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## **Interweaving Multiple Knowledges to Support Children’s Participation and Engagement in Biosecurity and Forest Health: Toitū te Ngahere**

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**ABSTRACT.** The arts, mātauranga Māori, and the environmental and social sciences might seem like unusual bedfellows for engaging children in biosecurity. But this article proposes that these diverse knowledges interwoven together in project activities can play an important role in facilitating children’s engagement in biosecurity issues. We reflect on our collective learning in a schools-based arts project, Toitū te Ngahere: Sustainability of the Forest and the Arts, which involved a transdisciplinary team from the Creative Arts, Social and Environmental Sciences, Education and mātauranga Māori, with partners from participating schools and local artists. We examine the contribution that different knowledges offer to children’s learning about, and engagement in, forest health

management, focussing, in particular, on the plant diseases kauri dieback and myrtle rust. We illustrate our approach to interweaving knowledges by describing and reflecting on three project activities. We then examine the structural and relational barriers that both undermine and promote the interweaving of knowledges for fostering children's participation in ngahere (forest) health. We argue that to effectively engage children in forest health requires a strongly relational, place-based approach to research and engagement that fosters bottom-up collaborative processes based on care and values and interweaves diverse knowledges in creative ways. How effectively this can be achieved depends on wider dynamics, including societal tensions between colonial norms, mātauranga Māori (Māori knowledge frameworks) and Kaupapa Māori (Māori customary practices); the level of engagement a school has with te ao Māori (the Māori world); aspects of curricula; and notions of time and strategies in teaching children. Our reflections from the first year of this project show that interweaving multiple knowledges into project activities can enrich children's inquiry and lead to locally relevant action that is well suited to complex socio-environmental issues.

Keywords: arts; Aotearoa; biosecurity; children's participation; socio-environmental issues

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## Introduction

Kauri dieback and myrtle rust are having devastating effects throughout the ngahere (forest) in Aotearoa|New Zealand, causing ecological, cultural, social and economic impacts. Identified 20 years ago, Kauri dieback has been found in seven key kauri forests on Aotearoa's North Island. Kauri are ecosystem engineers, and kauri dieback poses risks to co-evolved dependent native species (Bradshaw et al., 2020). Myrtle rust arrived in Aotearoa in 2017. Its rapid spread has already devastated some tree species and threatens others (Toome-Heller et al., 2020). Community participation and engagement have been a significant part of responses to these threats (Lambert et al., 2018; Hill et al., 2021).

Biosecurity requires people of all ages to be part of pest and disease management. The government agencies responsible for managing Aotearoa's environment want to involve people in caring for the environment, and the Biosecurity Strategy 2025 aims for New Zealanders to be involved in biosecurity as a 'team of 4.7 million' (Ministry for Primary Industries, 2016). But children are not typically included in biosecurity conversations and do not have consistent access to knowledge about ngahere ora (forest health) (Ram et al., 2016). To address this gap in biosecurity management, we created Toitū te Ngahere (TTN), a project exploring how mātauranga Māori (Māori knowledge), the arts and the

social and environmental sciences in schools might support children's, teachers' and their community's awareness of, and responses to, kauri dieback and myrtle rust. We are interested in the ways a shared creative inquiry might inform/express children's sense of their relationship to the ngahere and contribute to action addressing challenges posed by the two plant diseases.

TTN created a transdisciplinary partnership to address the challenging socio-environmental issues of kauri dieback and myrtle rust by intentionally including different knowledge systems, methodologies and values. The project involves researchers in Creative Arts, Social Science, Science, Education and mātauranga Māori, with partners outside academia who bring specialist knowledge in related areas. Crucially, TTN is a partnership with schools, valuing their local knowledge. The project's pedagogical and community engagement approaches are informed by our understanding of both Pākehā (New Zealanders of European descent) and Māori theories and frameworks.

In the first year of TTN, we partnered with two primary schools in Tāmāki Makaurau Auckland. We worked with three year 5 classes (aged 9–10) at one school and five mixed year 5–6 classes (aged 9–11) at the second. Both schools have forest on and around their land, where they have established conservation activities. This was not a criterion for taking part in TTN but was a significant influence on the development of the inquiry at each school. We worked with these schools for one year (four ten-week terms). In term 1, the research team co-planned an enquiry process with each school to last approximately two terms, 20 weeks. An overarching goal of TTN is for students to create artworks to be shared publicly to raise awareness of forest health in a locally relevant way. With this goal in mind, students and teachers defined inquiry questions, or problem statements, related to the research focus but also to their context and curriculum. The inquiry proceeded through terms 2 and 3, involving a mix of school-based activities led by the class teachers, students or visiting experts, as well as trips and visits. Weekly programming was managed by a lead teacher in each school and a project coordinator from the project team, but a core group of teachers and students planned and reflected on each phase of the process, along with the research team.

In this article, we reflect on our experience creating this transdisciplinary project that interwove multiple knowledges to empower tamariki (children) around the plant diseases kauri dieback and myrtle rust. We draw together the different perspectives of the authors after the first 18 months of TTN. Part One considers the rationale for interweaving multiple knowledges to support children's environmental engagement. We explore this within the context of complex socio-environmental issues and the team's commitment to culturally responsive methodologies. In Part Two, we consider the main knowledges that were interwoven into TTN activities – mātauranga Māori, the arts, and the social and environmental sciences, and discuss the ways they can support and inform children's environmental engagement. Part Three describes three activities that illustrate our efforts to interweave knowledges in a transdisciplinary way. The

reflection and discussion that follows draw out key learnings and challenges from these activities and the first year of TTN.

### **Part 1: Interweaving Multiple Knowledges to Support Children's Environmental Engagement**

TTN seeks to include multiple knowledges to support tamariki's involvement with forest health. These knowledges include mātauranga Māori, western science, particularly the biological, ecological and social sciences, the arts and local knowledge brought to the project by the school communities.

There is wide agreement that socio-environmental issues are most appropriately addressed through transdisciplinary collaboration, as well as place-based and problem-based learning (Brundiers et al., 2021; Evans, 2015; Somerville & Green, 2015). Such approaches can stimulate deep learning through students' active inquiry with teachers as active facilitators, not simply knowledge transmitters or translators (Budwig & Alexander, 2021; Darbellay, 2015). Scholars argue that if we are to respond to the ecological crises faced by the planet, we urgently need forms of education that are 'less human-centred, hierarchical, or controlling' (Morse et al., 2021, p. 263; Priyadharshini, 2021). Kates et al. (2001) specifically argue that addressing the complex issue of forest health requires input from multiple disciplines. Yet, educational research shows, from primary through to tertiary level, more needs to be done to create exploratory, open-ended processes in education that allow for movement across knowledge systems (Eames et al., 2008; Evans, 2015; Matthewman & Morgan, 2013). TTN aims for students to access different ways of knowing and doing through rich experiences to develop the transdisciplinary skills and competencies needed to address the complex issue of ngahere ora.

Culturally responsive methodologies underpin TTN's values, and so the team intentionally seeks to *interweave* and not *integrate* different knowledges within activities. The interweaving of knowledges, particularly western science and mātauranga Māori, must work in ethical ways to also reflect the project's commitment to Te Tiriti o Waitangi (The Treaty of Waitangi), the founding document of Aotearoa|New Zealand, signed by the Crown and many Māori iwi (tribes) in 1840, which contains guiding principles for their ongoing relationship and legislation and public policies (Orange, 1987). Integration approaches can unintentionally blend knowledges or result in the dominance of one knowledge. In Aotearoa, Māori knowledge is well known to historically have been marginalised. We suggest interweaving knowledges is consistent with the principles of Te Tiriti o Waitangi as a process that brings differing viewpoints into a relationship that enables each one to remain apparent.

Some TTN activities have been led by disciplinary experts, including science workshops and a mātauranga Māori wānanga with teachers. But we have aimed for most activities to interweave multiple knowledges and methodologies. From a learning perspective, our aim was to provide opportunities for children to draw

from different ways of knowing and doing in their inquiry (Somerville & Green, 2015). Below, we explore our rationale for focusing primarily on mātauranga Māori, the arts and the sciences to support children's environmental engagement.

### ***Interweaving mātauranga Māori to support children's environmental engagement***

The interweaving of tukanga (approaches) based in mātauranga Māori is seen as necessary to both build forest ecology awareness and support equitable participation for students. As TTN involves working with taonga (treasures) from the ngahere, the project places particular importance on including mātauranga Māori in many of the learning activities. Mātauranga Māori is grounded in the principle that all things are related, which includes whakapapa (genealogy), which structures and connects all things (Hikuroa, 2017; Mahuika, 2019).

This principle calls for an approach to ngahere ora that is very different to the paradigm of western conservation (Lambert et al., 2018). Lambert et al. (2018) propose mātauranga Māori 'has an increasingly important role to play in environmental management' and biosecurity (p. 110). Further, the involvement of Māori knowledge and practices 'can enhance and inform the long-term protection of kauri ecosystems and *Myrtaceae* across the country' (Lambert et al., 2018, p. 129; see Hill et al., 2021).

Educational research indicates that strengths-based, culturally sustaining practices and quality relationships can be effective in addressing disparities between students (Highfield & Webber, 2021), for instance, in response to the ongoing disparities between Māori and Pākehā within education that privilege the latter (Bishop, 2003; Durie, 2011; Statistics NZ, 2022). TTN aims to use practices that enhance the mana of Māori and other students. Mana is usually defined as prestige, power, authority, spiritual power, charisma, status and influence, interconnected with health and wellbeing, belonging and identity, in community and solidarity with others (Bishop, 2003; G. H. Smith, 2005; Rameka, 2021). In te ao Māori, children, in one sense, inherit mana from their ancestors, and educators can engage in specific practices to enhance children's mana, including making connections with mātauranga Māori, te reo Māori (the Māori language) and te taiao (the environment) (Rameka et al., 2022). As such, TTN has attempted to make space for mātauranga Māori in the activities we have collectively generated. Mana-enhancing practices in TTN also include establishing a sense of whanaungatanga within the team and with teachers and students (Rata & Al-Asaad, 2019; L. T. Smith, 2021), nurturing relationships, collaborating and consensus building. For TTN, this applies to our internal planning processes as well as co-designing arts projects with tamariki and their teachers.

We also aim to work with ako (reciprocal teaching; Bishop, 2003), encouraging all involved in TTN to learn with and from each other. Ako is a commonly valued student-centred teaching approach within Māori education, which also involves whānau (families) (Morrison & Vaiolletti, 2019). It can be mana-enhancing, as it addresses the recommendation that Māori students want to be listened to in their

education (Kia Eke Panaku, 2016). Kia Eke Panaku note how the Māori concept of ako aligns with a student-led, collaborative and sociocultural approach to education more than individualist, hierarchical approaches. We emphasise here that, for TTN, ako is a goal but is perhaps not fully possible in mainstream school contexts, where amongst other things, whānau is usually not included in classroom learning. Accordingly, we have also drawn on Vygotskiĭ's (1978; see Castagno-Dysart et al., 2019) notion of scaffolding as part of our aim towards ako. For instance, some teachers and students may be ready to learn aspects of mātauranga Māori that are specific to iwi/hapū (tribes/sub-tribes) in accordance with Māori tikanga (protocols) from knowledge holders. Others may require support to become comfortable with more general mātauranga Māori first.

Interweaving mātauranga Māori in TTN has involved numerous experts, Māori artists and kaiako (teachers), mana whenua (people of the tribe/iwi that holds jurisdiction over the whenua (land), Māori kaitohutohu (advisors) and a Māori project co-lead. It has involved sharing pūrākau (Māori stories, including origin stories), karakia (prayer), kaitiakitanga (guardianship) and manaakitanga (hospitality, care). Mātauranga Māori has helped us understand our tukanga (process) as interlinked in a kind of ecological sense with each area of knowledge we work with, arts, western science, and, of course, Māori knowledge being informed by and informing one another in facilitating tamariki and adults caring for forests.

Much Māori education research notes the kind of approach we are attempting to incorporate and introduce can lead to deeper learning and engagement for all students and teachers involved (Bishop, 2003; Kia Eke Panaku, 2016; Rata & Al-Asaad, 2019). As recommended by Māori educators, we also aim to include a critical multiculturalism,

to recognise and incorporate the differing cultural knowledges that children bring with them to school, *while at the same time* address and contest the differential cultural capital attributed to them as a result of wider hegemonic power relations. (May 1999, p. 32; emphasis in original cited in Bishop, 2003, p.224).

This is an approach that, on the one hand, attempts to embrace the many cultures that teachers and students bring, while, on the other hand, attempting to address the power imbalance for Māori in public education contexts by drawing on relevant expertise to scaffold them through Māori tukanga that provides space for this. In the words of Rameka & Paul-Burke (2015), this can be called an attempt to *reclaim space* for Māori and (our) traditional ways, while, as Bishop (2003) and many Māori researchers and leaders claim, looking to the future as inclusive of all. Alongside this, we are also navigating the challenge of applying the concept of kaitiakitanga. Kaitiakitanga often refers to guardianship, stewardship, trusteeship of someone, people or entities. TTN aims to apply the fuller meanings of kaitiakitanga without encroaching on the tikanga and mana of mana whenua, while

referring to specific contexts to do with forests, and we aim to explore this in further research.<sup>1</sup>

### ***Interweaving the arts to support children's environmental engagement***

The arts can be used in education to communicate information about the environment or promote pro-environmental behaviours, but TTN focuses on art-making as a process of creative inquiry (Hunter et al., 2018), through which students can explore and express complex aspects of ecology and take action. This is based on findings from prior projects using the arts within sustainability/ecological/environmental education. In Tasmania, for example, Hunter and colleagues (2018) found that arts education focused on sustainability could involve students in deep, student-centred, generative inquiry processes in which students connected with multiple other ways of knowing. They propose an arts-based approach to sustainability education 'enables students and teachers to experience complex and non-rational understandings' of themselves as part of (not as the centre of) a more than human world (Hunter et al., p. 29). In such ecologically-focused arts education projects, the sensory, affective and embodied processes of artmaking helped students attend to, explore and articulate intangible ideas about the environment and their relationship to it.

The arts can enable safe, engaging and inclusive ways for young people to participate in institutions and the wider public realm (Breed et al., 2022; Blaisdell et al., 2019; Hickey-Moody, 2016). Through the arts, children can work with adults in less hierarchical ways, explore and express complex ideas and connect personal experience to wider social factors (Blaisdell et al., 2019; Conrad, 2004). Artmaking can engender creative and social agency as young people embody processes of reflection and action (Alrutz, 2013; Dewhurst, 2011) and can be seen as meaningful civic participation (Hickey-Moody, 2016). The potential of the arts to support young people's participation is, however, not a given. Their participation through the arts can be co-opted and coerced. Blaisdell et al. (2019) argue that art-based processes only shift power relationships between adults and children when adults see children/young people as already competent and knowledgeable.

In Aotearoa, there is a longstanding belief that arts education can bring together Māori and Pākehā knowledge systems and creative practices to foster students' sense of interconnection with plants, animals and ecosystems. For example, in the mid-20th century, a progressive arts education project supported teachers and students across Aotearoa to integrate the arts with the study of nature, local history and pūrākau (stories). The project was part of a bi-cultural vision of Māori and Pākehā students learning their own and each other's cultural practices, knowledge and histories. The project has been critiqued for not serving Māori and Pākehā equitably but is also recognised as a ground-breaking attempt to enhance the mana of Māori students and artists, challenging some Eurocentric norms of mainstream education (Diamond, 2011, p. 2). A more recent research partnership in secondary schools found that culturally responsive, bi-cultural arts education contributed to

students' sense of environmental identity and connection to specific places and the broader Pacific region (Mullen & Johansson, 2017; Mullen et al., 2017).

### ***Interweaving the social sciences and environmental sciences to support children's engagement***

There is a call for New Zealand's education system to embed biosecurity in the school curricula to foster a more informed and engaged citizenry (Ram et al., 2016; Ram, 2020). However, we propose that a simple focus on transferring knowledge to develop scientific understanding will not achieve the attitudes and behaviours sought by New Zealand's Ministry for Primary Industries, which is responsible for biosecurity management. Indeed, like Shove's (2010), our work seeks to challenge the dominant paradigm of environmental policy, which focuses on the ABC approach (attitude, behaviour, choice). This approach assumes that shaping attitudes will create behaviours that lead to positive environmental choices. Because of the complexity of many environmental issues, TTN recognises the need for environmental education to be informed by diverse social and cultural theories (Shove, 2010).

Geographers influenced by the writings of eco-feminist Donna Haraway (2008, 2016) call for the inclusion of interspecies respect and understanding of interconnectedness and relationality in environmental education (Willing, 2022). Arguably, this will enable environmental education to move away from 'western tools of individualism, competition relations, restoration, the nature-culture divide and human exceptionalism,' which dominates the western philosophies, political economics and biosecurity/biodiversity narratives children are taught (Willing, 2022, p. 3). Rather than positioning humans as 'masters over nature' and 'sole agents of change' (p. 3), both positive and negative, environmental education should engage with Indigenous ways of knowing that are in touch with the lived past and present (Willing, 2022).

To develop deeper human-nature relations and cultural understandings, children need to engage in active learning (Otto & Pensini, 2017). Active environmental learning is underpinned by participatory approaches, which encourage the co-production of knowledge among a range of knowledge holders, including children, to identify common goals or problems with the aim of locally-determined action or change (Baars, 2011; Reed, 2008). Participants assign meaning to their environment that is relevant to them through an iterative and ongoing process of learning refined by experiences they encounter on the way (Keen et al., 2005). Through shared interactive learning, where multiple knowledges/knowledge systems are interwoven into the learning, participants are able to construct understandings that may trigger transformations in their perceptions and assumptions (Allan et al., 2013; Blackmore, 2007).

Experiential learning in environmental education has been shown to encourage pro-environmental behaviours (Norton et al., 2017), foster deeper connections to nature (Talebpour et al., 2020) and promote environmental agency (Freire et al.,

2022; Otto & Pensini, 2017). Lyver et al. (2017) claimed that the positive benefits of this type of learning go well beyond environmental outcomes to also enhance participants' sense of spiritual, emotional and physical wellbeing, especially for Māori communities.

Despite the clear benefits of active learning, the TTN team recognises the pitfalls of adhering to a 'dogma of participation' (Ziegler and Ott, 2010), which can be seen to naively measure success by the number of participants engaged or views higher levels of participation as some form of utopia (Arnstein, 1967; Hart, 1992; Treseder, 1997). Without critical engagement, child and youth participation can become just another way to discipline or control young people. TTN attempts to apply Farthing's (2012, pp. 91–92) call for researchers who engage in participatory approaches to expose their normative judgments by unpacking 'the implicit assumptions about the merits of participation.' Such assumptions can 'responsibilise' children by blaming them for any failure to engage, or viewing them as simply consumers of services or fully empowered individuals, overlooking existing power dynamics (Harris, 2006). To avoid this, the TTN team reflects on 'why we 'do' participation' (Farthing, 2012, pp. 91–92), critically exploring challenges and power dynamics that influence engagement (Cooke & Kothari, 2002; Graham et al., 2006) and examining how these might be mitigated where possible. Such reflections informed the development of TTN's transdisciplinary approach to co-developing school activities, three of which are described in the next section.

## **Part 2: Interweaving in Practice in Toitū te Ngahere**

We have selected three examples of activities from the first year of TTN, which exemplify some possibilities and challenges we experienced when interweaving multiple knowledges to support children's participation and engagement in biosecurity and forest health in relation to kaitiakitanga.

### ***Activity 1***

For our first in-person visit with the students, they were invited to create a collective map of their school and take us on a walk, introducing us to things they saw as important in the school environment. This activity aimed to cultivate whanaungatanga, for us to meet the students and learn about their place, what the environment meant to them and their existing knowledge of forest health. We hoped the task would allow for ako and encourage a fluid sharing of experience and knowledge. The activity was deliberately open to interpretation. There was no pre-set learning objective, students were invited to lead, and the body and sensory experience were recognised as central to learning.

**Figure 1**  
*Children creating a map*



*Note.* Photograph of children drawing a map of their school environment. Copyright 2022 by TTN.

**Figure 2**  
*Children leading a walk*



*Note.* Photograph of children leading a walk around their school grounds. Copyright 2022 by TTN.

An outline of this activity was emailed to the lead teachers at each school. We then discussed how it would work with the number of classes/students and class/break timings. At both schools, the activity was run over about 90 minutes, within class groups, with 1–2 members of the research team assigned to each class. In most classes, the mapping activity was facilitated by the research team, with support from the teacher. Following a brief introduction and sharing of names, a large piece of paper was unrolled, and the class were given the task of drawing the school environment. Often the research team asked the children how to organise this activity, e.g., would everyone just draw at once, or would people take turns? Rich conversations developed from disagreements about where things belonged, how big things should be and what to do if six people had drawn the same thing. In a few classes, the children did not draw any classrooms, and, in some of these, the teachers stepped in to point this out. We also discussed what it might mean if more than one person drew the same or if something was much bigger or smaller than in reality. Some children came to see the map less as a factually correct document and more as a way of communicating their experiences, feelings and knowledge about the school environment.

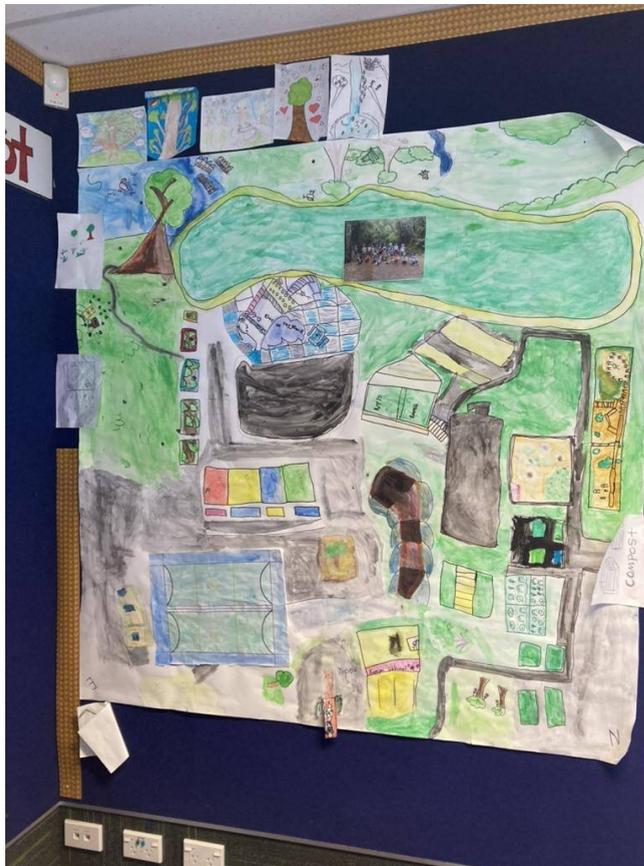
Once the maps were sketched, we moved outside to begin the walk. The researchers invited the children to pay attention to how they experienced the environment through all their senses, including a ‘sixth sense’: what you feel or imagine. Some teachers organised their class into groups and assigned each one a sense to focus on or assigned each person in the group one sense. In other classes, the researchers, teachers and students more spontaneously suggested a pause to focus on one sense all together during the walk.

Some classes had discussed the walk ahead of time. Supported by the teacher, these children had decided the route and prepared short explanations for key points. In other classes, the walk was entirely unplanned. Sometimes the teacher had an initial idea of a route, but, in all instances, the children eventually took the lead by suggesting where to go next or by walking (or running) in a particular direction, followed by the adults. As we walked, we talked informally to the children and teacher about the school environment. What did they do in certain places? What did they know and feel about the plants, trees, birds, bugs they spotted along the way? Tuning into the senses allowed for a different noticing and non-human-centred perspectives. For example, one of the children suggested the trees might think we are noisy as we stomp along the forest paths. The walks included places of clear significance: a very prominent tree, a waterfall, the school pou (a carved post representing significant ancestors). We were also taken to a plant bed where a school chicken had been buried, compost heaps, a favourite climbing tree and an overgrown garden made as a habitat for reptiles. In one class, the teacher seemed happy for the children to go out of sight into the bush and along a stream, explaining that they frequently played or collected rubbish there. This group only moved on from that favourite spot because another class arrived.

Back in the classroom, the students worked with the research team and/or the teacher to further develop their map. We brought a range of pencils and pens, and some classes experimented with visually representing things they had heard, smelt or touched along the way. Some classes added short pieces of descriptive or poetic writing, and others added rubbings they had done while walking. Many sessions ended with the children listing questions they now had about the forest or forest health. The maps themselves remained with the classes for them to use as they chose across the coming weeks. Some were extensively worked on as part of their engagement with the project; others were never revisited. This could indicate that some teachers saw value in this task and the sense of emergent learning we attempted to facilitate, while others did not.

**Figure 3**

*A map on a classroom wall*



*Note.* Photograph of a map of the school environment that the children created, hung on their classroom wall. Copyright 2022 by TTN.

## **Activity 2**

The value of interweaving different knowledges is illustrated in this activity, during which children created prints for a large wall display for an art gallery exhibition (see Figure 4).

### **Figure 4**

*Displays at Te Uru Waitakere Contemporary Art Gallery*



*Note.* Photograph of the children's displays in Te Uru Waitakere Contemporary Gallery. The prints are on the back wall. Copyright 2022 by TTN.

This activity consisted of three sessions led by Māori artist Charlotte Graham (Ngāti Mahuta, Ngāi Tai ki Tāmaki, Ngāti Whanaunga, Ngāti Pāoa, Ngāti Tamaoho, Scotland). She began each session with a whakawhanaungatanga process (or, in one sense, relationship building and working through things with others), which enabled children and teachers to learn about each other and develop a rapport before commencing the activity. In the first session, the children collected leaves from the school grounds to use in their prints. Charlotte performed a karakia (a ritual prayer) in Māori as part of tikanga for gathering these materials and led the children through a slowing and noticing breathing exercise. In the next session, pūrākau (storytelling) emerged. As the children chose a plate to print from a selection previously designed by the artist, Charlotte shared stories and personal reflections of the flora and fauna depicted on each plate. The children were then carefully taught how to create an ink print. The activity was initially framed through a te ao Māori lens and then communicated and experienced through the art practice of printmaking (see Figure 5).

**Figure 5**  
*Children printmaking*



*Note.* Photograph of the children making prints of Charlotte’s carvings. Copyright 2022 by TTN.

The children were then asked to write a small caption on their prints to reflect their connection with the forest. Initial captions were quite generic: ‘Save the forest,’ ‘Save the Trees,’ ‘Save the Ngahere.’ To foster a deeper engagement with this task, the team’s social scientist encouraged the children to draw on their previous science, storytelling and mātauranga Māori learning, as well as their memory of Activity 1 (above). Children were invited to think of the forest through different ‘voices /actors’ within the forest ecosystem – both human and non-human – e.g., forest visitors, the manu (birds), the trees, the soil, mana whenua. The children could explore how the actors might connect to, experience and value the forest. How might a tree feel? How might a forest visitor act or think? What does the disease want to do? How might mana whenua feel about kauri dieback in their forest? In this way, the activity drew on the children’s learning from Activity 1 (above), where they had experienced the forest through their senses: hearing, seeing, smelling and touching. In addition, the activity drew from earlier science workshops where scientists had talked with the children about the diseases of kauri dieback and myrtle rust, and the children had then undertaken further independent research through exploring educational sources on the internet to develop their own informational and creative websites. After this process, the children’s captions displayed a deeper connection with the forest ecosystem: ‘I am alive’; ‘Help me!’; ‘My roots feel.’ And of the impacts of kauri dieback: ‘Our ngahere is dying.’ And advice to forest users: ‘Do not litter on Papatūānuku’ (Mother Earth); ‘Stay on the path; ‘Use the cleaning stations.’ See Figures 6 and 7 below.



### *Activity 3*

Activities were co-designed to meet the needs and interests of each school. At one school, our first planning meeting revealed the teachers' desire to understand why their local forest park had been closed since 2018. Although signs indicated the closure occurred to protect the kauri forest from kauri dieback, the teachers were unaware if kauri dieback was present in the park, or if it had instead been closed to prevent the spread of dieback and preserve a healthy forest. While the park closure had occurred under the guidance of Te Kawerau a Maki as mana whenua and was supported by the local board and the community, the length of time since the closure raised unanswered questions for the teachers about the Council's long-term management strategy for the park, including whether the closure would be permanent. The park held significance for the school as it provided a much-loved nature walk through rare kauri forest, and the school also carried the park's name, so it was central to their identity.

TTN agreed to develop a relationship between the school and the Council, which was responsible for the park's administration. The aim was to support the school on its learning journey to understand the biosecurity management approach being taken to protect kauri in the park. Furthermore, the team agreed to investigate opportunities for the school to work with Council to support its dieback management efforts in the park.

This emergent activity built on the other initiatives in the TTN programme as well as the school's curricula activities and learning of te reo Māori and mātauranga Māori to enable a progressive journey throughout the year. This interwoven programme of learning would culminate in a collaborative 'stakeholder' workshop with Council. As a result, the activity was deeply embedded in the transdisciplinary approach of the TTN programme, interwoven through scaffolded learning over several weeks with the knowledge and understanding of multiple actors both from within the school and brought into school by the TTN team. Scientists enriched the children's and teachers' understanding of ecology, forest health, myrtle rust and kauri dieback. The teachers pro-actively extended the children's understanding by supporting them to research and create websites about forest health and developed a school performance centred around Mātariki (the Māori New Year), which told stories about protecting te taiao (the environment). The learning recovery teacher created a writing activity where the children wrote letters to Council. Visiting artists enriched the children's understanding of the ngahere through specialist dance, printmaking (activity 2) and drama/scriptwriting. A mātauranga Māori specialist told stories to extend the children's cultural perspective and understanding of the ngahere, while the TTN team in Activity 1 (above) provided a sensory experience of the forest. During one TTN team visit, a teacher took the children on a spontaneous stroll to the gates of the closed park, where they engaged in a conversation with a teacher and a TTN team member about the park.

## Figure 8

### *Locked gates at the local park*



*Note.* Photograph showing the school’s local park, which contains stands of kauri closed to the public to prevent the spread of kauri dieback. The pink council signs say ‘track closed’ while the locked gates prevent public access. Copyright 2022 by TTN.

The learning from all these activities underpinned the letters the children wrote to Council, where they asked questions about the park, its biosecurity status and plans for its long-term management (see activity box in Figure 9 below for questions).

## Figure 9

### *Activity box*

Activity Box: Children’s Questions for Council

**Focus Area 1: The reason and process for the park’s closure**

Why was the park closed? Was it because there is dieback in the park already, or to protect the park from people bringing dieback in?

When was it closed?

Who was involved in making the decision? What was the process?

**Focus Area 2: About the park itself**

When was it created as a park? How?

What is the story/history of the park?

Are there other forest diseases in there? Does it have myrtle rust?

**Focus Area 3: About the future of the park**

What would it take to re-open the park? Does the Council have plans? What are they?

Could Council build wash-stations at the entrances?

Could Council have a fence along the path to stop people stepping off?

Could there be more signage at the entrance about kauri dieback disease, what it is, how it spreads, with pictures?

Could someone fly a drone through the park to film it and enable people to go there without actually going there?

Could we grow new kauri from seeds from within the park?

Is there a way the School could help to re-open the park?

*Note.* Activity box used for children’s enquiry into park closure with Auckland Council. Copyright 2022 by TTN.

The questions indicate the children’s engagement with the supporting activities, which stimulated and developed foundational understanding, particularly in relation to the sciences and arts. Many of the questions in Focus Area 3 display the children’s problem-solving and creative thinking skills. The letters containing these questions were sent to Council so they could respond. Several letters were then read out aloud by each author at a collaborative workshop and verbally responded to by two Council people who were present.

The workshop allowed for whakawhanaungatanga and an exchange of knowledge between the children, teachers and Council staff. It helped the school to understand why the local forest park had been closed and needed to stay closed. The activity perhaps rekindled the children’s and teachers’ relationship with the park by enabling them to stay connected with this important part of their community and their identity while concurrently developing an understanding of scientific and cultural perspectives. The workshop has resulted in an ongoing initiative with Council to enable the children to contribute to the park’s management, most likely through the development of educational artworks for the park gates.

**Figure 10**

*Collaborative workshop with Council*



*Note.* Photograph showing the collaborative workshop between the school and Auckland Council about managing the closure of the local park. Copyright 2022 by TTN.

### **Part 3: Reflections and Key Insights**

Over the first year of TTN, our process for interweaving knowledges has been experimental and emergent. All activities described above show how active transdisciplinary learning provides opportunities for deep learning and not simply the transfer and acquisition of information to build an engaged and compliant citizenry (Budwig & Alexander, 2021; Darbellay, 2015). In this section, we reflect on key learnings and challenges from this first year.

#### ***Relationships are central to interweaving multiple knowledges***

We have come to realise that bringing together different knowledges and knowledge systems requires careful attention to the quality of relationships in the project as a whole and within specific activities. Relationships are central to all TTN's work, with our school partners, with specialist collaborators/visitors and within the TTN team. TTN's focus on relationships is informed by the te ao Māori principle of whanaungatanga, which, when fostered, recognises and enhances the mana (as defined above) of people. We have aimed for all activities to foster whanaungatanga, to facilitate respectful and attentive relationships between participants. Whanaungatanga has been critical for relationship building within the TTN team, which includes experts from different disciplinary and practice backgrounds. Trans-disciplinary teams like TTN seek to break down the silos in which they typically operate. As other researchers have found, this can be difficult in fragmented university environments (Evans, 2015). We found that cultivating relationships for transdisciplinary working required the deliberate commitment of time and effort from all team members, and our partners and collaborators, to understand the cultural practices and methodologies of other disciplines/knowledges.

Sustaining whanaunga-like (family-like), trusting collaborative relationships between all involved in TTN was foundational in allowing researchers, teachers and students to be creative and experimental and to explore less-instrumental approaches to environmental knowledge and action (Morse et al., 2021, p. 263; Priyadharshini, 2021). The early mapping activity required all involved to accept a level of uncertainty about what would happen and what the outcomes would be. Because the task disrupted usual expectations about who would lead and how knowledge would be imparted, a space was created in which people could take some risks in sharing what they knew, felt, thought, believed or imagined, and represent their knowledge in different ways. The effectiveness of the printmaking activity was contingent on the mutual trust and understanding of those involved. Because the social science expert understood how mātauranga Māori was being shared, and the artist's process and aims, she was able to suggest an activity that extended the task in an appropriate, generative way. Our hunch is that where respectful, trustful relationships and mutual understanding can be cultivated, teachers, students, research team members and any visiting experts become more

confident in making creative connections between different knowledges and experiences.

While our relationships with schools were guided by principles of whanaungatanga, including collaboration and consensus forming, we recognise that these were ideals. Even with time and efforts put into relationship building, achieving mutual understanding either within or beyond the research team could still be difficult and sometimes tangible tools, like shared planning templates, were needed.

### ***Co-developed planning of activities is essential***

Our experience has shown that to be of value, interweaving multiple knowledges into curricula activities needs to be a purposeful activity and requires careful, collaborative planning conversations with school partners, collaborators and the project team. Initial discussions with teachers, principals and students helped us understand each school's specific needs and desires (related to the project), the philosophy and pragmatics of their curriculum, and how these might affect the way mātauranga Māori, the arts and science could be interwoven to be generative for students, teachers and the wider school community. As noted above, learning in schools is typically organised around discrete subjects or learning areas, although more so in some schools/contexts than others. At each school, we found that bringing together multiple knowledges seemed most meaningful when connected to an extra-curricular purpose, e.g., contributing to a whole school event, or a problem impacting the school and community, e.g., the park closure. But we also worked with teachers to look at connections with curriculum planning. At one school, the teachers saw an immediate alignment between TTN's transdisciplinary aims and their established inquiry learning curriculum, within which teachers and students were used to drawing on different bodies of knowledge to explore an overarching topic. In this instance, teachers established goals for the inquiry unit that aligned with the goals of TTN, e.g., the creation of public artworks about forest health. We were then able to discuss what mātauranga-, arts- and science-based activities would help support and deepen the inquiry.

We acknowledge that while collaborative planning conversations helped reveal and align expectations, there were still times when project and school purposes or expectations diverged. It seems that not all teachers saw the mapping task as something with ongoing relevance, for example. Also, the printmaking activity took place only with a selected group of students from each of the project classes at one school. The intention was for these students to share the process back to their classes. This second step did not happen, and we realise it needed more planning and support to overcome the various constraints on the ground.

Co-developing collaborative transdisciplinary learning activities we propose provides the opportunity to discuss and negotiate concepts and explore how seemingly incompatible knowledges might work together. Such co-development happened through team members attending regular planning and reflection

meetings. But, to deeply embed learning from these collaborations into team culture and practices, we eventually found it helpful to create a planning template through which we could make the contribution and intentions of mātauranga, arts and science explicit for everyone. Nonetheless, even when there is detailed planning, TTN has shown that working in the challenging environment of emergent practice and child participation, practitioners/researchers must still be responsive to situations as they arise and, if necessary, adapt their approach to encourage deeper learning, as Activity 2 above shows.

***Schools are differentially ready for interweaving mātauranga Māori with art and science in ecologically based arts education***

Our first year has taught us that the possibility of meaningfully interweaving mātauranga Māori in ecological based arts education and kaitiakitanga is contingent on a degree of e oho (awakening), that is the degree to which the school/research team member/teacher/student has ‘awoken’ to accepting and supporting a reclaiming of space for te ao Māori, in addition to a sense of sensitivity for the ecological and arts-related emergent and collaborative tukanga we are endeavouring to implement. This idea of e oho has been useful for us to understand the very different team member, school, teacher and student expectations about the teaching and learning of mātauranga Māori, arts and science, and what they expect of visiting experts in these fields.

We found the mapping exercise (Activity 1 above), where the children collaborated with us to construct and represent ‘their world’ through their creative responses, helped us understand or sense participants’ openness to processes of ako, to te ao Māori and to intersecting ecological perspectives. In other activities, such as the printmaking workshop (Activity 2 above), there were differing levels of awareness amongst all involved of how the artist and the TTN members who were present were interconnecting mātauranga Māori, ecological and social science and forest (non-human) perspectives through the art process. Understanding how the same activity could be received/responded to very differently by those involved helped inform our structuring of TTN as we tried to align future activities with existing knowledge but also degrees of oho.

Another example of this sense of e oho can be seen in Activity Three (above). We propose that the collaborative session with Council was valuable and productive because it was part of a learning journey, where the many workshops and activities we held with the school were interwoven into the learning, including the many scaffolding moments through the arts, science and mātauranga Māori. Given the strong attachment the school had to the park and the sense that communication from Council had been limited, there was a real risk of resentment towards Auckland Council over not having access to this local park. However, what the students and teachers instead displayed was empathy towards the Council staff and their information, culminating with them brainstorming over how they could support the Council to educate other members of the community about the

forest closure. For the Council staff, this was a rare opportunity for them to actively engage in exchange with a school and gain mutual understanding.

***Schools require safe spaces where they can build confidence in mātauranga Māori and kaupapa Māori learning***

For schools to be able to engage in the student-centred approach of ako, we have so far found it to be helpful that they are open to learn and engage in mātauranga Māori and kaupapa Māori (Māori approaches). Other scholars have found this sense of openness can be eroded by the adherence to colonial narratives of individualism, siloed disciplinarity and consumer-service-instrumentalism fuelling a sense of productivity ‘for the sake of itself’ within the curriculum in many public schools (Bishop, 2003; Kidman et al., 2011; G. H. Smith, 2005). Developing such openness, in turn, we propose, requires schools to foster safe spaces. For instance, knowing their own whakapapa and accompanying politics, and how these things operate in relation to that of others, especially Māori and those from different cultures other than Pākehā - and with this comes involvement of whānau (family). In addition to this, developing a sense of listening to their students and colleagues and a willingness and openness to take on board their ideas and needs through processes of wānanga (discussions) and to embrace and support reciprocity through it all, while learning how to guide others through such methods. Along with this can be a sense of trusting their own tukanga that they guide their students and colleagues through. Perhaps a metaphor is the spindly oioi rush-plant that blows with the winds of change (listens, adapts) while staying in the ground to absorb nutrients (develops confidence and trust with their tukanga, kaupapa Māori, whakapapa and so forth). Without e oho in this, we have observed in our experience that it can be unsafe to bring in guest Māori kaiako (teachers) adept in kaupapa Māori, and that the depth of learning and the potential for understanding ako and mātauranga Māori is lost – resulting in what many te ao Māori experts would consider to be token and surface-level engagements in related topics. For example, we noticed how one school drew on their previous learnings in Māori knowledge and te reo Māori to engage with the local council over kauri dieback-related closures in ways that showed sensitivity towards mana whenua. Also, we were able to introduce in-depth mātauranga Māori around soil with one school because they had spent several years prior developing their knowledge in te ao Māori.

***Activities require a careful balance between ‘freedom’ and control***

How much do we intervene to interweave knowledges? When does intervention become imposition or control? These questions emerged after reflecting on all our activities, including those above. There were moments when we found ourselves as facilitators trying to bring things back under ‘control.’ For example, in Activity 1, some of our team felt compelled to try and create order, to make coherent sense of what was being expressed on the maps or the walk for the teachers and students. As

visitors, we were sensitive to our developing relationships with the teachers and students and to what they might expect of us as ‘experts’ and from an outside educational programme, and we wanted to show we were in control of the learning. Also, each teacher interpreted the mapping task slightly differently, and it seemed, initially, some were trying to reassert control by ordering it into a pre-planned route. What eventuated, however, was the structure asserted by the teacher who supported the children to have a high sense of ownership and agency in leading the walk and sharing their local knowledge.

In reflecting on Activity 2, a team member’s intervention was used to encourage a more diverse and rich range of captions on the children’s screen prints. It did not seek to direct the children on what to write, but rather facilitated an exploration of their own foundational learning by prompting the children to remember and then to reconnect to their own experiences at the beginning of the programme when they walked through the forest (activity 1), and when they undertook their own research about the ngahere and forest diseases. The intervention, therefore, was felt to be justified as it sought to reconnect the children with their prior learning.

### **Final Thoughts**

TTN’s transdisciplinary approach to engaging children with biosecurity issues in schools involves interweaving multiple knowledges into activities, which, over time, contribute to rich inquiry and locally relevant action. This approach, we argue, is suited to complex socio-environmental issues and consistent with culturally responsive methodologies. TTN specifically interweaves mātauranga Māori, the arts and environmental and social sciences, each of which has the potential to make a distinct contribution to children’s ecological knowledge and participation/engagement with environmental issues. The inclusion of mātauranga Māori and the intention to interweave, rather than integrate it with other knowledges is based on our recognition of Te Tiriti o Waitangi, the significant contribution mātauranga Māori is making to biosecurity research and practice, kaitiakitanga, and of the need to address longstanding educational inequities for Māori in Aotearoa. By reflecting on three examples of how we have attempted to create in-school activities that interweave these knowledges, we have highlighted some of the possibilities and challenges of TTN’s approach.

Our experiences over the first year of TTN, and review of relevant literature, suggest that supporting children to contribute meaningfully to ngahere ora requires more than communicating pre-existing information to them about what they should know and do. It requires a strongly relational, place-based approach to research and engagement that fosters bottom-up collaborative processes and values and interweaves diverse knowledges in creative ways. Trusting and respectful relationships supported the teachers, the research team, guest experts and the children to engage with the environment in creative ways, encouraging active and emergent learning about complex environmental issues. Children’s understanding of, and connectedness with, the ngahere appeared to develop through tailored

activities that connected with school and community priorities and which scaffolded those involved to engage with multiple ways of knowing – both western and Indigenous.

TTN aimed to acknowledge and connect activities to ‘local’ knowledge and understanding within the schools. Many schools value opportunities to engage pupils with outside expertise. We have found, however, that to collaboratively develop an emergent and active learning programme such as TTN, it has been important for us, as researchers and visitors, to respect and connect with each school’s culture and curricula, to learn to work in their environments and to build on their existing relationships and connections. Over the first year of the project, we have realised this approach places more demands on teachers and researchers than a fully pre-planned outside-expert-led programme might. However, where TTN has successfully made these connections, it seems like activities supporting children’s engagement with biosecurity and ngahere ora, like activity 3 above, will continue.

Some common features of schooling in Aotearoa make it difficult to create spaces where knowledges can be interwoven, learning can be reciprocal and emergent, and young people’s agency/participation can be supported. This includes large class sizes, the organisation of the curriculum and timetable around discrete, priority learning areas and the heavy workload of class teachers. As outsiders coming to work in schools, we were not always able to respond to these challenges in ways that were consistent with the ecological and cultural contexts at hand. Decisions were sometimes made based on what would be expedient or enable easier ‘management’ of large groups in a constrained time, which led to differential levels of engagement and learning opportunities for some. Schools and teachers also experience difficulties when trying to integrate various learning activities into their curricula and routines. As we move into year 2 of TTN, we know additional time and resources are needed to work closely with teachers, and/or for teachers to work with each other, to make connections between activities and to integrate them into longer schemes of work that draw together multiple learning areas.



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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## **Note**

1. Hutchings et al. (2020, p. 87) note kaitiakitanga ‘in a broader sense involves physical, emotional and spiritual connectedness, and a sense of being embedded in a particular place.’ Kawharu (2000) adds, kaitiakitanga cannot be understood without the concepts of mana, rangatiratanga (authority), mauri (life force), tapu (‘sacredness, set apart’), rāhui (prohibition or conservation), manaaki (support, care, hospitality and up-lifting of mana and reciprocity of it) and tuku (‘transfer, gift, release’) (p. 349). It is understood in Māori contexts to not just be something that humans can perform, but also other living, natural and spiritual entities, for/on behalf of many things, living, non-living and otherwise. Many Māori researchers note how kaitiakitanga is often taken out of this wider kaupapa Māori context (Māori customary practices and approaches) and misinterpreted as just referring to humans as guardians of the natural environment. This usage is seen throughout government and institutional contexts, such as the Resource Management Act, Department of Conservation and in education (Hutchings et al., 2020; Kawharu, 2000; Walker et al., 2019). Many Māori argue that it is a concept that only applies to Māori, a stance which may be fuelled by widespread institutional misappropriation. To illustrate the complexities of the term kaitiakitanga, we note here that there are instances where Māori kaiako have invited Pākehā and other Tangata Tiriti to be kaitiaki (performers of kaitiakitanga) in specific instances, such as in relation to a threatened kauri tree (in the Save Our Kauri protest campaign, 2015), or in community and school projects looking after specific beaches, forests and so forth. In these contexts, the term is often referred to in general terms.

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