives.’ I realised that it logically follows by using the term ‘myths and legends’ I am denigrating these explanations and disrespecting their role and value in Māori culture and identity.

A Gradual Blossoming of Awareness

The introduction of the science capabilities, developed by Rose Hipkins and NZCER, further deepened my understanding of the nature of science and along with conversations I have had with Georgina, I’ve come to realise that science is but one way of knowing about the world that is constructed in a very particular manner according to specific ‘rules’. I also view scientific knowledge more critically, understanding that it has its frailties and limits. Mātauranga Māori is another way of knowing about the world, and while it has some similarities to the way that science knowledge is constructed, there are sharp differences. It seems to me that one major point of difference is the manner in which knowledge and explanations are constructed. Even amongst Māori scholars, there are different points of view, another idea that has surprised me. I thought that there was a common understanding and had never appreciated that there were differences in knowledge between iwi.

I now incorporate these ideas about different ways of explaining the world into my science education courses when teaching how to teach about the nature of science. I’m never sure what the student teachers think, but in my courses, there are people of many different ethnicities – Pacific Islands, Indian, Chinese and people from South-east Asia – and there are times when I see a ‘light’ in their eyes as they seem to make the connection that their culture too has its explanations. For me, the nature of science provides a foil for not only thinking about the strengths and limitations of science but also for thinking more deeply about other cultures’ knowledge systems.

Towards the end of the second decade of this century, I noticed an increasing desire and willingness amongst educators to incorporate mātauranga Māori into their teaching programmes. I’m not even sure when we started to refer to mātauranga Māori instead of taha Māori. In response to this shift and in my role as education representative on the New Zealand board of the Australia and New Zealand Council for the Care of Animals in Research and Teaching (www.anzccart.org.nz), I decided to develop a resource about mātauranga Māori and animal ethics. I asked Georgina to collaborate on this work and our shared project blossomed over the ensuing few years. Working with Georgina on this project led to a deepening of my understandings about mātauranga Māori and te ao Māori in relation to animals that live in Aotearoa New Zealand. I learned that mātauranga Māori has a depth and richness I’d never previously considered. In my earlier work I had briefly considered this type

of depth in terms of the wolf and how it is demonised in English narratives (think of Little Red Riding Hood). From our project I learned how Māori utilized animals in barter, as food and clothing sources, but also, as in other cultures, about ways that animal behaviour is captured in oral texts and iconography (Stewart, 2024).

Another significant learning concerned Māori concepts, such as *aroha*. Not only did we analyse how our Māori experts were expressing these concepts in their work with animals, but also about how Māori concepts about the care of animals (as well as land and people) related to the ethical principles used in scientific animal research when thinking about the Three Rs (Stewart & Birdsall, 2025). I had never realized that Māori concepts are so much more complex and multifaceted than the ‘flat’ way they are commonly defined, and their expression as a binary or intertwined together. For example, I had previously associated *manaakitanga* with hospitality—offering refreshments and ensuring your guests are comfortable—but it’s more nuanced. It’s about upholding and nurturing another person’s *mana* through showing care and respect for them.

Now, when thinking about *mātauranga Māori*, the most important thing I’ve learned is its depth and breadth. It is far more than a body of knowledge - it encompasses values and a spiritual dimension, which means that it is more far-reaching and richer than Western scientific knowledge that relies on evidence and inference alone. I realise the more I learn, the more I need to learn. It’s not just a matter of finding a website or looking in a book. Nor is it a ‘tick the box’ on the planning template. Instead, I need to actively search out relevant *mātauranga Māori*, looking at sites such as Te Ara Encyclopedia of New Zealand or the Science Learning Hub, and think about how I can weave it into my practice in a respectful way.

Often my inclusion of *mātauranga Māori* is to illustrate difference – to help students realise there is more than one way, their taken-for-granted Western scientific perspective, of viewing the world. For example, when working with them on the topic of teaching about water quality, I introduce *mātauranga Māori* about water, that there are different ‘types’ and that water has *mauri* and *wairua*. I challenge them to consider what it means for them as educators that a waterway, such as the Whanganui River, has personhood. How could they present this perspective in their teaching?

Going forward, there’s just so much more to learn. I did not grow up immersed in *te ao Māori* and my learning to date has given me just a glimpse of how it could be to view the world from this perspective. I wonder whether *Pākehā* can ever be truly bi-cultural, because we have grown up in the privileged dominant culture. Can we ever really appreciate and understand what it is like to be the ‘other’, the colonised culture? As *Pākehā*, I continue with my learning journey, acknowledging the uncertainty of not knowing the endpoint.

Pūtaiao and the Gifts of Difference

Georgina: Science and *mātauranga Māori* share some common features, but I would say their differences are more interesting and important than their similarities. What they have in common is that both are knowledge systems, and both are bodies of knowledge about the natural world. Both involve careful observations of natural phe-

nomena, on the basis of which knowledge is acquired, stored and transmitted to the following generations.

I have always been interested in nature, which developed into an interest in science, and I have always been committed to my 'Māori side' as we used to call it. Growing up in Auckland in the 1960s and 70s, those worlds were quite distinct, and represented my personal experience of the 'two worlds' that Māori people routinely report living in. I knew my paternal grandmother until her passing when I was about 20, and she was well-known to be of Māori ancestry only, which contradicted what I was being taught about 'no full-blood Māori' in the good Auckland schools I attended. She spoke in te reo and never learned to speak English beyond short, broken utterances. My father and his 15 siblings grew up speaking Māori as their first language. Up north to visit family or attend hui, I felt that to be the 'Māori world' in contrast with my Auckland life in the 'Pākehā world.'

Even after all these years and experiences, I recall the intense cognitive dissonance I experienced in the mid-1980s, the early days of Kura Kaupapa Māori, when I first heard of teaching and learning science through the medium of te reo Māori. I wasn't teaching then, but changed careers a few years later to become a secondary teacher of Science, Mathematics and Te Reo Māori. In 1993, the two worlds collided when I began teaching Pūtaiao (Māori-medium Science) and Pāngarau (Māori-medium Mathematics) at Te Wharekura o Hoani Waititi Marae in Auckland. That was the start of my involvement—as a teacher, teacher educator, researcher, curriculum writer and resource developer—with this fascinating topic.

I began teaching Pūtaiao before any Māori science curriculum existed, so I invented my own. Since mātauranga Māori is holistic and unrestricted by comparison with science, I envision 'science' as a sub-set or smaller set of knowledge represented by a circle that can fit inside the super-set or bigger circle that represents mātauranga Māori. This model counters the widespread Venn diagram one, in which science and mātauranga Māori/Indigenous knowledge are represented by two intersecting circles, the intersection representing ecology and environmental studies. But this implies that most of science has nothing to do with Māori. The advantage of my superset model of Pūtaiao is that it shows all of science being relevant for Māori students to learn. Based on this concept of mātauranga as a superset of science, I designed my Pūtaiao teaching programme in units based on ngā atua. Tānemahuta for study of ecology, plants and animals, Tāwhirimātea for climate and seasons, Rūaumoko for earthquakes and volcanoes (this schema sounds ordinary and obvious now, but it wasn't then).

These comments suggest that Māori knowledge can be incorporated in science curricula and classrooms by: changing the headings under which the content is organised; focusing on local examples of flora, fauna, ecologies and natural features; learning Māori words to use for science vocabulary items; and reaching out to Māori people with expertise in the topics being taught. Each of these steps takes time and effort, beyond what classroom teachers can generally afford. Moreover, while any effort to bring the world of science closer to te ao Māori has potential value, the pedagogical aim remains to help students learn science. These steps involve surface-level changes, and don't delve into the fundamental differences between science and mātauranga Māori.

As a teacher of Pūtaiao, I grew critical of the Kaupapa Māori call for language purism and coining new words instead of using transliteration, because it was apparent to me that transliteration of scientific vocabulary would help my students access the world of science and its global language (Stewart, 2010). I read the Whorfian ideas about how thought and language influence each other (Fishman, 1982). I read the concept of ‘worldview’ (Kearney, 1984) that implies the boundaries of knowledge systems, which are required for incommensurabilities to exist, as implied by use of the plural forms of words like ‘sciences’ and ‘epistemologies.’ I think that although relativism must be entertained to some degree, in order for me to identify as a Māori, all humans live in one world, and are subject to the same physico-chemical environment that commands the conditions in which we live as biological organisms, so we are united as one at the planetary level.

A key output of my doctoral research on the Māori science curriculum was the novel concept of ‘Kaupapa Māori science’—intended as a Māori critique, not a Māori version, of science. By the time I finished writing my thesis, I was more interested in exploring the myths of science than in claiming that mātauranga Māori is science (or a science, or scientific). I became interested in the idea that every form of knowledge has an underpinning philosophy, which eventually led to my book, *Māori Philosophy: Indigenous thinking from Aotearoa* (Stewart, 2021a). Looking at the underlying philosophical value commitments of both knowledge systems helps alleviate the obvious discrepancies between them at empirical levels. In my readings of the scholarly literature, comparisons are often invalidly made between the ‘facts’ of science and the ‘values’ of Indigenous knowledge.

Science as we know it today emerged in Western Europe in the post-Enlightenment era and entailed the ‘fact/value dichotomy’ where, for reasons demanded largely by the fraught but contingent relationship of the times between science and the Church, a bifurcation was made between ‘fact’ and ‘value.’ Laurel Richardson (1990) helpfully unpacks how this Western bifurcation in philosophy was reflected in the Western world of writing, which split, between about 1750 and 1850, into two distinct written realms, namely, science (fact without value) and literature (value without fact). The fact/value dichotomy was a Western invention, and remains a defining difference between Western and Indigenous (Māori) cultures and worldviews. One of the implications is that, unlike scientific concepts, key Māori concepts are both facts and values at the same time. The argument is often made that multiple perspectives lead to better knowledge, but this assumes that all ‘perspectives’ are commensurate so as to be compared with each other. This argument disallows for a Māori or Indigenous perspective that is radically ‘Other.’

This is the basic problem with the ‘knowledge systems’ idea for justifying the inclusion of mātauranga Māori in science classrooms. Pākehā science education researchers reason that learning multiple knowledge systems confers cognitive advantages to students, which they construe as grounds for including mātauranga Māori in science education (Gilbert et al., 2005; Hipkins, 2021). But this argument fails because Māori have been obliged to learn about both Māori and Western knowledge systems for over 100 years, and it clearly hasn’t helped Māori to succeed in science education. If we take seriously the concepts of worldviews and knowledge systems, it stands to reason that these are radically different, or incommensurable (Lyotard, 1988), and

therefore unable to be compared or taught alongside each other. This renders meaningless the Venn diagram model, or any blithe call to teach mātauranga Māori in science classrooms.

I remain critical of attempts to capture complex Māori meanings in national education policy, with the inevitable mixed results and superficial interpretations. These debates are too complex to be collapsed into an either-or argument, but that's what tends to happen, because few people have an adequate grasp of the complex history and philosophy that sits behind the policy principle of *mana ōrite mō te mātauranga Māori* (Stewart, 2025).

In the conclusion of my doctoral thesis, I called for more engagement between different stakeholders in this debate. Back then, in 2007, Māori-medium science educators and conservationists were the two main groups discussing the relationship between science and mātauranga Māori. The introduction of the Vision Mātauranga policy brought this debate to the forefront of research in Aotearoa New Zealand. The bar has been raised by Kaupapa Māori schools and the expectations are greater than ever. I am still finding more to think about in the relationship between science and mātauranga Māori in education, which is unsurprising given the deeply philosophical nature of the questions involved.

Walking a Fine Line: Mātauranga Māori in the Science Curriculum

In sharing our learning journeys and discussing our collective knowledge of the secondary science sector, we've uncovered another instance of 'a fine line but a big difference' operating as a binary of interpretation of '*mana ōrite mō te mātauranga Māori*' for science education. We refer to this binary as the 'strict' or 'loose' inclusion of mātauranga Māori in science classrooms. The 'loose' inclusion of mātauranga Māori refers to *any* Māori content—traditional narratives, Māori vocabulary, waiata, etc., and even extends to include 'science' knowledge itself, via the definition that mātauranga Māori includes all knowledge.

Conversely, the 'strict' inclusion of mātauranga Māori in science education refers to teaching and learning about specific, well-researched Māori Indigenous knowledge of relevance to judiciously chosen topics, such as in the research-based classroom resources we have authored on animal ethics and native fungi (Buchanan et al., 2017; Stewart & Birdsall, 2024, 2025; Stewart & Buchanan, 2020). The loose meaning of including 'any' Māori content in the classroom can be considered under the heading of 'cultural responsiveness' but does not equate to substantive learning of mātauranga Māori for its own sake.

Recent work by Rose Hipkins and colleagues explores the use of the 'knowledge systems' concept to strengthen teaching and learning about the nature of science (Hipkins et al., 2022). Here the term 'knowledge system' is being used instead of 'epistemology,' the prominent term used in the earlier multicultural science education research literature, such as the 2001 special issue of *Science Education* (see introduction section above).

A revealing short article by Hipkins (2024) summarises the evolution of efforts to include the nature of science (NoS) in curricula since 1993. The title of this paper

includes three consecutive terms—key competencies, science capabilities, and enduring competencies (Hipkins, 2024). These new names may or may not ‘clarify their purpose’ (Hipkins, 2024, p. 20) and can also be described as ‘a steady trajectory of curriculum change under the surface of developments that might seem arbitrary or inconsistent’ (Hipkins, 2024, p. 21).

Hipkins examines how the ‘knowledge systems’ idea came to be included in this timeline of efforts to include NoS in school science, noting the imperatives to (1) reduce inequalities for Māori and Pasifika students; and (2) give effect to Te Tiriti o Waitangi. Hipkins continues:

At the same time, we could also see that building knowledge of science *as a knowledge system* might help make the NoS aspect of the curriculum more visible for teachers, and therefore help address the issues that had led us to develop the science capabilities some years earlier. This strategy would work if mātauranga Māori held up a mirror to reflect science practices back. (Hipkins, 2024, p. 25, original emphasis)

In other words, positing science and mātauranga Māori as knowledge systems was a strategy intended to draw renewed attention to the nature of science in school science teaching and learning. Despite lack of examples of success in practice, mātauranga Māori was covertly utilised by Hipkins and colleagues in their quest to include nature of science in school science education but overtly justified by claiming that including mātauranga Māori in science classrooms could overcome inequity for Māori and Pasifika students.

Conclusion

Our sustained collective reflections about teaching science and the place of mātauranga Māori in science classrooms have generated fresh insights into this intransigent debate, which centres on exactly what is meant by ‘including’ mātauranga Māori in science classroom programmes. The concept of knowledge systems has been introduced into science education in efforts to strengthen teaching and learning about the nature of science. But the notion of multiple knowledge systems is rejected by science, which claims to be ‘universal’ knowledge.

By presenting science and mātauranga Māori as two different knowledge systems reflecting two different worldviews, it was hoped that students would better understand the nature of science. But different knowledge systems are by definition incommensurable, so it logically follows that two different knowledge systems cannot be placed alongside each other or fairly compared from within either worldview.

The main reason why the nature of science is not taught in school science programmes is because it is not considered part of science itself, but more akin to the history and philosophy of science. History and philosophy of science are not taught in schools nor in university science education in Aotearoa New Zealand. Few working scientists or secondary science teachers get the opportunity to learn about the history and philosophy of science, which means they will not understand how or why the nature of science could or should be taught. By this reasoning, it is unsurprising that linking mātauranga Māori to nature of science has caused so much concern and discussion.

In writing this article we have identified a new binary between ‘strict’ and ‘loose’ levels of practice for including mātauranga Māori in science classrooms. As pressure to include ‘things Māori’ in all classrooms has even reached secondary science, a dominant response has been to play the epistemic trick-card, saying that teaching ‘anything’ can be considered teaching mātauranga Māori, if mātauranga Māori potentially includes ‘all’ knowledge. This is what we call the ‘loose’ form of teaching mātauranga in science classrooms. In contrast, we advocate for responsible, research-based inclusion of items of Māori knowledge relevant to the topics being taught, which we call ‘strict’ inclusion of mātauranga Māori in science classrooms.

The ‘fine lines’ idea helps us understand how work in this area can easily be taken out of context and misinterpreted. There is a fine line but significant difference between ‘enhancing’ and ‘replacing’ science with mātauranga Māori in curriculum and classroom practice. And there is a fine line but wide gulf between the concept of mātauranga Māori as a system of knowledge and the efficacy of using mātauranga Māori to better teach the nature of science.

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