

## Partnership in action: Embedding te ao Māori into a Chemical Engineering Programme

Garrick Thorn<sup>a</sup>, Elizabeth Brown<sup>b</sup>, Daniel Holland<sup>a</sup>, Melany King<sup>b</sup>, Corban Te Aika<sup>c</sup>, Peter Gostomski<sup>a</sup>, Matthew Watson<sup>a</sup>, Becky Macdonald<sup>a,d</sup> and Carlo Carere<sup>a</sup>

*Department of Chemical and Process Engineering, University of Canterbury<sup>a</sup>, Office of Treaty Partnership, University of Canterbury<sup>b</sup>, GHD<sup>c</sup>, Jacobs New Zealand<sup>d</sup>*

*Corresponding Author Email: carlo.carere@canterbury.ac.nz*

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### ABSTRACT

#### CONTEXT

Te Tiriti o Waitangi is the founding document of Aotearoa | New Zealand and Te Whare Wānanga o Waitaha | University of Canterbury is committed to embedding its principles into student learning. In partnership with mana whenua (Māori with territorial rights), Ngāi Tūāhuriri (a rūnanga of Ngāi Tahu), the Office of Treaty Partnership was created; demonstrating its commitment to empowering tangata whenua and giving effect to Te Tiriti. This paper describes how partnering with mana whenua to co-develop curriculum combining chemical engineering education with mātauranga Māori (Māori knowledge) empowers student learning which meets our treaty obligations and realises the University's graduate attributes.

#### PURPOSE OR GOAL

Aotearoa is a bicultural society. Te Whare Wānanga o Waitaha aims to prepare students to work alongside both cultures and to understand its relevance to their study and career. To achieve this, seven kaupapa (principles) were embedded across a chemical engineering programme.

#### APPROACH OR METHODOLOGY/METHODS

The Office of Treaty Partnership and the Department of Chemical and Process Engineering cultivated relationships with Ngāi Tahu entities. Beginning with whakawhanaungatanga, we have developed teaching activities combining mātauranga Māori and chemical engineering education.

#### ACTUAL OR ANTICIPATED OUTCOMES

We have developed relationships with eight rūnanga (Māori grouping) two project specific iwi (tribe) groups, a Ngāi Tahu owned commercial enterprise, and tangata whenua (Māori or people of the land) businesses. Consequently, a selection of workshops, classes, case studies, and specific design related projects requiring direct engagement with iwi have been co-developed. Positive feedback from these organisations and evidence (e.g. survey feedback, anecdotal) shows our students demonstrate improved understanding of te ao Māori (Māori world).

#### CONCLUSIONS/RECOMMENDATIONS/SUMMARY

Building meaningful relationships with iwi partners has supported embedding te ao Māori into our chemical engineering programme, enabling students to become biculturally competent and confident and responsible tangata tiriti (people of the treaty).

#### KEYWORDS

Mātauranga Māori; chemical engineering education

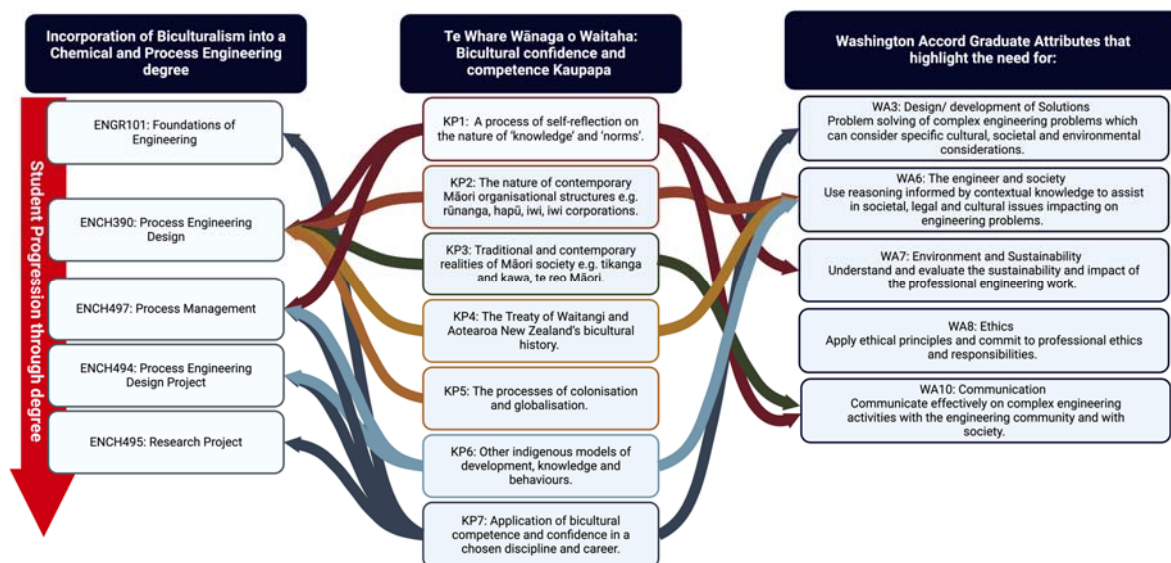
# Introduction

Te Tiriti o Waitangi is the founding document of Aotearoa | New Zealand. The written agreement made in 1840 between the British Crown and over 500 Māori chiefs established New Zealand as a British colony. Ultimately establishing a partnership between tangata whenua | people of the land – Māori and tangata tiriti | people of the treaty – non-Māori.

Te Whare Wānanga o Waitaha | University of Canterbury (UC) recently became New Zealand's first 'treaty led university', therein reinforcing its commitment to embedding its principles into student learning (O'Callaghan, 2021). In partnership with mana whenua (Māori with territorial rights), Ngāi Tūāhuriri (a rūnanga of Ngāi Tahu), the Office of Treaty Partnership was created; to empower tangata whenua and give effect to Te Tiriti through partnership. In addition to these obligations, this change has been driven by education policy framework in Aotearoa and the desire to address inequities in the education system (Brown, 2023). Integrating cultural competence effectively within tertiary institutions is crucial for establishing cross-cultural environments where undergraduates and academics can gain insights into how culture and belief systems impact professional decision-making (Brunhaver *et al.*, 2018). The incorporation of cultural competence is especially challenging within chemical engineering, as this discipline largely relies on traditional reductionist approaches to teaching.

Within Aotearoa-New Zealand, cultural competence and confidence is increasingly valued within the job market (Ide & Beddoe, 2022). Many companies and organizations are now actively incorporating te reo Māori (Māori language), tikanga (cultural practices), and mātauranga Māori (Māori knowledge) into their operations. Just as in science, there are numerous ways to approach engineering challenges, and considering cultural perspectives can inspire innovative problem-solving (Cross *et al.*, 2020; Poli *et al.*, 2022). Consequently, we must better equip our engineering graduates for the workforce, ensuring they understand the stakeholders they'll encounter and the work they'll do for communities. In 2010, the Office of the Assistant Vice-Chancellor Māori was established, with the first full-time Assistant Vice-Chancellor Māori appointed (2011) to implement Te Rautaki Whakawhanake Kaupapa Māori | the Strategy for Māori Development. In 2015, the UC Academic Board established five graduate attributes to equip UC students for successful careers (Brown, 2023; *What does the graduate profile mean to me?*, 2024). One of these attributes emphasizes that all graduates should be 'biculturally competent and confident'. This graduate attribute was designed to recognise Aotearoa-New Zealand's two distinct cultures (tangata whenua | people of the land – Māori and tangata tiriti | people of the treaty – non-Māori) and is further described by seven kaupapa (principles, Figure 1). Bicultural confidence is an awareness of, and the ability to relate to, different ideas. It also builds understanding with cultural identity and the ability to see how culture connects with others, how ideas can be influenced by culture, and how culture can affect the work created (Brown, 2023).

The primary aim of the UC graduate profile is to ensure students are competent in their core academic discipline. For engineering disciplines, such as chemical engineering, this is reinforced via Aotearoa-New Zealand's signatory status through Engineering NZ to the Washington accord (WA); an agreement among engineering degree accrediting bodies outlining 12 key attributes that graduates should possess to be competent professional engineers (*Washington Accord* >> *International Engineering Alliance*, 2022). Several of the WA attributes and aspirations of the university (kaupapa) are linked to the graduate attributes. Although the cultural component of these skills is often over-looked or superficially addressed, with technical skills prioritised in many learning environments, there is a growing trend within the engineering and tertiary education community to better incorporate understanding of indigenous cultural perspectives into education programmes (Brown, 2023; Durie, 2009; Poli *et al.*, 2022). In this paper, we describe how, using te ao Māori values, curriculum can be enhanced with co-developed indigenous relevant content.



**Figure 1: Elements of University of Canterbury’s Biculturalism kaupapa, and their linkages to select Washington Accord (WA) Graduate Attributes (*Washington Accord*)) International Engineering Alliance, 2022), are implemented throughout the Chemical and Process Engineering degree. Created with Biorender.com.**

## Our approach to embedding te ao Māori

The University of Canterbury’s Department of Chemical and Process Engineering offers a Bachelor of Engineering with Honours degree that is accredited by two organisations: The Institute of Chemical Engineers and Engineering NZ | Te Ao Rangahau. At UC, all engineering students complete a common first year of foundational courses before selecting their specific discipline. Within the chemical engineering programme, the modest class sizes within each programme year ( $n \sim 50$ ) allow for high levels of student interaction with their instructors, enhancing the learning experience.

The process of embedding bicultural teaching content within a chemical engineering programme first involved understanding what effective/successful engagement resembled from te ao Māori perspective. At this point ako (co-operation of learner and teacher) was essential in developing an understanding of te ao Māori, particularly the relevant Māori values. The understanding and assimilation of these values of traditional and contemporary mātauranga Māori and pedagogical approaches are key to a shift towards biculturalism (Brown, 2023). The University structurally enabled this via the appointment of faculty-specific kaiārahi (cultural guide) to support the process of implementing graduate attributes and to represent mana whenua. Through fostering an understanding of values (whakawhanaungatanga, manaakitanga and kaitiakitanga – defined below) and co-design approaches, a strong foundation was built for success. Next, a reiterative process of 1) whakawhanaungatanga, 2) co-design and 3) kōrero (dialogue), underpinned by the values of manaakitanga and kaitiakitanga, was used to develop an ever-growing kete (bag) of teaching material demonstrating joint value.

### Whakawhanaungatanga

From a te ao Māori perspective, whakawhanaungatanga is the concept of forming and maintaining relationships. It emphasises connections and extends beyond benefits to individuals, encompassing value to communities. This indigenous worldview recognises the interconnectedness between humans, nature and place, fostering respect and a holistic understanding (Durie, 2009). Beginning with our kaiārahi, and through the process of whakawhanaungatanga, we first established a foundational partnership with UC’s Office of Treaty

Partnership. This was then expanded via introduction and connections, raranga | weaving a network of iwi, practicing engineers and academics to co-design engaging teaching material.

## **Manaakitanga**

Manaakitanga is a fundamental concept that embodies the value of hospitality, kindness, and respect towards others. Regardless of your location, manaakitanga is about creating a welcoming environment for guests, making them feel appreciated and respected. This value emphasises caring for others and nurturing relationships going hand in hand with whakawhanaungatanga. For example, providing kai | food when meeting kanohi ki te kanohi | face to face or valuing peoples time. Manaaki is a powerful expression of how Māori communities engage with one another, embodying the essence of hospitality and interconnectedness, and this value helped connect Te Kaupeka Pūhanga | Faculty of Engineering and te ao Māori.

## **Kaitiakitanga**

Sustainability through the consideration of the environment, society and economic perspectives is a concept deeply engrained within chemical engineering education. It is a value closely connected with kaitiakitanga, which is rooted in the traditional Māori worldview, embodying guardianship and protection. It encompasses environmental conservation, sustainability, and a deep interconnectedness between wai (water), tangata whenua (people of the land), and te whenua (the land). This common goal and aspiration shared by both the engineering community and tangata whenua is eloquently expressed through the Ngāi Tahu whakataukī | proverb (Wikaira, 2022).

## **MŌ TĀTOU, Ā, MO KĀ URI Ā MURI AKE NEI**

For us and our children after us

## **Co-design**

Co-design in Aotearoa-New Zealand refers to a philosophical approach for involving people in the design of services or processes; in this case, the development of the pedagogy and content for embedding te ao Māori within an existing chemical engineering programme. It emphasises collaboration between the parties, creating improvements together. Ensuring that education programs align with the unique needs and perspectives of New Zealand communities (Mark & Hagen, 2020). Early on, the need to partner with The Office of Treaty Partnership was recognised as crucial to provide students the opportunity to 'Learn from' rather than 'Learn about' (Hoskins & Jones, 2022) and ensure mātauranga Māori was connected authentically to chemical engineering content. By engaging, educators, iwi, and practicing engineers, a range of knowledge, perspectives and experience can be embedded across the programme.

## **Result & Discussion**

Through the process of whakawhanaungatanga we have established relationships with eight rūnanga (Māori grouping) within Ngāi Tahu, two project specific iwi groups, a Ngāi Tahu owned commercial enterprise, and some tangata whenua owned or led businesses. Through these connections we have co-developed workshops, classes, case studies, and a series of specific design related projects requiring direct engagement with iwi. Feedback from these organisations is positive and evidence shows our students demonstrate improved understanding of te ao Māori.

As we continue to meet and engage with new groups, new opportunities for teaching are identified. Often this results in new guest presenters who provide different perspectives, opinions and teaching styles. Encouraged and facilitated by the Office of Treaty Partnership, these classes are often presented by Māori presenters supporting a model of 'Learn from' rather than 'learn about'. An approach that recognises the knowledge limitations of non-Māori regarding te ao Māori (Hoskins & Jones, 2022). Opting to create touch points across multiple courses, as opposed to a

singularly focused and intensive course, we have integrated mātauranga Māori and te ao Māori into five different courses. Below we outline a selection of these activities, classes, and exercises.

### **1<sup>st</sup> Year – ENGR101: Foundations of Engineering**

This first-year course is taught across all engineering disciplines offered at UC and introduces students to the process of design, problem solving, technical sketching, teamwork and report writing. Additionally, the importance of sustainability, ethics, diversity, and biculturalism in an engineering context are also introduced. Bicultural engagement is taught via experienced practitioners who share their experiences through lectures, a panel discussion and the use of case studies.

The key learning outcomes relating to biculturalism in this course are:

1. Show awareness of the relationship between Māori and the Crown in the management of Aotearoa-New Zealand's resources, mana whenua perspectives of the natural environment, and Aotearoa-New Zealand's unique relationship with the Pacific Islands.

This content is assessed in the course's final exam based on one of the case studies presented within lectures.

### **3<sup>rd</sup> Year – ENCH390: Process Engineering Design**

The group of activities included in this third-year course represent the most intensive dedicated content relating to biculturalism within the degree. In a series of 2-hour workshops, students learn to consider the opinions, desires, and goals of iwi within the context of chemical engineering practice. This content is exclusively delivered via guest lecturers. The overall objective of these workshops is to teach students to understand how engineers should effectively engage and collaborate with mana whenua to achieve better engineering outcomes. To this end, all students become familiar with basic tikanga | Māori protocols and how core Māori values may influence decision making processes. Through this, we aim to show our engineering students that effective engagement with Māori stakeholders contributes to better engineering outcomes for the entire community.

The key learning outcomes relating to biculturalism in this course are:

1. Understand who mana whenua are in Waitaha | Canterbury (including social structure, values, historical and current situation).
2. Understand and propose effective engagement strategies with Māori, including familiarity with tikanga Māori

Student learning against these outcomes is assessed via both a series of participation activities and a formal report. Following each workshop, students are asked to complete a short web-based activity that challenges them to reflect on what was discussed. These activities are only available for 24 hours to ensure the cohort remains engaged. For example, following an introductory workshop to Māori social structures, values, tūrangawaewae and tikanga Māori, students may be asked to "Explain what a mihi is intended to communicate and how knowing your mihi could help in the engagement process". Secondly, students are required to complete a short-form report outlining their key thoughts from the entire series of biculturalism workshops. The assessment brief prompts students to "Include impressions on how the engagement process should proceed. What concepts need to be considered? Citing the case study examples discussed in class, describe examples of positive engagement. What lessons can you take forward to use in the workplace?" The following outlines the style of the workshops delivered within this course.

### **A practicing engineer perspective**

These workshop sessions, delivered by a practicing engineer that works collaboratively with iwi to find effective and culturally appropriate solutions, are designed to bring together a variety of perspectives and experiences. In these workshops, students typically work through two 'real-

world' case studies (e.g. the design of a community wastewater treatment plant). In the first case study, an example of effective engagement with mana whenua resulting in an implementable solution is discussed. In the second, an early-stage project is introduced, and students are challenged to develop a solution by identifying the technical and cultural challenges of the project, and how to effectively engage with mana whenua.

## **Māori business**

Ngāi Tahu describe themselves as “tenacious, innovative, and resourceful — holding the knowledge that sustainable practices will ensure the health and wealth of the iwi (tribe)” (*Nō hea mātou*, 2024). In a workshop delivered by management within the commercial operations of Ngāi Tahu, students understand some of the values that underpin the business activities of the iwi and how those activities connect and support the whānau. Increasingly the students are recognising the relevance of their own engineering understanding to the aspirations of the iwi.

## **Cultural narrative walk**

Te ao Māori is not always visible or obvious in the built modern world. Using a guided fieldtrip into the city center, we provide visible examples of co-designed infrastructure, highlighting how cultural narrative of a place can provide unique engineering solutions. These informative sessions are run by a local historian and provide detailed context and the cultural narrative underpinning new designs within our city.

## **Pāpātīpu rūnanga and the challenges they face**

Pāpātīpu rūnanga from within the Ngāi Tahu takiwā | region all have their own whakapapa | genealogy, connection to the whenua | land, cultural narratives and challenges. Through individual workshops with members of different rūnanga, students hear their messages, illustrated with the mātauranga Māori generated from generations on the land. One example stemmed from the role of a marae in the community. A marae holds significant historical and cultural importance in Māori culture. It serves as a central gathering place for the community, fostering community bonds and providing a platform for language learning and personal development. Marae can be located in remote parts of Aotearoa meaning supplying services and infrastructure (e.g. water and power) can be difficult and expensive. In one workshop, the marae manager from a Waitaha | Canterbury marae spoke of the important role the marae plays in their community, the challenges in drinking water supply they experience, and how that is being exacerbated by climate change. This workshop also reflected on how collaborative work with our students had supported the rūnanga by developing their engineering understanding and hence building their own capability.

## **Mihi development %**

A mihi mihi (or pepeha) is a practice of introduction that allows people to connect, share their whakapapa and connection to place and tūrangawaewae | place to stand. This is an interactive session, where students share where they grew up or places that are important to them. This is whakawhanaungatanga both between peers, but also with the teachers. This session also includes a te reo Māori component, where students explore pronunciation and translation of “their places” a practice designed to normalise the use of te reo Māori. Many students expressed they would have enjoyed more time (via group work) to develop and practice their mihi futher; which is something we will continue to develop in the future.

## **4<sup>th</sup> Year – ENCH497: Process Management, ENCH494: Process Engineering Design 3, ENCH495: Research Project**

In the final year of our programme, we have several touch points across three courses. Within “Process Management” students consider how processes are incorporated into the business world and how those businesses are operated.

With the specific learning objective:

1. Understand social and cultural matters that might influence investment decisions

This paper is strongly influenced by concepts of sustainability, including community sustainability and how businesses interact and engage with a variety of communities. Within an Aotearoa context, iwi communities are an important part of that consideration. The other two papers consist of a final year team design project and an individual research project. Within the design course an experienced Māori chemical engineer shares their experiences and discusses partnership examples from across Aotearoa; thereby expanding the scope of interactions with different iwi.

The other activities in the final semester, before completing the degree, allow the students an opportunity to apply their learning. Within the team design course, student groups work on a process design and in doing so identify relevant iwi groups and consider how they would engage with that group.

With the specific learning objective:

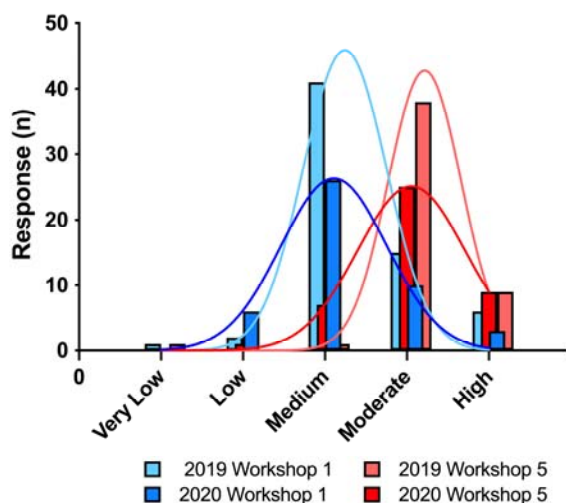
1. Evaluating the impact the process will have on the surrounding community

On several occasions these projects have engaged directly with iwi, assisting them with design challenges, offering opportunities for whakawhanaungatanga, including a marae visit. These projects bring significant value and understanding to everyone involved. For the iwi groups, these interactions broaden their understanding of chemical engineering, and the opportunities it can create for different groups. These have formed the basis of teaching within other parts of our programme.

The other aspect of the final year is a research-focused paper, where students investigate an open-ended investigation task. Students apply learning in this course by considering if and when iwi need to be engaged on the project. Some research topics have been specifically related to iwi business.

## Evidence of student learning

As part of the accompanying web-based activities (3<sup>rd</sup> year class), following Day 1 and Day 5 workshops, students were asked to voluntarily self-evaluate their understanding of biculturalism and how it relates to chemical and process engineering. Feedback shows that student's feel their understanding of biculturalism has increased, with the majority responding 'medium (I appreciate how biculturalism relates to chemical engineering, but I still have a lot to learn)' or 'moderate (I appreciate how biculturalism relates to chemical engineering, and I'm confident in my understanding of how to engage with others)' (Figure 3).



**Figure 3: Student's self-reporting on the question "How would you assess your own understanding of biculturalism and how it relates to chemical and process engineering?" Following the first and final of the ENCH390 biculturalism workshops (2019 and 2020 data shown).**



When asked, “How confident are you in understanding the protocols surrounding engagement with mana whenua?”, most students responded ‘medium’ (70%, n = 64). A similar proportion of the class (70%, n = 65) reported ‘yes’ when responding to the question “Would you feel confident explaining to a peer why it is important to engage with local mana whenua when consulting on a project?”. While each of these questions were asked immediately following workshops specifically relating to tikanga Māori and a practicing engineer perspective, respectively, we interpret these responses as evidence that the guest speakers are conveying the intended learning objectives to students. This sentiment is reinforced in student feedback. Students commonly asked that future workshops include greater content on the specific engagement protocols (tikanga Māori) and case studies.

## Accreditation and benchmarking

Our accreditation process includes a combined visit and review process assessing our programme against the Washington Accord. The most recent accreditation review was undertaken in 2023 resulting in positive feedback on our bicultural inclusion. Engineering NZ commended the programme for “The increasing bicultural approach of the programme and engagement with Ngāi Tahu was positive”. While IChemE cited it as an example of good practice, stating “The mechanism for incorporation of bicultural and multicultural practices and learnings into the curriculum is worthy of sharing more broadly in the Chemical Engineering community”.

## Conclusion

In partnership, the Office of Treaty Partnership and the Department of Chemical and Processing Engineering have built bicultural content into a chemical engineering programme. By building meaningful relationships through whakawhanaungatanga and our shared values of manaakitanga and kaitiakitanga, we have co-designed content that is meaningful and relevant. The collaborative delivery of this content has included teaching from mātauranga Māori experts, academics and practicing engineers. The activities and lessons incorporated elements of ‘Learn from’ rather than ‘learn about’ adding authenticity to the learning experience for students. Acknowledging the development of this content is on-going, we will continue to work collaboratively to bring together te ao Māori and chemical engineering to enable students to become biculturally competent and confident and responsible tangata tiriti. Our advice to other groups looking to develop and deliver te ao Māori content into their programme is to embrace working in partnership with iwi (e.g. mana whenua, kaiārahi) towards a shared vision.

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