



Building the Cultural Capacity of Engineers in Aotearoa, New Zealand: A Students Perspective

Teresa Poli^a, Mark Lay^b, Mahonri Owen^c and Megan Boston^d.

*Masters Student, University of Waikato^a; Senior Lecturers, School of Engineering, University of Waikato^{b,c,d}
tap18@students.waikato.ac.nz*

ABSTRACT

CONTEXT

Like many countries in the world, Aotearoa, New Zealand has a dependence on the engineering profession to add value to the economy, respond to community needs and improve the lives of its inhabitants. However, New Zealand's society is unique in that it houses both "Mātauranga Māori" (the indigenous knowledge system) and a "western knowledge system". As a result New Zealand based engineers require additional skills to navigate and respond to community needs in unique, equitable and innovative ways. One way these skills can be taught is through the accredited engineering programmes New Zealand Universities offer.

PURPOSE

This study investigates Māori education within the School of Engineering at the University of Waikato with respect to building cultural capacity relating to Māori (the indigenous people of New Zealand).

METHODOLOGY

This study uses a teaching intervention in a core engineering subject to investigate and develop student understanding about the Māori and their needs. The intervention was facilitated by a Māori Engineering lecturer from the University of Waikato.

The study attempted to understand student perceptions of responding to and including Māori perspectives within engineering and evaluating how effective the intervention was with regard to the following research questions:

- What are the engineering students familiarity in current education with regards to Māori culture and beliefs
- What are the student perceptions of the necessity of including Te Ao Māori
- Do students understand the connection of Te Tiriti o Waitangi (The Treaty of Waitangi) and engineering
- What were students' perceptions of the course, and any suggested improvements.

CONCLUSION

The study found the engineering students had limited knowledge of Māori cultural beliefs, Māori traditions, and Māori language, however there was a strong desire to learn more. The information provided from the study indicated that there is a need from the student perspective as well as a societal perspective for the engineering curriculum to catch up to other professional degrees in including Mātauranga in their curriculum.

KEYWORDS

Engineering, education, Indigenous, Te Ao Māori, Building cultural capacity, Graduate attributes

Introduction

Engineering consists of mathematical and scientific problem-solving skills and design to provide creative solutions for industrial and societal problems. However, the engineering qualification often overlooks the soft skills required to be an engineering professional. Our engineering qualification is focused heavily on ensuring students are equipped with strong technical backgrounds in mathematics, modelling, and design. As engineers we are so often pigeonholed into the finer technical details that we often forget the bigger picture such as how our project contributes to society and the people it supports. Due to this we need to better prepare our engineering graduates for the workforce, the stakeholders they meet and work that they will complete for communities. Just like in science, there are a multitude of ways to approach an engineering challenge, and looking at it through a cultural or Western lens can often inspire new ways of solving the problem (Cross et al., 2020).

Many companies and organisations are beginning a journey where they are building cultural intelligence through more frequent use of Te Reo Māori (language), tikanga (cultural practices) and Mātauranga Māori (cultural knowledge). It is becoming more common that these skills are required in modern day jobs. This journey is influenced by the following:

- Vision Mātauranga - New Zealand's science policy that requires that Te Ao Māori (world-view) be included in all aspects of the research and innovation sector ("Vision Mātauranga | Ministry of Business, Innovation & Employment", 2022).
- The growing Māori economy. Iwi (Māori tribes) are having a much greater contribution to New Zealand's economy. This has a direct effect on industry and the activities it undertakes ("Te Ao Māori Trends and Insights", 2017).
- The government incorporation of equity, diversity and inclusion into many of its funding structures for science and engineering research and business and enterprise.
- International desire for Māori products, businesses and enterprises as they are unique and innovative (Ruckstuhl et al., 2019).
- Te Tiriti o Waitangi (The Treaty of Waitangi) - the treaty between the Māori and the Crown ceding governance to the Crown, while retaining chieftainship of their land, villages and treasures, and giving Māori full rights and protections as British subjects.
- Development of groups like Taumata Aronui, which provides advice to tertiary education providers on how to better meet the needs of Māori learners and communities.

Building cultural intelligence and competence in students is becoming a necessity in our education curriculum to produce well rounded professionals. However, there must also be a shift in the mindset of the tertiary institutions to work between cultures, instead of just through plans and strategies in a Western manner, as we have seen that does not always work and can marginalise indigenous cultures. In 2020, The University of Waikato underwent an internal review after public claims of racism were made at the university. The findings showed that the university markets itself as having a commitment to Māori, however the internal management structures, world view and knowledge base from it operates embodied Western university culture and practices. A part of the findings were that reconciliation with Māori and mana restoration were required (Satyanand, Gardiner & Parata, 2022).

While New Zealand universities have often operated within a western framework, they have developed plans to support Māori aspirations. The University of Waikato has a strategic planning framework of which a key feature is the Māori Advancement plan. This plan is intended to uphold

the University's charter and their commitments to Te Tiriti o Waitangi (Treaty of Waitangi), as well as to support the university's mana as a leading university for Māori. While there are four goals highlighted in the plan, goal three regarding the integration of kaupapa (Māori policy), tikanga, Te Reo and Mātauranga into the university experience should be highly embraced. The Māori Advancement plan describes how the university will achieve this goal (The University of Waikato, 2014):

Explore opportunities to infuse the curriculum with Māori knowledges and perspectives, to ensure graduates of the University have a level of bicultural awareness and capability that enhances their contributions in the workforce and in society generally.

Often these plans and strategies have not been enough, so Taumata Aronui was established to assist in designing an education system that supports partnership between the Crown and Māori. Some of their recommendations for the tertiary education space included the need for commitment to Mātauranga Māori, Te Reo Māori and Tikanga Māori in practice and in philosophy for the education sector to support and promote cultural revitalisation (Taumata Aronui, 2022).

The engineering curriculum at the University of Waikato has not had an emphasis on integrating Mātauranga Māori. What has been available to students in their learnings regarding cultural capacity was previously a handful of lectures delivered about Te Tiriti o Waitangi (Treaty of Waitangi), the Resource Management act and the consenting processes. These lectures were often taught from staff outside the engineering faculty. This is a shame, as there have been New Zealand engineering projects which have been undertaken which have had poor engagement practices with Māori. When we are not effectively engaged and partnered with Māori in the right way, it can lead to increased project costs, mistrust, and resistance by Māori. Often, these relationships can be seen as a "tick-box exercise", however when engineers really listen and embark on the journey with Māori and have Māori at decision making levels, it can change the way we undertake our projects, for example New Plymouth Airport with local hapū (sub-tribe) Puketapu. The airport project allowed hapū to lead and provide visibility of their culture and creation narrative through the design (Philp, 2021). These partnerships should not be limited just to formal obligations, i.e. a "tick-box exercise", therefore it is an important component to consider in education for engineers.

Understanding the value of and implementing Mātauranga in engineering projects will help broaden our knowledge base. There are several instances where Mātauranga has supported or inhibited infrastructure. An example where appreciating Mātauranga and incorporating it into a project has been successful was the establishment of a marae in Matatā. This marae is sited close to the Waitepuru stream. The stream was blocked with debris as a result of extreme weather in 2005 and its path had shifted. The marae was not affected, as the local Māori had selected locations of the marae away from the shifting path of the Waitepuru stream. This knowledge had been embedded in the form of pūrakau (storytelling/ Māori narrative), where the stream is depicted as a ngārara (Lizard), where the hiku (tail) flickered. The tail of the stream is in the low-lying sections of land and often changed with large floods, which indicated to Māori not to build in those sections (Thompson, 2020). Furthermore, another instance in which Mātauranga could have supported an engineering project was in 2002, the Waikato expressway near Meremere. There was a small wetland and a culturally significant site where the local Māori believed a Taniwha (supernatural creature) had lived. There were several fatal road accidents believed to be caused by the Taniwha due to the road disrupting its habitat (Hamsworth, 2005). The articles regarding the project were conflicting as to whether there was an effective partnership with the local Māori. However, if Māori were engaged with, perhaps the Mātauranga could have shaped the project differently to prevent accidents. Incorporation of Mātauranga and engineering knowledge could change the way we design, and also improve our partnerships with Māori, providing them with a voice.

The engineering curriculum is driven by the Washington Accord, which is an agreement between engineering tertiary degree providers regarding 12 key attributes graduates should have to be a good professional engineer ("Washington Accord » International Engineering Alliance", 2022). There are five graduate attributes listed in Table 1 which consist of soft skills required to be an engineering professional. The cultural component of these skills are often over looked or addressed superficially and technical skills have higher importance.

Table 1: Washington Accord Graduate Attributes that highlight soft skills (International Engineering Alliance, 1989)

Washington Accord Graduate Attributes	Description
WA3: Design/ development of solutions	Problem solving of complex engineering problems which can consider specific cultural, societal and environmental considerations.
WA6: The engineer and society	Use reasoning informed by contextual knowledge to assist in societal, legal and cultural issues impacting on engineering problems.
WA7: Environment and sustainability	Understand and evaluate the sustainability and impact of the professional engineering work.
WA8: Ethics	Apply ethical principles and commit to professional ethics and responsibilities.
WA10: Communication	Communicate effectively on complex engineering activities with the engineering community and with society.

In New Zealand, Te Ao Rangahau (Engineering New Zealand) monitors and assesses the tertiary institutes offering engineering programmes. Engineering New Zealand recognises the importance of engaging with Iwi and Māori and letting the voices of the Māori community be heard. However, there is a lack of representation of Māori in the industry ("The ABC of inclusion and diversity | Engineering New Zealand", 2018). Recently, Engineering New Zealand had proposed building Te Ao Māori capabilities into their governing board by appointing a Māori Board member (Johnson, 2022). Engineering NZ did note that it is not ideal to solely rely on one member to speak for the Māori community, therefore the governing board is required to build Te Ao Māori capability amongst the full team ("Building Te Ao Māori capability on our Board | Engineering New Zealand", 2021).

While the leadership in the engineering profession recognise the importance of building cultural capability, we do not have enough Māori in the industry to do this alone. Cultural competency, cultural intelligence and building Te Ao Māori capabilities are not new concepts, it is just taking some time to reach the workforce in the engineering sector. The health and legal sectors have already undergone a shift. In the health industry the Hauora Māori curriculum is offered, which covers indigenous rights, impacts of colonial history on indigenous health, Māori protocol and models of care (Medical Council of New Zealand, 2019). Law education in New Zealand has also undergone a transition ("New Zealand Council of Legal Education", 2021), where in 2021 the New Zealand Council of Legal Education mandated the inclusion of Te Ao Māori in the legal curriculum taught at universities (Clement, 2021).

Tertiary teaching in different disciplines all have commonalities regarding equal access and opportunity for everyone, as well as creating safe environments to support the needs of local and regional community groups, while also aiming to achieve bicultural relationships and partnerships underpinned by the Treaty of Waitangi (Mackinnon & Te Aho, 2004). Therefore, due to the shift in the education and industrial landscape with the incorporation of Te Ao Māori, the engineering curriculum at the University of Waikato also needs to better include Te Ao Māori to better prepare engineering students for industry.

For the purpose of this study, an intervention was facilitated by a Māori engineering lecturer to incorporate three lectures of Māori education into the current curriculum for a third year engineering course. The aim of this study was to understand the following:

- Student backgrounds and how to best engage with them

- Engineering student familiarity with regards to Māori culture and beliefs
- Student perceptions regarding the necessity of including Te Ao Māori in engineering education
- Student perceptions regarding the connection between The Treaty of Waitangi and engineering
- Student perceptions of the course, the intervention and suggested improvements

The associated potential outcomes from introducing this intervention include

- Contributing to reducing racism held in the profession
- Better understanding stakeholders that engineers may come across in their profession
- Better understand how to engage and liaise with stakeholders
- Better understand Māori aspirations
- Better appreciate and understand engineering's connection to The Treaty of Waitangi

Methodology

The University of Waikato offer a series of four papers (courses) that provide the students with development of soft skills required for the engineering profession. The papers are considered the ENGENX70 papers and are titled Engineering and Society (ENGEN170), Engineering and Business (ENGEN270), Engineering and the Environment (ENGEN370), and Engineering and the Profession (ENGEN570). ENGEN370 provides students with skills to assess and address environmental challenges ("Waikato Paper Outlines", 2022). It includes the evaluation of engineering practices and projects through assessment tools such as life cycle analysis, environmental and societal impact assessment and resilience and risk analysis. It also teaches the principles of designing to reduce the impact of projects on the environment. As part of the course, students organise themselves into groups, identify an environmental problem they would like to solve, propose a solution for the problem, and then assess the solution using life cycle assessment, impact assessment and risk and resilience assessment. ENGEN370 was chosen for the teaching intervention due to the obvious connection between Te Ao Māori and the environment because the environment is entwined in the Māori identity and spirituality (Poa, 2020).

The intervention in this course consisted of three lectures in Māori education. The Māori education component included the following:

- The Treaty of Waitangi
- The interface between Te Ao Māori and engineering
- Māori knowledge / Mātauranga
- Navigating relationships with Māori
- Understanding Māori Aspirations
- Engagement and partnership - case study examples of bilateral partnerships
- Cultural competency in the Aotearoa context
- Understanding tikanga – Māori protocol and customs
- Pōwhiri/ Whakatau – Māori welcoming ceremonies, including informal and formal procedures
- Understanding Whare Tipuna - Māori meeting house

Students enrolled in ENGEN370 were asked to participate in a survey regarding their perspectives of the Māori education component once the teaching intervention had concluded. The survey asked students to rate their own knowledge of Te Ao Māori, what previous exposure they have had to Māori education, and what Māori knowledge and skills they thought were required in the engineering profession.

The survey included the following questions:

1. What gender do you identify as?
2. What year at university are you?
3. What degree are you studying?
4. What major are you studying?
5. What is your ethnic background?
6. What level of education have you received in Māori education prior to now?
7. Rank your proficiency of: Māori history; Māori cultural beliefs; Māori traditions; Māori language; Māori protocol on a Marae; Treaty of Waitangi.
8. Rank your agreement/disagreement to the following:
 - The need in engineering to speak Te Reo Māori in the work place
 - The need of iwi / tangata whenua to be involved at the governance level in projects
 - The need of iwi to be engaged prior to starting a project
 - The connection between the Treaty of Waitangi and engineering
 - The importance of cultural competence and understanding Te Ao Māori in engineering
9. Your enjoyment of the Te Ao Māori lectures and workshop
10. Is there anything you would like to learn about Māori culture?
11. Is there anything you really enjoyed / anything interesting you learnt?
12. Is there anything that could be done to improve the course?

The study was approved by the Human Research Ethics Committee of the University of Waikato under HREC(HECS)2022#10.

Results & Discussion

Approximately 12% of the students enrolled in the course (16 participants out of 130 students) participated in the survey. While this seems low, this was actually a good response rate compared to other engineering surveys such as class evaluations where only 2-5% of the class participant in the evaluations. All of the participants in the survey identified their gender as male. While it would have been better to have a mixture of genders in the respondents, only 20% of the students enrolled

in the course were female. The majority of the participants (94%) were three years into their engineering qualification, while remainder were in year two. The participants consisted of students from mechanical (37.5%), civil (25%), software (25%), mechatronics (6.25%), and electrical/electronic engineering (6.25%) (Figure 1).

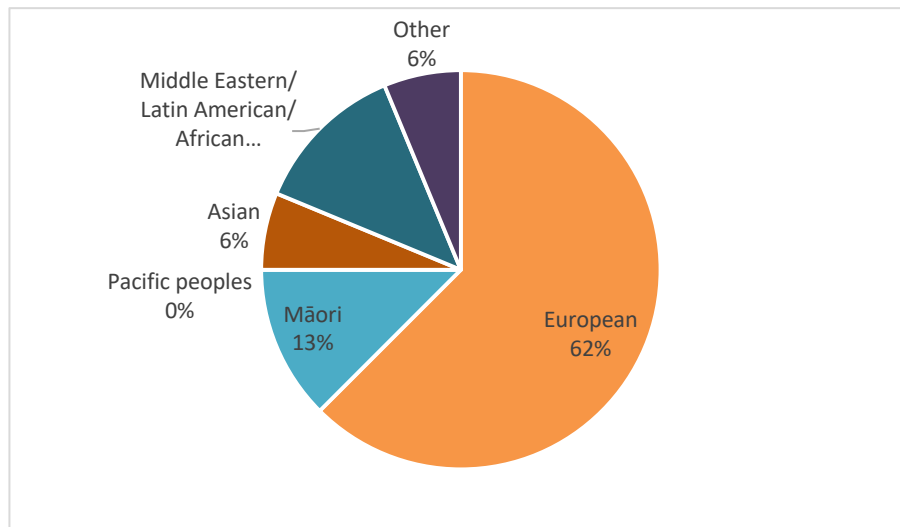


Figure 1: Participant ethnic background

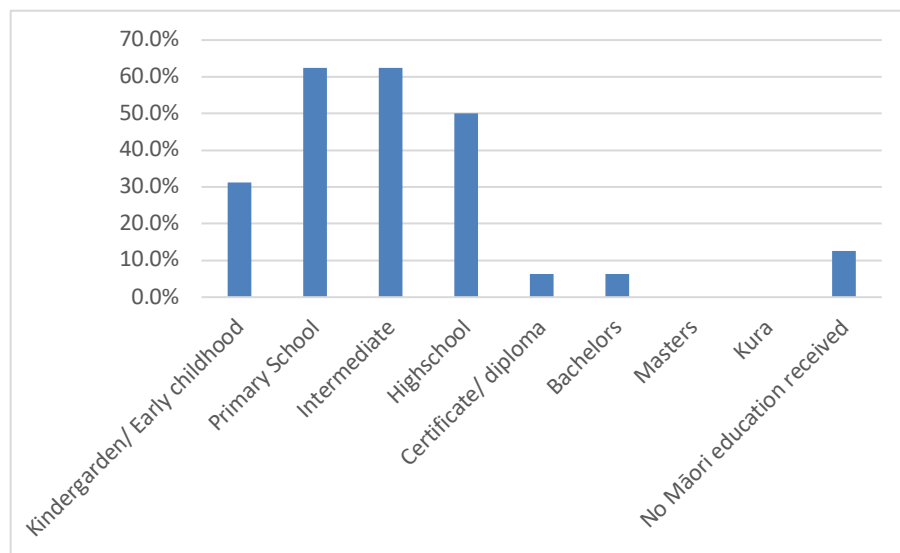


Figure 2: Participants previous Māori education

The majority of respondents had received previous Māori education in primary and intermediate school (62.5%) while 50% of participants had received Māori education in high school. Only two participants have not received any prior Māori education.

Assessment of engineering student familiarity with regards to Māori culture and beliefs

The survey participants ranked their competency in Māori history, cultural beliefs, traditions, and language. It was seen that 50% of respondents ranked themselves as being “somewhat competent” in Māori history, with 8.33% being “competent”. The respondents that believed they are competent in Māori history had also indicated they had received prior Māori education throughout their education at primary school, intermediate and high school. This allowed the students to continually

build on the knowledge they had previously learnt, as well as further retaining the knowledge they had already gained.

Surprisingly, 36.4% of respondents believed they were experts or competent in marae protocol while 27.3% of respondents believed they were not competent in marae protocol. It is uncertain why so many participants claimed to be competent in marae protocol. The lead author, even being Māori, did not have an opportunity to visit her marae until she was 22 years of age, while the second author had stayed on a marae numerous times, in one instance for nine days (he would still not claim he was an expert in marae protocol). Having said that, there are a variety of marae education packages and visits that people and schools can participate in. There is also opportunity to visit Te Tii Waitangi marae where Te Tiriti o Waitangi was signed ("Te Tii Waitangi Marae | National Library of New Zealand", 2022).

The majority of students said they were unsure or not competent in Māori cultural beliefs (85.7%) and traditions (71.4%), 88.9% said they were not competent or somewhat competent in Te Reo Māori language.

According to the Ministry of Education, teaching Māori in the school curriculum was not compulsory ("Frequently asked questions / Te Reo Māori in Schools Strategy / Professional learning / Home - Te Reo Māori", 2022). However, from 2023 all schools and kura will be required to teach Te Takanga o Te Wā (Māori history) and Aotearoa New Zealand's history, to understand how the two histories have shaped the country ("Aotearoa New Zealand's histories and Te Takanga o Te Wā", 2022). This change will enable future engineering students entering tertiary education have a deeper base knowledge of Māori history.

Understanding the student perceptions of the necessity of including Te Ao Māori

It was clear that students believe that inclusion of Māori were significant for projects. 56.3% of students agreed to strongly agreed that Iwi / tangata whenua need to be included at governance level in engineering projects. 75% of participants believed that iwi need to be engaged with prior to starting a project. 56.3% of participants agreed to strongly agreed that cultural competency and understanding Te Ao Māori is important in engineering, while 25% strongly disagreed.

The statement which exhibited a high level of disagreement was "Engineers need to speak Te Reo Māori in the work place", where 56.3% disagreed to strongly disagreed. There were 37.5% that neither agreed nor disagreed. Observing the class undertaking the survey, the lecturer said "There was a lot of interest in the idea that engineers should be able to speak Māori in the profession. I noticed the students got really passionate about it, to the point where the quiz stopped and they started to debate within the lecture theatre". Often when people do not agree with information they automatically reject it, particularly if it does not align with their previous beliefs (Kappes, Harvey, Lohrenz, Montague & Sharot, 2019).

Understanding the importance of Bilateral relationships with Māori

Bilateral relationships was an important concept covered in the intervention, as relationships with Māori can be considered "ticking a box", particularly if participating in engagement or consultation with Māori is forced due to there being laws or rules rather than something that is genuinely desired. Through the intervention students were exposed to case studies regarding bilateral partnerships such as Te Awa, the shopping mall at the Base in Hamilton, New Zealand. The shopping mall was a bilateral partnership which enabled the incorporation of Māori design, reflective of the culture of the Waikato-Tainui people. The building resembled a Māori waka (canoe), and included elements signifying the local environment, the Waikato river and the landscape. By providing the opportunity to local iwi to collaborate in the design, allowed for Waikato-Tainui carvers to be involved and Māori stories to be shared through their art (Hawkes, 2012).

When students were surveyed regarding this part of the intervention, there were many comments about "learning about relevant groups for consultation" and they "felt better prepared for industry". Students also mentioned that the partnership prompts were useful, and that they "hoped to apply these when they got into the industry". The partnership prompts were presented during the intervention, as follows:

- What Māori processes, resources and people are affected by what's being done?
- Is the partnership mutually beneficial?
- What do both parties contribute? (Kaupapa, Tikanga, Mātauranga)
- How do I make sure what I am bringing to the table is valuable? (understanding Māori aspirations).
- Do all parties benefit equally from the outcome and partnership?
- What Te Tiriti (Treaty) principles apply to what I am doing?
- Is there a kaitiaki of the process or resource you are impacting?

Another comment made by students was the lack of understanding and knowledge about the New Zealand government's Vision Mātauranga policy. The policy aims to develop the science and innovation potential of Māori knowledge, resources and people in the following areas: indigenous innovation, the environment, health and social well-being, and indigenous knowledge. The aim of the policy is to build the capability of Māori individuals, organisations, rūnanga, trusts, iwi, hapū, and marae to engage with science and innovation to benefit New Zealand as a whole. This policy recognises Māori as partners in science and innovation, seeks to promote relationships between Māori and the science and innovation sectors, and to ultimately recognise Mātauranga Māori as a valid knowledge system in science and innovation. This is important, particularly leading into the fourth-year engineering projects where students are asked how their project relates to Vision Mātauranga.

Engineering organisations which recognise Mātauranga as a valid knowledge base to support engineering and science activities will help ensure successful project outcomes such as the siting of the marae adjacent to the Waitepuru stream, in this instance by recognising the value of pūrakau as a source of knowledge. A key element supporting genuine engagement with Māori is the acknowledgement that Māori have the resources and capability to contribute (Guidelines for engagement with Māori, 2022). Through the use of education and supporting our engineering graduates to understand and adopt these mindsets, they will be able to have better partnerships with Māori in projects.

Assessing the connection between Te Tiriti o Waitangi and engineering

The participants were surveyed around their competency of Te Tiriti o Waitangi (The Treaty of Waitangi), 50% said they were competent to expert level. There were 56.25% of the participants agreed to strongly agreed there is a connection between Te Tiriti o Waitangi (The Treaty of Waitangi) and engineering. Both areas are important points to explore further, particularly how students would define what makes them competent regarding Te Tiriti o Waitangi (The Treaty of Waitangi), but also to educate the students further in how engineering relates to Te Tiriti o Waitangi. While governance of Māori is ceded to the Crown, Māori still retain chieftainship of their lands, which means they should still have a say in what engineering activities are undertaken on their lands, particularly when looking at major civil or infrastructural projects that have a significant impact on the land, resources and people.

Evaluation of the course, and suggested improvements

The content and delivery style of the intervention were evaluated by the participants. A large proportion, 81.25% of participants, were satisfied or really enjoyed the Māori content. The positive feedback included comments from students looking forward to the ENGEN570 paper. Many students felt the content was comprehensive and students felt encouraged by the inclusion of this content.

Highlights of the course noted by participants include the Whare Tipuna challenge, and building and understanding the whareniui. Participants had noted that they did not know much prior to these learnings, or students which knew some components were also introduced to new concepts. Some of these new concepts which came up often were around the powhiri, understanding the challenge

process on marae, and having a better understanding of marae traditions. A participant had said they:

“enjoyed just thinking about Te Ao Māori again, hearing the language. Learnt bits and piece they hadn’t heard before, like the mention of other relevant groups to consult for a project – good to be more prepared for the social structures and be open minded to realise one group may likely not be the only one of relevance. also hadn’t heard of vision Mātauranga before.”

There was a small minority group, which accounted for 12.5% of the class, who said it was terrible in their opinion. In response to the question “Is there anything you really enjoyed/ anything interesting you learnt?”, one student said

“That the first thing was said was the lie that ‘Māori are the indigenous of New Zealand’. In recent years changes have been made to the understanding and legislation surrounding the treaty of Waitangi to properly include the Mori Ori of which were in New Zealand before the Māori. History is written by the Victors”.

This was interesting as research into Moriori language and genealogy suggests the Moriori were actually Māori Polynesians who migrated from mainland New Zealand to the Chatham Islands in the 1500’s, and their dialect has similarities with the Ngāi Tahu tribe of the South Island. The Chatham islands were invaded by displaced Māori from the Ngāti Mutunga and Ngāti Tama tribes, and due to a misunderstanding, resulted in a massacre of the Moriori.

What could be added/ what do you want to know

Out of the nine respondents that answered the question: “Is there anything you would like to learn about Māori culture?”, three participants said that there was nothing more they would like added to the course or they were unsure. A third of the participants said they would really like to learn more or improve their Te Reo Māori. There was a desire to also learn more about Māori culture, myths, beliefs and history, as well as understanding more about how Māori were engineers, such as how they would hunt, and build waka and whareniui.

Improvements to the course

The participants were encouraged to suggest improvements to the course from improved teaching styles to the content covered. Just over a quarter of the participants who commented said to continue in the same direction, and the current course was enough.

A response from a participant noted it would be better to align the course more closely to engineering. Some of the other responses suggested removing any Māori content from the course or making the course voluntary. One participant said:

“If something has to be included think about it as an international level instead of pigeonholing to New Zealand. An engineering degree is of science, not politics.”

In contrast, another student noted that:

“Having a set of Māori lectures is nice, but to truly convey Te Ao Māori and Mātauranga Māori I believe a stronger move would be to have papers convened by Māori (engineer) lecturers. That way, rather than a handful of Māori lessons in a paper you could have a paper where Mātauranga Māori infuses the whole paper.”

This student also noted:

“If we are trying to teach Māori worldview then teach the normal material through that lens. Otherwise it is merely a check box exercise.”

Law education in New Zealand had undergone a transition, where in 2021 the New Zealand Council of Legal Education mandated the inclusion of Te Ao Māori in the legal curriculum taught at universities. Te Ao Māori concepts were incorporated into every law subject (“New Zealand Council of Legal Education”, 2021).

Students who were against learning Te Ao Māori, had strong opposing views. Comments like “...An engineering degree is of science, not politics”, show ignorance in Māori cultural revitalisation (Doerr, 2009). The Vision Mātauranga policy that was introduced by Ministry of Business, Innovation and Employment, was developed to assist in the recognition of Māori and their knowledge being an

important component of science and innovation. One student showed their bias that engineering and Māori education were two very separate topics, when in fact engineering is conducted in the context of society and their needs, i.e. society drives what engineering projects are conducted according to what is acceptable socially, culturally and politically at time. People learn to be whatever their society and culture teaches them (Wan & Kaplan, 2017).

Other students suggested learning Te Ao Māori should be voluntary. These students are continuing to encourage silencing, a technique used to comfort and limit acknowledgment of the history and inequities experienced by priority groups. By encouraging cultural competency to be voluntary, this allows for those individuals to reaffirm their own perspectives, rather than confronting their biases and reflecting on what has happened previously (MacDonald, Smith & Funaki, 2021).

Neriko said “ignorance can empower some people to disempower others”, he spoke Te Reo being an issue due to some Pākehā (non-Māori) not understanding it rather than just embracing or promoting learning. If we continue to disempower Māori, through ignorance as a collective by not incorporating cultural competency into our engineering curriculum, we will further continue in creating a separation between Pākehā and Māori, as well as limiting the knowledge and potential opportunities for innovation our industry could have (Doerr, 2009).

There were a small minority of students who were opposed to what was taught. In other instances, resistance tactics were used to undermine what was taught about Māori. These tactics are often used to take attention away from the cause. Other resistance tactics used by those who do not want to learn about Te Ao Māori are diversion, denial, detriment-centring, and the demand to move on (Harris, 2018).

Style of teaching

The style of teaching can impact how a student receives and maintains information, and it is important for teachers to understand the students perspectives (Dennick, 2016). The teaching method applied to the delivery of this intervention would be classified as constructivist, where the students were given the opportunity to construct their knowledge rather than the typical lecture style of passively receiving information ("Constructivism", 2022).

It was found that half the participants had noted that they enjoyed the style of teaching, as they said it was more similar to a discussion rather than a typical lecture. One of participants said they:

“Enjoyed engagement, group conversations and open questions. The lecturer made them think by actually asking the class and waiting for answers”.

Another participant noted:

“Felt a little rushed, some relevant content had to be skipped over for time’s sake, although I prefer that it was sacrificed so that a more robust understanding through conversation could be had.”

The course permitted open discussion and was promoted as being a safe space for questions to be asked.

The style of the delivery suited the students needs and assisted with their enjoyment. Even though there was mention that lectures may had been rushed it indicated that the students wanted to be there, and wanted to learn more. The open discussion forum worked well in this study, however this could pose a potential risk of students asking questions to their group or lecturer which are confronting to their peers, and therefore could make some peers feel unsafe. This could be particularly true for Māori students when their cultural and belief systems may be questioned and scrutinised. Therefore, whoever is delivering the content, must navigate the fine line between robust discussion and students feeling their worldviews and values are being attacked.

Conclusion

The study found that the engineering students felt they had limited knowledge of Māori cultural beliefs, Māori traditions, and Māori language, however there is a strong desire to learn more. The style of teaching using a constructivist approach was appropriate and students found it an engaging way of learning.

Overall, the students felt that they enjoyed the content and students had noted that they looked forward to learning more in future years. There is a risk of cultural safety for Māori students being involved in these learning environments, with students who might not be culturally aware when asking questions. There would need to be further investigation on how to minimise this risk. There is the risk that incorporating Māori education lectures could be viewed as a 'tick box', therefore for the incorporation to be more meaningful, Mātauranga needs to be imbedded in the full paper for it to be done successfully. It is acknowledged that the response rate was low from the students who participated in the study. However, it still suggests that the next generation of engineers is ready to incorporate a different knowledge base into their curriculum and into the profession to better prepare themselves for Māori partnerships in projects. We can look to the legal education, where they have mandated the inclusion of Mātauranga. It is recognised that cultural capability is becoming more common, and engineering needs to move ahead and be progressive; our future generation, and our future engineers are ready.

References

- Aotearoa New Zealand's histories and Te Takanga o Te Wā. (2022). Retrieved 15 July 2022, from <https://www.education.govt.nz/our-work/changes-in-education/aotearoa-new-zealands-histories-and-te-takanga-o-te-wa/>
- Building Te Ao Māori capability on our Board | Engineering New Zealand. (2021). Retrieved 15 July 2022, from <https://www.engineeringnz.org/news-insights/building-te-ao-m%C4%81ori-capability-on-our-board/>
- Clement, D. (2021). *Tikanga becomes compulsory for law students*. Auckland District Law Society. Retrieved from https://adls.org.nz/Story?Action=View&Story_id=338#:~:text=The%20biggest%20shake%20Dup%20in,all%20core%20law%20degree%20courses
- Constructivism. (2022). Retrieved 15 July 2022, from <https://www.buffalo.edu/catt/develop/theory/constructivism.html>
- Cross, R., Bone, E., Ampt, P., Bell, T., Quinnell, R., & Gongora, J. (2020). Embedding Cultural Competence in Science Curricula. *Cultural Competence And The Higher Education Sector*, 255-275. doi: 10.1007/978-981-15-5362-2_14
- Dennick, R. (2016). Constructivism: reflections on twenty five years teaching the constructivist approach in medical education. *International Journal Of Medical Education*, 7, 200-205. doi:10.5116/ijme.5763.de11
- Doerr, N. (2009). 'Rude speech' and 'ignorant audience': power of ignorance and language politics at an Aotearoa/New Zealand school. *Critical Studies In Education*, 50(3), 323-335. doi: 10.1080/17508480903161946
- Frequently asked questions / Te Reo Māori in Schools Strategy / Professional learning / Home – Te reo Māori. (2022). Retrieved 15 July 2022, from <https://tereomaori.tki.org.nz/Professional-learning/Te-Reo-Maori-in-Schools-Strategy/Frequently-asked-questions#isnt>
- International Engineering Alliance. (1989). *Washington Accord* (pp. 14-15). Retrieved from <https://www.ieagreements.org/assets/Uploads/Documents/History/25YearsWashingtonAccordA5booklet-FINAL.pdf>
- Hamsworth, G., 2005. *First programme: Roding enhanced by Māori values and knowledge Case study: Transit New Zealand and Ngati Naho, Meremere- Springhill Road* Landcareresearch.co.nz. Available at: https://www.landcareresearch.co.nz/uploads/public/researchpubs/FinalMeremere_Rodingcasestudy.pdf [Accessed 3 October 2022].
- Harris, M. (2018). *Racism and White Defensiveness in Aotearoa: A Pākehā Perspective*. E-Tangata. Retrieved from <https://e-tangata.co.nz/comment-and-analysis/racism-and-white-defensiveness-in-aotearoa-a-pakeha-perspective/>
- Hawkes, C., 2012. *Te Awa retail mall reflects local iwi identity*. [online] Trends. Available at: <https://trendsideas.com/stories/te-awa-retail-mall-reflects-local-iwi-identity> [Accessed 2 October 2022].
- Johnson, A. (2022). "... my contribution back to Māori" | Engineering New Zealand. Retrieved 15 July 2022, from <https://www.engineeringnz.org/news-insights/my-contribution-back-to-m%C4%81ori/>
- Kappes, A., Harvey, A., Lohrenz, T., Montague, P., & Sharot, T. (2019). Confirmation bias in the utilization of others' opinion strength. *Nature Neuroscience*, 23(1), 130-137. doi:10.1038/s41593-019-05492
- MacDonald, L., Smith, A., & Funaki, H. (2021). "When Am I Supposed to Teach Māori and Find the Time to Learn it?": Settler Affirmations in Aotearoa New Zealand Schools. *New Zealand Journal Of Educational Studies*, 56(2), 165-180. doi: 10.1007/s40841-021-00222-3

- Mackinnon, J., & Te Aho, L. (2004). Delivering a bicultural legal education: reflections on classroom experiences. Retrieved 15 July 2022, from <http://www.nzlii.org/nz/journals/WkoLawRw/2004/4.html>
- Medical Council of New Zealand. (2019). *He Ara Hauora Māori: A Pathway to Māori Health Equity*. Retrieved from <https://www.mcnz.org.nz/assets/standards/6c2ece58e8/He-Ara-Hauora-Maori-A-Pathway-to-Maori-Health-Equity.pdf>
- New Zealand Council of Legal Education. (2021). Retrieved 15 July 2022, from <https://nzcle.org.nz/>
- Philp, M., 2021. *Te tūturutanga o te taumautanga ki te Māori | Engineering New Zealand*. [online] Engineeringnz.org. Available at: <<https://www.engineeringnz.org/news-insights/te-t%C5%ABtututanga-%C5%8D-te-taumautanga-ki-te-m%C4%81ori/>> [Accessed 2 October 2022].
- Poa, T. (2020). Mātauranga Māori: Applying a Māori lens to environmental management | EPA. Retrieved 15 July 2022, from <https://www.epa.govt.nz/community-involvement/science-corner/matauranga-maori/>
- The University of Waikato. (2014). *MĀORI ADVANCEMENT PLAN1 2015 - 2017*. Retrieved from https://www.waikato.ac.nz/__data/assets/pdf_file/0008/608975/Maori-Advancement-Plan-2015-2017-approved-by-Council.pdf
- Taumata Aronui. (2022). *Māori success and Tertiary Education towards a comprehensive vision*. Retrieved from <https://www.tec.govt.nz/assets/Publications-and-others/Manu-Kokiri-by-Taumata-AronuiApril-2022.pdf>
- Te Arawhiti. 2022. *Guidelines for engagement with Māori*. [online] Available at: <<https://tearawhiti.govt.nz/assets/Maori-Crown-Relations-Roopu/6b46d994f8/EngagementGuidelines-1-Oct-18.pdf>> [Accessed 3 October 2022].
- Ruckstuhl, K., Haar, J., Hudson, M., Amoamo, M., Waiti, J., Ruwhiu, D., & Daellenbach, U. (2019). Recognising and valuing Māori innovation in the high-tech sector: a capacity approach. *Journal Of The Royal Society Of New Zealand*, 49(sup1), 72-88. doi: 10.1080/03036758.2019.1668814
- Satyanand, A., Gardiner, H., & Parata, H. (2022). *Findings of the independent review into public claims of racism at the University of Waikato*. The University of Waikato. Retrieved from <https://cms.its.waikato.ac.nz/major-projects/taskforce/?a=629577>
- Te Ao Māori Trends and Insights. (2017). Retrieved 15 July 2022, from <https://chapmantripp.com/media/j1slpr3f/te-ao-maori-2017-english.pdf>
- Thompson, E., 2020. *The River's Lizard Tail: Braiding Indigenous Knowledges with Geomorphology - Eos*. [online] Eos. Available at: <<https://eos.org/features/the-rivers-lizard-tail-braiding-indigenousknowledges-with-geomorphology>> [Accessed 3 October 2022].
- Te Tii Waitangi Marae | National Library of New Zealand. (2022). Retrieved 15 July 2022, from <https://natlib.govt.nz/records/37349785>
- The ABC of inclusion and diversity | Engineering New Zealand. (2018). Retrieved 15 July 2022, from <https://www.engineeringnz.org/news-insights/abc-inclusion-and-diversity/>
- Vision Mātauranga | Ministry of Business, Innovation & Employment. (2022). Retrieved 15 July 2022, from <https://www.mbie.govt.nz/science-and-technology/science-and-innovation/agencies-policies-and-budget-initiatives/vision-matauranga-policy/>
- Waikato Paper Outlines. (2022). Retrieved 15 July 2022, from [https://paperoutlines.waikato.ac.nz/outline/ENGEN37022A%20\(HAM\)](https://paperoutlines.waikato.ac.nz/outline/ENGEN37022A%20(HAM))
- Wan, W., & Kaplan, S. (2017). Why are people still racist? What science says about America's race problem. Two psychologists explore the roots of racism. *WP Company LLC D/B/A The Washington Post*. Retrieved from <https://www.proquest.com/docview/1928600641?parentSessionId=KwTUdxJZejSlzMsrO5SSTslhTWknwXyVhQjNAj3lka%3D&pq-origsite=primo&accountid=17287>
- Washington Accord » International Engineering Alliance. (2022). Retrieved 15 July 2022, from <https://www.ieagreements.org/accords/washington/>

Acknowledgements

I wish to express my gratitude to my supervisors and Marama Salsano, who have helped my immensely throughout my kaupapa. I acknowledge your expertise, the valuable kōrero shared, contributions and support.

Copyright statement

Copyright © 2022 Names of authors: Teresa Poli, Mark Lay, Mahonri Owen and Megan Boston. The authors assign to the Australasian Association for Engineering Education (AAEE) and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to AAEE to publish this document in full on the World Wide Web (prime sites and mirrors), on Memory Sticks, and in printed form within the AAEE 2022 proceedings. Any other usage is prohibited without the express permission of the authors.