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Empowering the Indigenous voice in a graphical representation of Aotearoa's biocultural heritage (flora and fauna)

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Abstract. Aotearoa's (New Zealand's) biological heritage is in decline due to threats such as climate change and habitat destruction. Aotearoa's biological heritage and the wider environment are critical to the Māori world view and culture and Māori have long advocated for greater engagement in efforts to reverse this decline. One negative outcome of localised declines in biological heritage is a concomitant loss of local Māori language (dialectical) terms. Compounding this is the growing use of standardised Māori terms that can displace local dialectical terms. This also runs the risk of losing the associated mātauranga (knowledge) that is inherent in the meaning of these local terms for their unique flora and fauna. Retaining this biocultural knowledge is considered important and could play a role in conservation efforts. This collaborative research addressed the concerns articulated by a Māori biological heritage expert about the loss of their own unique local Māori terms for flora and fauna. The research explored ways to retain and empower local indigenous biocultural terms via the creation of a static visual educational resource for Tūhoe–Tuawhenua youth displaying the forest vegetation of their rohe (area that defines a tribe's traditional mandate or authority). The plants in the final resource are identified by their local Māori term and their corresponding scientific name. Depicting ecological accuracy in the artwork was a specific requirement of the kaumātua and created some unique outcomes in how the artwork formed. The approaches employed in this research and an analysis of the results and wider implementation are discussed.

Keywords: Aotearoa, biocultural, bioheritage, fauna, flora, language preservation, language revitalisation, Māori, mātauranga, New Zealand, poster, species identification.

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Introduction

Aoteroa's (New Zealand's) biological heritage is in decline due to a range of anthropogenic pressures, such as climate change, pest incursions, loss of habitat, human land use activities and environmental pollution (Ministry for the Environment and Stats NZ 2019). Māori have long insisted that they need to be engaged in efforts to reverse this decline, including how best to preserve their mātauranga (knowledge, wisdom, understanding or skill) and tikanga (protocols, practice, lore), which are viewed as a key component of Aotearoa's biological heritage (Harmsworth and Awatere 2013; Ruru *et al.* 2017; Ataria *et al.* 2018). From a Māori world view, biological heritage is one aspect of a wider interconnected cosmology that structures all living and non-living things within a meaningful relational framework. Through the fundamental Māori values and principles, such as whakapapa and Māori identity, obligations and expectations are derived that regulate human interactions with the environment and drive the evolution and development of their language and praxis (Roberts *et al.* 1995; New Zealand Waitangi Tribunal 2011; Harmsworth and Awatere 2013;

Clément 2017). Whakapapa is fundamental to the Māori worldview and describes a person's genealogical connections to where and who they're from. When a person cites their whakapapa, they are presenting their identity, kinship and linkages with the physical and non-physical world. The Māori identity is composed of all the values and obligations that come with being Māori including whakapapa and many others. This is important here because it is through preserving mātauranga knowledge and traditions that the Māori identity is strengthened. Renowned Ngāpuhi leader Sir James Henare is often quoted for coining the phrase, '*Ko te reo te mauri o te mana Māori*', meaning '*the language is the core of our Māori culture and mana*' (mana being a Māori value that is linked closely with, and influenced by, other Māori values – it is often defined as prestige, authority, control, power, influence, status, spiritual power, charisma and is something that is inherited or is afforded to a person, people or an object) (New Zealand Waitangi Tribunal 1989). Māori use te reo (Māori language) to express their mātauranga, which codifies their perception, understanding and comprehension of the surrounding physical environment and universe (New Zealand Waitangi Tribunal 2011; Harmsworth and Awatere 2013).

Since the arrival of Europeans, the Māori language has been a casualty of the colonisation of Aotearoa. Whether this is because of the policies and structures of an education system that aimed to establish English as the dominant language (Bell *et al.* 2005; Harlow 2007; Ka'ai-Mahuta 2011; Calman 2012) or the impacts of Māori moving to urban areas after World War II in search of work (Bell *et al.* 2005), the Māori language has suffered. There is also wide-ranging evidence that iwi (tribe, kinship group) dialects contribute positively to Māori wellbeing, especially in terms of their connection and identity to their local environment and their culture, and mātauranga through whakapapa (Lyver *et al.* 2009; Wehi *et al.* 2009; New Zealand Waitangi Tribunal 2011; Keegan 2017).

In the 1970s Māori language revitalisation started to gain momentum due to decreasing numbers of fluent speakers and fears that the Māori language might be lost (Timms 2013). The Kaupapa Māori schooling (incorporating the knowledge, skills, attitudes and values of Māori society), Māori broadcasting and a dynamic community of activism in opposition to Aotearoa's government's policies, for what they believed were breaches in Aotearoa's government's responsibility to protect te reo Māori as a taonga (treasured item) as guaranteed under the Treaty of Waitangi grew out of this fear (Timms 2013). A breakthrough was made with the *Māori Language Act 1987*, which recognised te reo Māori as an official language of Aotearoa, and efforts were made to ensure its preservation (Timms 2013). However, when the government attempted to revitalise the Māori language in the education system, a standardised version of the Māori language was put in place (Keegan 2017), seemingly at the expense of local dialects. While it is recognised that the Māori Language Act was vital in ensuring that the language survived, according to our Māori Kaumātua, it was this standardised language that has been the key driver for the loss of this dialect in their communities (Matua Jim, pers. comm.).

The intergenerational transfer of mātauranga is another significant issue that is facing Māori communities. Current evidence indicates that there is a growing demographic within Māoridom, especially within the younger generation, who have decreasing competency in the Māori language and Māori customs. Even more stark is knowledge of mātauranga and language associated with their ūkaipō (home or local environment), which is also impacted by the increasing number of Māori who live outside their traditional home territories (New Zealand Waitangi Tribunal 2011; Dick 2012; Whaanga *et al.* 2013; Keegan 2017).

The loss of iwi dialects has increased the risk of losing mātauranga Māori (Māori knowledge – the body of knowledge originating from Māori ancestors, including the Māori world view and perspectives, Māori creativity and cultural practices) that may be vital in reversing the decline in Aotearoa's biological heritage. Considerable mātauranga Māori is passed down through whakataukī (ancestral sayings), pūrākau (traditional narrative), kōrero (myths and stories, discussion and speech, etc.), karakia (prayer) and waiata (song) (Wehi *et al.* 2009; Harmsworth and Awatere 2013; Ataria *et al.* 2018). Since Indigenous knowledge is passed down orally through iwi dialects, the preservation of iwi-specific mātauranga Māori is dependent on the conservation of iwi dialects. Meaningful connections between rohe (geographical area that defines a tribe's traditional mandate or authority), the iwi within that rohe, their dialects and mātauranga have been identified in the literature (Pihama *et al.* 2015; Albury 2016). This connection shows that if iwi dialects are not preserved, the unique location-specific mātauranga associated with those dialects is at a significant risk of being lost.

This manuscript introduces a unique pilot project exploring ways of preserving and promoting local Māori dialects with the founding goal of intergenerational transmission and preservation of those dialects. The project originated from the concerns of an elder from the Ngāi Tūhoe iwi group around the standardisation of the Māori language within Aotearoa's education system, and the subsequent loss of the use of local dialects in the community. This concern also encompasses the fact that a loss of the Tūhoe dialect would also mean a loss of the deeper mātauranga and meaning that accompanies the Indigenous terminology. This is a concern that is expressed by many iwi around the country. It was thought that a resource should be developed to allow for not just the preservation of Tūhoe–Tuawhenua dialect and mātauranga, but also as a learning tool for all children who descend from the Tūhoe–Tuawhenua region, including those that live in the rohe or that are domiciled outside.

The project also aimed to develop a transferable framework within which a static graphical resource for the people of Tūhoe–Tuawhenua could be produced and populated with rohe-specific biocultural heritage knowledge. This manuscript reports on the process and results of producing a graphical educational tool as one approach of preserving and empowering local mana whenua in their efforts to reverse the loss of their regional dialects and protect the localised biocultural heritage mātauranga encoded within these dialects and terms.

Methods

Methods and theory that shaped the development of the framework

This research focused on one case study with Matua Jim who is mana whenua (a person with geneological linkages to the Māori

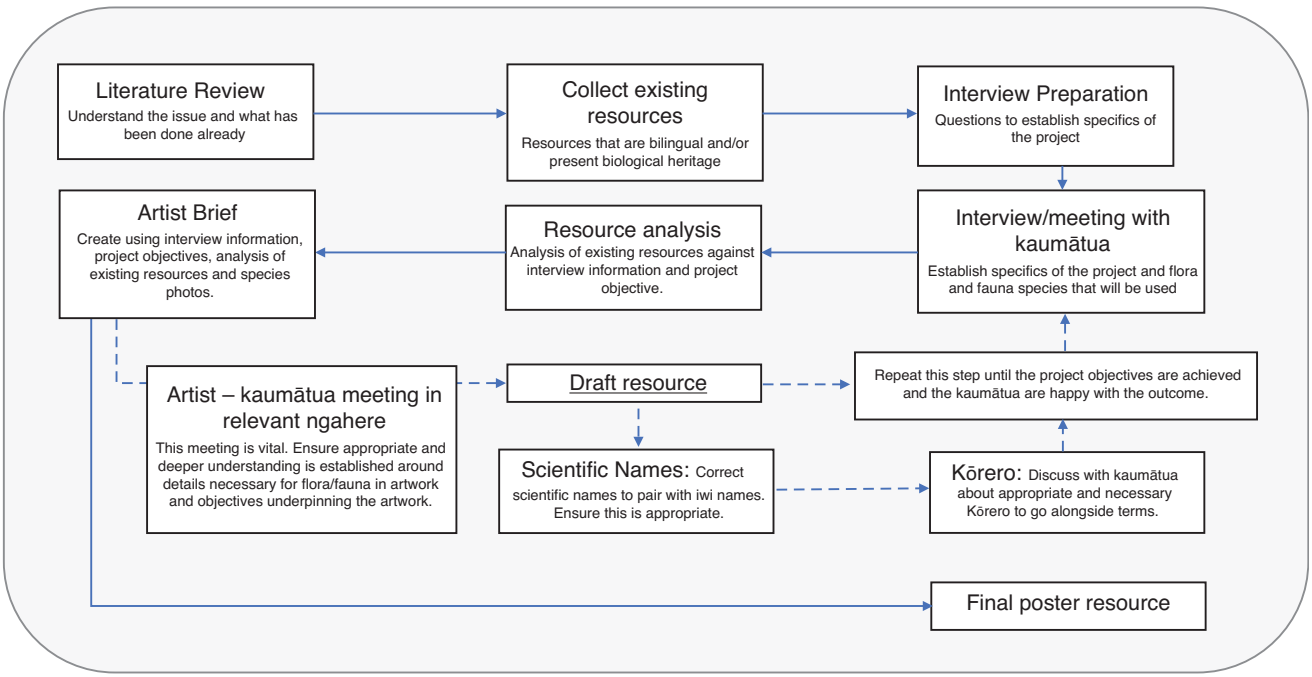

Fig. 1. Framework – empowering the Indigenous voice in graphical representation of Aotearoa's biocultural heritage (flora and fauna).

community that has recognised cultural authority over a specific area) of the Tūhoe–Tuawhenua rohe. A case study approach involves a highly focused and intensive study of a single case or small number of cases with the intention to use observational data to produce a result that may have implications for a larger population of cases (Gerring 2017). The decision to focus on one case study derived primarily from two reasons: (1) this was a Māori-derived and Māori-driven project that was originally conceived by kaumātua Matua Jim and it was important to successfully prove the concept before broadening the geographical and topic scope; and (2) this case study was a pilot study with time and resource limitations that prescribed an intensive focus on the one case study. Undertaking research that is dependent on collaboration with Māori communities is often challenging within the western scientific tradition, especially in situations that involve working within the corpus of Māori knowledge and where western 'assimilationist' approaches can prevail, where the value and validity of Māori knowledge lies only in the extent to which it can be validated and utilised by the mainstream science system (Williams 2001). This project utilised methodologies that were embedded within Kaupapa Māori Research and Action Research. This pilot was Kaumātua-led and four of the authors are Māori, only one author is not, although they were approved by the Kaumātua. From this it felt appropriate to follow a Kaupapa Māori research strategy. Kaupapa Māori theory is considered to be aligned with critical theory because it aims to show power relations perpetuate the continued oppression of Māori (Pihama *et al.* 2002) and therefore can be viewed as a response to the dominant Western power base and positivist worldview (Pihama *et al.* 2002; Smith 2012). Kaupapa Māori as a methodology is described as being based on Māori philosophy and guiding principles (Wong 2006). The kaupapa Māori method liberates Maori and creates pathways of self-determination. Kaupapa Māori is also underpinned by mātauranga Māori knowledge, and manifested through tikanga customs and practice (Kennedy and Jefferies 2007). These acknowledge the historical connections of Indigenous communities and recognise that research should arise from the needs of 'the researched', as defined by themselves (Pihama 2001; Cram 2011; Smith 2012).

Action research is a methodology that employs research questions to narrow the scope of the study and is normally associated with qualitative research. It involves an iterative and cyclical process of action, and critical reflection on action (Jacobson 2007). It has a goal of 'acting' to bring about positive change and 'researching' to increase the understanding on the part of the wider community (Rapoport 1970). Action research methodology is made up of a diverse range of research methods that include: participatory action research, action science, developmental action research, critical action research, practical action research, collaborative inquiry, emancipatory research, action learning, community-based participatory research, and contextual action research (Kemmis and McTaggart 1988; Allen 2001; Jacobson 2007). Action research methodology guided the development of the framework that can be found in Fig. 1. We discuss each of the steps of our conceptual and methodological approach.

Literature review for existing biocultural/bioheritage resources

An analysis of the literature provided a good understanding of the issues pertaining to Māori language dialectal and environmental mātauranga loss, and initiatives implemented to reverse the declines. The main aim of this search was to identify resources that focused on the visual presentation of biocultural heritage knowledge, from which criteria to assess

Table 1. Criteria for the resource

Criteria	Explanation
Clear and simple	Is the artwork/resource able to show the key identification features in a precise and accurate manner? Are children able to identify the species in the artwork/resource in an outdoor setting? *Note: Matua Jim felt that pictures were important for children to be able to make connections with what flora and fauna they already knew, and that they should be able to identify the species from the resource.*
Functional as a template	Are the methods repeatable beyond this project and in other tribal areas? *Note: This project was intended to be a pilot for a bigger research project where many more ecosystems and rohe would have their dialectal names recorded and presented. Ensuring that methods are repeatable then is vital for taking this project beyond the pilot.*
Natural eye-level viewpoint	Is the artwork/resource representative of what a person in the forest would observe at eye-level? *Note: It was felt that the artwork should show features the user would naturally see while walking through the forest. For example, forest walkers do not often see the tops of canopy trees but instead see the bark of those trees.*
Appropriate placement of words and kōrero	Is the artwork/resource cluttered, does any one concept dominate others? *Note: The researchers and users felt that the artwork, words and kōrero were all equally important and should not 'fight for attention'. Ensuring that no one element dominated the attention of the user was important.*
Shows relationships	Does the artwork/resource show the holistic relationship between flora, fauna and people – is it representative of a Māori worldview? *Note: Matua Jim noted it was important to show both cultural and ecological relationships – how the flora, fauna and people all interact together in a given environment. Representing these interactions in an appropriate manner was important.*
Suitable for young children	Does the artwork/resource appeal to a young audience? *Note: As noted previously, the idea for this research stemmed from Matua Jim's quest to ensure his mokopuna (grandchildren) knew the Tūhoe–Tuawhenua names for their flora and fauna. Consequently, primary-age children became the target audience.*

the pros and cons of each were developed (Appendix 1). The search engines used included the Lincoln University (NZ) and the University of Canterbury library databases, Google search engine and Google Scholar. The key terms used in the online search included: poster, bioheritage, species, identification, indigenous, language preservation, language revitalisation, Māori, resources, fauna, flora, plants and animals. During the literature review 45 articles were reviewed, with 19 of these including different forms of visual resources (see Appendix, Table A1). The decision to focus on visual resources was intentional due to visual resources, such as static posters, having been shown to be an effective learning tool for children in the classroom when it comes to second/foreign language acquisition (Cetin and Flamand 2013). Furthermore, given this was a pilot study, a visual resource, such as a poster, was considered to be effective in developing the framework that could empower local indigenous groups in the preservation of their local dialects and biocultural knowledge within the allocated timeframe and budget. In future projects, there may be more scope within the framework for other forms of second/foreign language acquisition resources. However, the key premise to this study focused on exploring options for a poster that was in line with the kaumātua Matua Jim's consistent request in the initial brief that the resource be available to rangatahi (youth) of Tūhoe–Tuawhenua descent living outside of the rohe. A poster fulfils this criterion because it can be scanned and made available online to rangatahi, wherever they may be, and was feasible from the resourcing perspective. The static graphical resources identified through the literature review varied markedly in their approach to presenting biocultural heritage. Examples of this variation include simple graphic resources through to colouring books and posters with interactive QR (quick response) scan codes (New Zealand Marine Studies Centre 2016; Hikuroa *et al.* 2017).

Interview preparation and meeting with Kaumatua – place-based kōrerotahi (talking together, dialogue)

The resources were analysed specifically with respect to the aims stated in the initial brief of the project and how certain elements of each resource fulfilled those aims. The initial brief focused on the creation of a bilingual educational resource that could be distributed amongst the children of Tūhoe–Tuawhenua. This information formed the basis for a range of questions that were then posed to Matua Jim during a visit to his kāinga (home). This set of questions focused on the purpose of the resource in relation to rangatahi and Tūhoe, as well as establishing more detail around the origin of the idea. An artwork resource was decided on during a previous hui (meeting) where a biodiversity poster happened to be hanging on the wall of the whare (house) where a conversation was taking place about the concern Matua Jim had regarding his mokopuna (grandchildren) not learning Tuhoe–Tuawhenua names for biodiversity that occurs in their Tūhoe–Tuawhenua region. Further discussion took place on the pros and cons of the variety of potential resources collected during the literature review, what ecosystem and species were going to be depicted in the pilot poster, how the artist should be sourced and, finally, the means of distribution for the final resource. How the artist would be sourced was an important part of this process – we initially asked Matua Jim if there were any local Māori artists that he was aware of. Unfortunately, it seemed that all the Tūhoe–Tuawhenua artists of whom he was aware had left their home to move to Auckland or Australia and largely cut ties with Tūhoe–Tuawhenua.

Therefore, we found an artist who, based on her previous works, seemed suitable, so we took her to meet our Kaumātua and got his approval. The poster was intended to be place-specific and therefore it was logical that the development of the resource took place in Ngāpūtahi, Te Urewera, the environment that the artwork would reflect and the tūrangawaewae (a place to stand, ancestral land, origins) of the knowledge holder (Matua Jim). This conversation was the starting point for the process that was to take place to address these concerns. There were four hui with Matua Jim as part of the process that aimed to shape and constantly give feedback on the learning resource being created. At each of the hui, a semistructure interview was conducted (Merton and Kendall 1946; McIntosh and Morse 2015) and time was allocated for informal, unstructured discussions in relation to the learning resource. Integral to the discussions were site visits around the local district that were used to reinforce specific facts and provide broader context about the Tūhoe rohe, its history and its biocultural heritage. The ngahere (forest) of Matua Jim is dominated by rimu (*Dacrydium cupressinum*) and tawa (*Beilschmiedia tawa*); however, historically, the land has also been home to sheep and beef farming as well as the forestry industry. These site visits were important for reinforcing points and embedding the knowledge that was important from Matua Jim's perspective. During these site visits and hui Matua Jim provided his own personal feedback on how well the material met the project brief and offered advice to refine the resource from an idea to a defined concept that better met the aims. Conversations were recorded on a digital recorder, and transcripts allowed researchers to check information after the hui. At the completion of the project these digital files will be returned to Matua Jim.

Resource analysis

Analysis of the resources found during the literature review highlighted elements considered to be desirable in the 'yet to be developed' Tūhoe resource. It was noted that the elements would be restricted by the resources, skills and time available to the project but that these would not be prohibitive of production of a strong resource. Based on further discussions with Matua Jim it was decided that an artwork, in the form of a poster, would allow the most creative space to incorporate as many of the desirable elements into one resource. Discussions that highlight the desirable components of the existing biocultural/bioheritage resources and other resource analysis led to the establishment of six key criteria for the artwork (see Table 1).

Scientific names and kōrero

English and Māori names for most of the plant species were known by Matua Jim or the researchers; however, for the plants that were unknown, photographs and samples were taken for identification. Correct scientific names were confirmed through Matua Jim and iNaturalist.nz. One example that will be included in the final resource is *Carpodetus seratus*; its common name is marble leaf and the Tūhoe name is kaiweta. Another is *Sophora tetraptera*; its common name is kowhai. Although this is also a Māori name it is not the Tūhoe name; in the Tūhoe dialect the kowhai tree is the kohai. Matua Jim's expertise is as a knowledge holder regarding Tūhoe–Tuawhenua and its environment. He has also served as an expert on many national boards, committees and Māori Trust boards related to environmental and Māori matters. iNaturalist is a network where you can share observations and have species identified by experts and other nature watchers. It was decided early in the process during an interview with Matua Jim that text should be placed on the resource to explain its use, why it was created and how the terms used on it are specific to Tūhoe–Tuawhenua. Interviews later in the process were used to discuss and establish what that would look like.

Creation of the artwork: visualising Tūhoe–Tuawhenua connections with nature

Analysing resources and preparing the artist brief

The criteria developed during the interviews and key points from discussions with Matua Jim were used to analyse the existing resources identified in the literature review. Elements within the existing resources that matched the criteria were highlighted and, in turn, this was communicated to the artist as guidance on what the preferred look and layout for the poster would be. The artist brief also included a list of all the plants Matua Jim wanted present in the poster, photographs of the plants and how they were to be arranged. The plants he chose were those that either had a name unique to the region exclusively, and were therefore important to record, or were key to traditional Tūhoe practices. Three of the authors conducted four trips to Ngāpūtahi as part of the cyclical and iterative process of action research. These trips were also helpful in ensuring that accurate and detailed photographs were included in the artist brief.

The artist recruitment was also a cyclical and iterative process. As this was Matua Jim's project, it was felt that the search for an appropriate artist should first begin within Tūhoe before expanding the search parameters. Having not found an artist within this space, an artist was recruited through the process of referral. The artist's work was explored to ensure that the style of work they produced matched the aims of the project. The artist was asked for a test piece where three key tree species were to be depicted in a forest scene. The artwork was then sent to Matua Jim for feedback and discussion around whether he believed the artist would fulfil his vision of what the poster should look like. Once kaumatua approval was received, researchers continued developing the poster alongside the artist.

Artist and Kaumatua meet in the relevant ngahere

In the later stages of the project, it was vital for the artist to visit the ngahere in Ngāpūtahi and talk with Matua Jim to ensure that the resource captured the key objectives of this project and Matua Jim's vision. This step was critical for the artist to gain an understanding of the details of the forest that are required in the poster and an understanding of the deeper meanings behind the names for certain trees. Given that this project stems from Matua Jim and his desire to ensure that his mokopuna know the Tūhoe–Tuawhenua terms for flora and fauna in their ngahere (bush, forest), it was vital that artist and Matua Jim have a discussion around this desire to ensure that the artwork captures this as a core principle.

Fig. 2. A preliminary rough sketch that the artist, Ilze Pretorius, produced following her trip to Ngāpūtahi and meeting with Matua Jim, showing the placement of the plants and how she was going to represent the different layers of the forest in her artwork.

Matua Jim felt that the kaupapa (research) was also about reaching out to those Tūhoe–Tuawhenua descendants who were living in other tribal rohe, as a way for them to remain in touch with the names of their forest flora and be able to pass this information onto their children. Kōrero (discussion) about what the resource is, why the resource was made and highlighting the fact that these terms were specific to the Tūhoe–Tuawhenua rohe was thought to be a way this could be achieved. Plant species were chosen as a starting point for the creation of the poster because following the completion of the plants poster resource the artwork could be used as a background to support the addition of fauna species.

The plants were split into the following groups: Tier 1 trees, tier 2 trees, tier 3 trees, ferns, flaxes and vines. This grouping system was chosen based on Matua Jim's feedback during the first lot of interviews. Tier 1 trees were described by Matua Jim as being the 'big tall trees'. Examples of these trees include *Dacrycarpus dacrydioides* (kahikatea, white pine), *Prumnopitys taxifolia* (matai, black pine) and *Prumnopitys ferruginea* (toromiro, brown pine). Tier 2 trees were described as the trees in-between the Tier 1 trees and the Tier 3 trees. Examples of these trees include *Elaeocarpus dentatus* (hinau), *Knightia excels* (rewarewa, NZ honeysuckle) and *Weinmannia silvicola* (tawhero, towai). The Tier 3 trees were the small trees. Examples of these trees include *Kunzea ericoides* (kanuka, white tea-tree), *Carpodetus serratus* (kaiweta, marbleleaf) and *Pseudopanax crassifolius* (hohoeka, lancewood).

Matua Jim expressed a view that this poster was about more than just forests and birds – it was about Tūhoe–Tuawhenua culture and tikanga. This point led to conversations surrounding the inclusion of Māori in the resource and it was agreed that Māori interacting with the ecosystem should be a key element in this resource if these interactions were shown in an appropriate way.

Developing the resource

The brief was provided to an artist, Ilze Pretorius, who was personally known to a member of this research team and who expressed interest in the research project. The artist established a first draft representing a few of the key trees so that an example could be taken to Matua Jim to gain more feedback before starting the final artwork (Fig. 2). A cycle of getting Ilze to do work, showing it to the kaumātua for feedback and feeding that back to the artist with additional resources to aid the work constituted the next steps in the framework. As panels of the artwork have been completed, they have been sent to Matua Jim for feedback. Once the panels have been completed the Tūhoe–Tuawhenua names and some kōrero will be added to the poster and these steps will constitute its completion.

Discussion

The framework demonstrates the process used to establish the resource. It describes the consultation process that took place with relevant experts to develop a static poster resource. This resource met the expectations of the mātauranga experts involved and provided an appropriate educational tool for rangatahi and descendants of the Tūhoe–Tuawhenua rohe. Specifically, it outlines the steps required when working with kaumātua and a graphic artist in order to reach the desired outcome. The framework is significant in the sense that it can be applied to produce similar resources in several different

scenarios. The resource could be for other groups within the Tūhoe iwi, for other iwi in different rohe, for different ecosystem types and for different age groups.

Māori society is historically based on oral history where knowledge has been fervently protected and cherished to ensure that the integrity and consistency of that knowledge is maintained. The intergenerational transfer of knowledge depended on strong and unbroken succession of knowledge sharing. Unfortunately, due to negative impacts of colonisation, urbanisation and many other issues, the once tight knit social cohesion and kinship bonds that existed are now severely eroded and many knowledge holders have struggled to find young people to impart their knowledge to (Roberts *et al.* 1995; Bell *et al.* 2005; Harlow 2007; Pretty *et al.* 2009; Ka'ai-Mahuta 2011; Whaanga *et al.* 2013). In the case of Matua Jim, who is a recognised Māori expert and biocultural knowledge holder, he is interested in finding ways by which his knowledge can reach current and future generations of Tūhoe–Tuawhenua descendants. It is therefore important to protect and learn from these kaumātua and support their efforts to stem the loss of biocultural heritage knowledge. The framework developed in this research is, at its basis, an approach that creates appropriate spaces to allow relevant conversations and interactions between Māori and non-Māori who wish to work with each other and that ultimately lead to a desirable and collectively shared outcome. By committing to the essential tenants proposed in the framework developed for this program, it is hoped that more research can be done to appropriately preserve, record and protect mātauranga, particularly in ways that ensure it can be passed down to following generations. Historically there exist numerous examples of where Mātauranga Māori has been misappropriated and used out of context, or inappropriately and incorrectly translated and explained when non-Māori, often not versed in the linguistic and cultural nuances of Māori, have attempted to report Māori knowledge for academic and public audiences (Roberts *et al.* 1995; Baker 2009). This project has aimed to create a visual tool that accurately displays exactly what the Tūhoe–Tuawhenua names are for specific forest plant species. By directly pairing the Tūhoe–Tuawhenua and scientific names with a picture on a poster mistranslations and confusion can be avoided. The suggestion of adding wider kōrero to the poster is also important as this means that the true value of the names, as seen by Tūhoe–Tuawhenua and other Māori can be better and more clearly understood by non-Māori.

As discussed above, the framework could be applied to produce a variety of different resources. These resources range from colour-in story books, to apps, and interactive online posters with QR codes. The framework is versatile in the sense that it is not restricted to any one type of resource or a certain type of stakeholder. Of course, the outcome is dependent on the priorities and expressed wishes of the collaborating knowledge holder or community. However, the framework does allow considerable flexibility and tailoring of the final product, which is a strength. Since the project stems from Matua Jim's concerns, the success of the project is measured through his feedback. Given positive feedback on the project from the kaumātua Matua Jim, the project team were confident that the brief that had been set by him was met. This framework supports calls for the production of cost effective learning resources that retain iwi dialects (McKenzie 2014). This framework and Kaupapa Māori and Action Research approach offers guidance around the creation of a variety of resources and ensures that they are made using Māori processes and in a Māori context.

Variations in dialects within language groups is common globally. Historically, Māori have used their language, te reo Māori, as a key repository for knowledge. This is because words, specifically the names of people, places, flora and fauna, describe and hold knowledge within themselves. Therefore, names vary significantly across iwi and hapū as different groups interact with their local environment in different ways. This use of the language is why dialects are so crucial to the way mātauranga is understood and transmitted. The framework developed here has been used to allow the analysis and recording of these names while also linking associated kōrero/information to the names of, in this case, plant species. The connection between mātauranga and dialects, as well as the wider language, is most often used to describe natural phenomena and uses of them. Therefore, by preserving the names, the higher goal of protecting and acknowledging biological heritage and cultural diversity can be supported.

The WAI262 report recommended increased support and funding for mātauranga Māori in science, te reo Māori and Māori culture (New Zealand Waitangi Tribunal 2011). The WAI262 claim was about gaining recognition around the control of and rights regarding mātauranga Māori, tikanga and Māori relationships with the natural environment. This framework is one tool through which mātauranga Māori and te reo Māori can be appropriately supported. It offers a tikanga appropriate around collecting and presenting iwi mātauranga so that it can be preserved, and Article 2 of Te Tiriti *o* Waitangi can be adhered to.

This framework can also help non-Māori when interacting and working with Māori, but it is important to note why this is needed. Western science differs from mātauranga Māori in many ways, the biggest difference being mode of transmission. Māori are, as mentioned earlier, an oral society, while western science prioritises the recording, writing and cataloguing of knowledge. These are two completely different systems for how knowledge should be treated, respected and kept (western science knowledge is available to all but mātauranga was maintained within a controlled environment) (Roberts *et al.* 1995; Baker 2009). Perhaps the biggest issue is that western science practitioners have viewed other knowledge systems as being inferior, which has had the effect of marginalising and also hastening the declines of other knowledge forms (Roberts *et al.* 1995; Battiste 2000; Baker 2009). The framework is therefore structured in a way that allows western researchers, specifically in conservation, to take the necessary steps to properly engage and discuss with Māori to get the best results for both parties through ensuring the goals of Māori are kept at the forefront of all actions within the project. The poster that has been created using this framework helps bridge this divide by creating a resource that sits in middle ground between the two ways of knowing. The resource created here includes visual and storytelling elements that would normally be present in Māori knowledge transfer, while also incorporating western methods of recording information for knowledge transfer. Also, vesting control of this project (from inception through to distribution of the resource) with the kaumātua, Matua Jim, further aids the bridging of this divide.

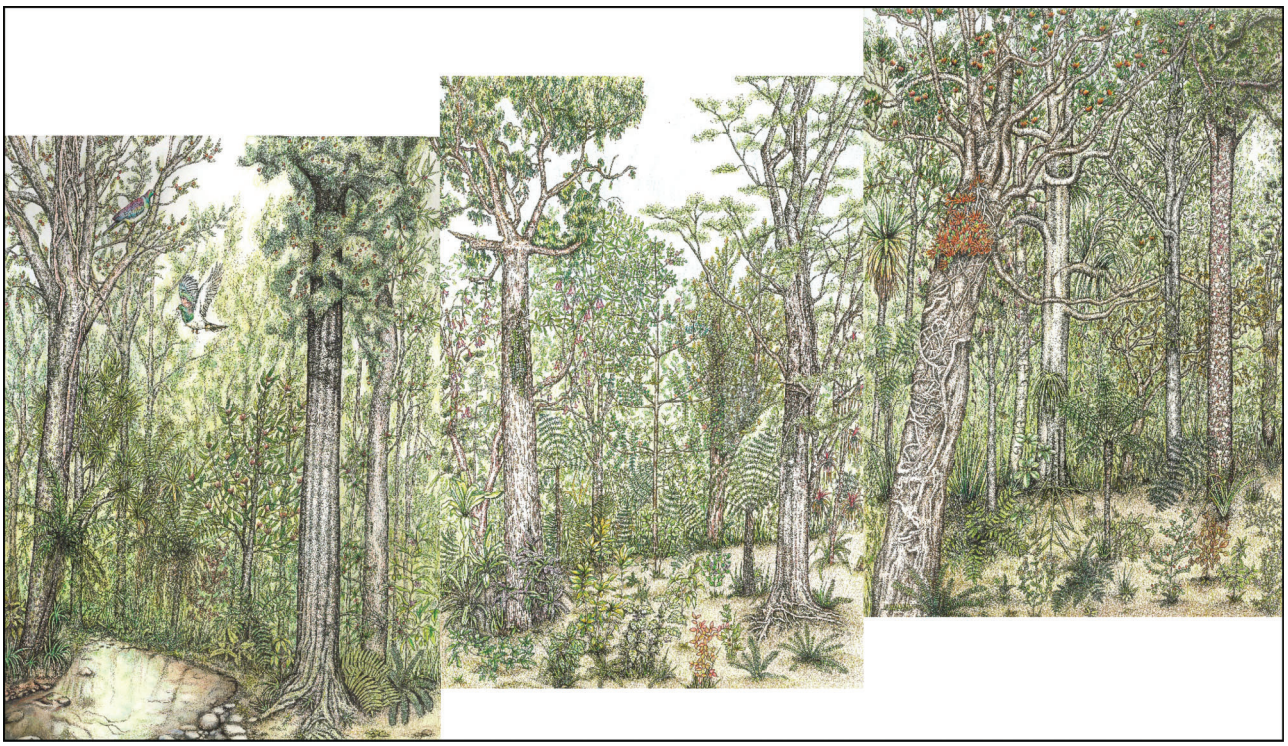

Fig. 3. The complete panels without text produced by the artist, Ilze Pretorius, showing the lowest level of the Tūhoe–Tuawhenua forest.

An action research approach enabled the production of a fully completed educational display that can be used as a teaching tool for the names of plant species. The research therefore is useful in an education-based space by preserving the Tūhoe–Tuawhenua names, which could otherwise be lost. Importantly, the framework is a blueprint for appropriate engagement with Māori in general to preserve and present other forms of mātauranga. This framework is different from other social–ecological learning frameworks, such as those mentioned in Krasny and Tidball (2009) and Thomas (2018). Krasny and Tidball's framework focuses on the positive feedback loop between civil ecology practices and environmental education. The feedback loop then fosters resilience attributes such as diversity and self-organisation and enhances social and ecological system outcomes (Krasny and Tidball 2009). Thomas's framework focuses on how the stories of a place can be used to produce embodied learning in natural places (Thomas 2018). The framework created here is focused on story pedagogy and enhanced social and ecological systems through diversity. However, the framework focuses specifically on tikanga Māori and the knowledge holder being at the centre of the kaupapa and this provides the unique point of difference from other approaches. Adhering to tikanga Māori is important in ensuring positive relationships are formed and maintained with Māori (Baker 2009). Their mātauranga is a taonga (socially or culturally valuable object, resource, phenomenon, idea or technique) and therefore it is vital that mātauranga is shared and used in a way that abides by such customs (Roberts *et al.* 1995; Baker 2009; New Zealand Waitangi Tribunal 2011; Te Puni Kokiri 2014). The framework provides a pathway for others to follow, to ensure that the knowledge holders sharing the information are fully involved in the process, and that they are satisfied with how it is being used and distributed. There is the potential for such a framework to be used in other indigenous communities outside of Aotearoa; however, it would need to be adapted to reflect different cultural contexts.

The format of a static poster was chosen due to restrictions in resourcing and timing, and to the ability of this format to meet the criteria set by Matua Jim. However, in developing this static poster resource there have been challenges that have not been completely overcome. For example, it is near impossible to realistically reproduce the typical Tūhoe–Tuawhenua forest scene within the limitations of a 2-D poster, as requested by Matua Jim, while simultaneously retaining an uncluttered layout. Authenticity to the task set by Matua Jim has been addressed through several measures, with the first of those involving having the artist come and visit the knowledge holder, their rohe and hear their kōrero around their forest and their desires for this project. From this the artist can gain a more thorough understanding of what needs to be graphically represented and some of the kōrero and meanings behind what is being represented. This thorough understanding directs the artist towards developing an art piece that is closer to an accurate snapshot of the Tūhoe–Tuawhenua forest than would have been developed had this step not taken place (Fig. 3).

Another weakness of the resource is that a poster limits the ability to add detailed information. A poster limits how well kōrero can be worked into the design, in comparison to how well it could be presented in another model such as a book. This is simply because, on a poster, too many words can detract from the overall impact and usefulness of the images in displaying the species accurately. This weakness has been addressed through

the artist's visit to Tūhoe–Tuawhenua. The artist's visit to Tūhoe–Tuawhenua gave her the understanding and details necessary to be able to incorporate detailed information into the artwork that would have otherwise had to be explained through words. Being able to see the information about the ngahere that Matua Jim wanted incorporated into the poster allowed the artist to accurately depict it visually in the artwork.

Through working with Māori in the Tūhoe–Tuawhenua region, the issue of language became apparent. Although general conversation was fine and there were no issues, when it came to determining what the scientific names were for some species, challenges arose. This was because many of the species names used in Tūhoe–Tuawhenua are unique to Tūhoe–Tuawhenua and were different from other te reo names for the same species. Although showcasing this difference and uniqueness in names was the goal of this project, the challenge lay in assigning the correct scientific species name. This did require the collection of extensive records (photographs and samples of plant species like leaves, bark and reproductive bodies) to be taken from around Ngāpūtahi to ensure that all of the species could be assigned with their correct scientific names, and accurately paired with their Tūhoe–Tuawhenua name. It is also important to mention that all physical plant samples removed from Ngāpūtahi for the purpose of identification will be returned to Te Urewera following the identification and assignment of the genus and species name, as required by Ngāi Tūhoe tikanga.

The major limitation of undertaking more research of this kind is in having and finding those kaumātua who have the required knowledge and are willing to share it (Roberts *et al.* 1995). However, the reality for many Māori communities is that they are losing their knowledge holders, meaning that significant amounts of knowledge are also being lost, and many who remain are unwilling to share what they know (Roberts *et al.* 1995; Baker 2009) – often because they feel researchers conduct inappropriate processes or are focused on self-gain. It is because of this that our Kaupapa Māori research strategy, which focuses on Kaumātua-led research was so important. To lose this biocultural heritage knowledge is akin to losing a species. Once it is gone it is impossible to get back and, sadly, this phenomenal loss is particularly relevant for indigenous people and gives a sense of urgency for projects like this (Wehi *et al.* 2009).

The next steps in this pilot project will involve running the framework with another iwi and in another ecosystem to ensure that the framework is versatile and functional outside of Tūhoe. This is an important step in the process as each iwi has its differences that need to be taken into consideration for successful resources to be developed. Future research could focus on different iwi, hapū, ecosystems or even indigenous people in other countries. At its roots, this work is about providing tools to indigenous peoples that allow them to preserve and teach in areas facing language and knowledge loss. Research could continue in any indigenous community that is open to cooperating and sharing their local knowledge, as long as interactions are carried out properly and the focus remains with helping those communities.

Engagement between the arts and Māori has empowered the Indigenous voice and improved efforts to transfer intergenerational learning in a culturally appropriate way. This project is ultimately a pilot and the future applications of this in its ability to teach children could cover many platforms. Technology experts, for example, could be engaged in the future to ensure that local dialects can be preserved and strengthened as defined by Māori. To secure the future of Aotearoa's bio-heritage, better engagement with Māori and mātauranga knowledge on a localised scale is also needed.

Conflicts of interest

The authors declare no conflicts of interest.

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Appendix 1

Table A1. The resources found in the literature review and the feedback each resource received against the criteria developed during the analysis section of the methods

Pre-existing resources	Clear and simple while showing key identification features	Can be used as a template for other purposes	At natural eye level	Appropriate placement of words and kōrero (Māori and English)	Relationships (cultural and natural)	Suitable for young children
Pishief (2002)	×- Too much detail in one poster. However, if layers were broken down into separate posters, then it would satisfy this criterion.	✓- Names (species for different iwi) could easily be swapped out for others.	×- Shows more than what you would naturally see at just eye level.	½- Relevant information is not distracting from images; however, for our purposes more detail would be needed.	×- As this image does show a relationship by including birds in the relevant forest layers, much more is needed to satisfy this criterion, both culturally and ecologically.	×- Too complicated and bland for young children to effectively engage with.
Sargent *et al.* (2005)	×- Too much detail in one poster. Identification features are not shown as the resource is aimed at being a comic more than a tool for learning.	×- Very specific to one purpose, information can not easily be changed without the whole resource being changed.	✓- Shows a view of the environment that matches what a person would see at the edge of a lake.	×- Words are lost among other details and make the resource seem crowded.	✓- Shows how different natural features and species interact, and has people engaging with the environment.	✓- Shows a simple story that children can engage with and even colour in.
Forest and Land Birds of Guam and the Commonwealth of the Northern Mariana Islands (2013); Haworth (2018)	✓- Clear and simple, shows key identification features.	✓- Easy to swap out names and pictures.	×- Shows species individually in a way that can't be observed naturally.	½- Relevant information is not distracting from images; however, more kōrero is needed for our purposes.	×- Shows species individually on a white background with no information other than name.	½- No reason why children couldn't or wouldn't use this but could be made more interactive to maximise engagement.
New Zealand Marine Studies Centre (2016)	×- Clear and simple display; however, lacks ability to be used for identification as children would not know how to colour it in appropriately.	×- While the idea could be used elsewhere the stories and information are very specific to the images in the book. Terms could be swapped for another iwi but no more than that.	✓- Shows a view of the environment that matches what a person would see when they encountered these species on a rocky shore.	✓- Words do not distract from the images or cover them.	½- Shows ecological relationships very well but does not have any cultural links.	✓- Can be coloured in, making it very good for children to become engaged and learn.
Hikuroa *et al.* (2017)	✓- Shows many species clearly while also showing enough detail to identify species without cluttering the image.	✓- Has been applied to many other ecosystems and areas of ocean. Would not be difficult to move to another iwi.	✓- Shows a view of the environment that matches what a person would see when scuba diving in the Hauraki Gulf.	✓- Words are clear and easy to read, kōrero about the poster is displayed separately from pictures at the top. Both Māori and English names are displayed.	✓- Species are seen in their specific environment with other species that exist in that area. People are also seen engaging with the environment as scuba divers can be seen.	✓- Poster is not only colourful and bright but also has a QR code feature where the poster can be scanned by a smart phone and videos appear explaining the poster and species on it.
Zealandia (2018)	✓- Photographs mean that identification is clear, and features are accurate, layout is still simple.	✓- Easy to swap out pictures and names, and even the environment.	×- Although the images give detailed views of the species it does not display them in the way that a person would naturally encounter them.	✓- Words are well placed, not distracting, and don't confuse the images.	½- Shows ecological relationships between certain select species but no cultural relationships.	✓- Made as an interactive guide for children so it is engaging and educational.

(*Continued*)

Table A1. (Continued)

Pre-existing resources	Clear and simple while showing key identification features	Can be used as a template for other purposes	At natural eye level	Appropriate placement of words and kōrero (Māori and English)	Relationships (cultural and natural)	Suitable for young children
Department of Conservation *et al.* (2016)	✓- Photographs mean that identification is clear, and features are accurate.	✓- Easy to swap out pictures and names, and even the environment.	×- While the images give detailed views of the species it does not display them in the way that a person would naturally encounter them.	½- Although words don't detract from the images the point of the words is to allow a card game to be played, meaning that the text is mostly irrelevant to the actual species.	×- The cards do not allow any of the species to have any form of interaction as each species is on its own separate card.	✓- Made as a card game for children so it is engaging and exciting.
MacDonald (2014)	×- Poster is simple and clear; however, there is no detail on what the species look like at all.	✓- Easy to swap out pictures and names for a different system.	×- Shows silhouettes of species, meaning that it is not what a person would see.	✓- Lots of words and information without cluttering the images or the poster. Different colours on certain types of effects make the poster more engaging.	✓- Shows clear relationships between species and also how humans have interacted with the system in the past.	½- While this poster is likely not engaging enough and too informative for young children, high-school-age kids could possibly engage well.
Lee (2020)	✓- Shows detail on each tree both from a distance and from close-up.	½- Could work well with other plant species as individual species can be swapped out but this would not work for other types of organisms (e.g. birds, mammals, etc).	✓- Shows how a person would see from a distance and from closer inspection.	✓- Words and names do not clutter the image, names are outside the main image with the zoomed-in images. The corners of the poster are where describing text is to avoid the rest of the poster.	×- The poster suggests that trees shown are in the same forest but there is no more relationship information displayed culturally or naturally.	×- Not made for young children as it is too complex; however, could be seen in a high school biology classroom.
Gunson (2004)	✓- Lots going on in the poster, but species are still clear, has appropriate detail to identify many of the birds and smaller plants.	✓- Names separate to main picture, allowing names to be swapped out easily.	✓- Ideal level for a person who has walked into a forest and is looking around.	✓- Uses the back of the poster to add much more detail rather than cluttering the main image; however, still has names and kōrero on the front.	½- Has a wide variety of natural relationships; however, there are no cultural relationships.	✓- Useful as a teaching tool as it is bright and colourful; however, there may be too many words and it is not bilingual.
Cometti (2004)	✓- Simple and clear, has appropriate detail to identify many of the birds and smaller plants.	✓- Basic template could be replicated for another environment	✓- Zoomed in slightly to give more detail but is still a realistic human view.	✓- Transparent text boxes mean that although text is in the image it does not detract from the overall image.	×- Many species are present; however, none of them are interacting with each other in the image.	✓- This poster is colourful and simple, meaning that young children should be more engaged with the simplicity.
Cometti (1994)	✓- Lots going on in the poster, but species are still clear, has appropriate detail to identify many of the birds and smaller plants.	✓- Names separate to main picture, allowing names to be swapped out easily.	✓- Ideal level for a person who has walked into a forest and is looking around.	✓- Names and all writing are separate to the poster, meaning that the image stands alone. However, a shadow map feature is used for identification which, due to the huge number of species present, becomes difficult to use.	½- Has a wide variety of natural relationships; however, there are no cultural relationships.	✓- Useful as a teaching tool as it is bright and colourful; however, the resource uses common names rather than Māori and English.