HE KURA TOI, HE TOI HOU – TRADITIONAL DESIGN INFORMS DESIGN FUTURES

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He mihi

> E rere rā te reo kōmihimihi i ngā hau o tai, kia tūtuki atu ki ngā hau o uta, i ngā kōkoiawa, kōpikopiko o te motu, i ngā maunga whakahī o runga, o raro. Takahia te whenua a hō koutou mātua tupuna, nā rātou te ara i whakatakoto hei hīkoinga mā tātou ngā uri. Nau mai, rarau mai ki tēnei whakapuakitanga e hora ake nei hētehi whakaaro ki tō tātou taiao, e rangaranga nei i a tātou i te wā iti nei e...hai!

Abstract

This paper seeks to understand how indigenous knowledge and practices can be revitalised and extended within a contemporary fashion context. Specifically, the research is being undertaken in Aotearoa / New Zealand. The long-term aim is to establish an indigenous design framework which draws from Te Ao Māori (the Māori world) to offer an alternative, regenerative fashion and textiles system. It is expected that such a framework could be applied within a contemporary design context, working alongside other tools and practices to counter the current dominant linear textile system.

Early considerations and explorations reported in this developmental paper, including the application of indigenous design and dyeing practices in contemporary knitwear, were facilitated through engagement with Te Ao Māori, mātauranga Māori (Māori knowledge), digital design, and on-shore sustainable manufacturing methods.

As the research spans numerous areas of knowledge and expertise, and considers a garment lifecycle from natural resources in fibre extraction through to end-of-life impacts, there are numerous participants within this research. The work presented in this paper is largely focused on findings from a collaborative partnership between Whiri Design and Auckland University of Technology's (AUT) Textile and Design Lab. Whiri Design comprises a group of Māori practitioners with practice rooted in traditional forms and customary designs expressed through whakairo (carving), tāmoko (tattoo), rāranga (weaving) and tāniko (twining).

Key areas of practice to date include investigation of indigenous dye pigments and practices with locally sourced, renewable fibres including wool. Connected and sustainable design is also considered within a digital knit context, with digital knit technologies enabling local, sustainable methods of garment manufacture. Additionally, the technology's design system supports exploration of indigenous design and making processes within a virtual context, functioning as a method to capture design whakapapa and cultural narratives.

The learning from this project supports the ongoing exploration of new forms, materials and innovative technologies whilst maintaining key indigenous values and principles. Specifically, this kaupapa (initiative) gives us a chance to consider how ancient knowledge systems, and practices such as kaitiakitanga (guardianship), can reframe the current take, make and waste overproduction model, returning to design and production methods that are values based, sustainable and regenerative.

Introduction

The devastating and soon to be irreversible environmental impact of global fashion and textile industries is widely acknowledged. The worldwide apparel industry has now significantly surpassed its role as a designer of a fundamental human need. The interaction between fashion and our contemporary lifestyles continues to have a substantial and direct effect on the resources of our world. A collective approach is required if we are to counter the urgent environmental and societal impacts brought on by climate change and resource depletion to ensure a more sustainable future for people and the planet (Quantis, 2018).

However, the size of the industry and extensive supply chains mean solutions or alternative models that adequately address a regenerative, cradle-to-cradle approach remain limited. As Quantis (2018) notes:

> "... the most effective way the apparel and footwear industries can achieve an ambitious industry-wide emission reduction is to focus on renewable energy and energy efficiency across their supply chains with particular emphasis on the highest impacting life cycle stages (Dyeing and Finishing, Fiber Production, Yarn Preparation, Fabric Preparation, and Assembly) ….". In this, a collective approach needs to work across traditional discipline and international boundaries to take a holistic global view. (p.37)

Against this context, this research engages with indigenous pedagogy and mātauranga Māori as it attempts to understand and establish alternate processes for textile and fashion production that respects and elevates indigenous voices, Te Ao Māori worldview and methods of stewardship. The participation of Māori communities in science and research through kaitiakitanga[1] is inherent to who they are as Māori, through their indigenous ways of knowing and being. There is unprecedented potential in indigenous peoples' knowledge that might serve as the foundation for fresh innovation within the fashion and textile industries.

Specifically, the research emerged from a practitioner-led project: He Oranga Taiao, He Oranga Tāngata – A Fashionable Fight. The project was established by Whiri Design and Wanoa Four with funding from the Ministry of Business, Innovation and Employment's Curious Minds Taranaki fund.[2] Project partners included educational professionals, students and whānau from Te Wharekura o Te Pihipihinga Kākano Mai i Rangiātea, community and industry partners specialising in mātauranga Māori and Māori design and textiles, biopolymer and fibre experts from AgResearch NZ and textile design specialists from AUT's Textile and Design Lab.

This developmental paper provides an overview of the research context alongside practice and thinking to date. The paper begins with a background to Te Ao Māori, discussing three key themes in indigenous knowledge. A brief discussion of models of sustainability follows. Practice and findings in relation to locally digitally knitted woollen garments are outlined against life cycle analysis (LCA) phases of raw material extraction, fabric manufacturing including spinning and dye processes, clothing manufacturing, use and end of life. The paper ends with a discussion on next steps and areas for further consideration.

Positioning the Research

A long-term aim of this research is to establish an indigenous design framework which draws from Te Ao Māori to offer an alternative, regenerative fashion and textiles system. While such a framework draws from ancestral knowledge and practices, it is intended to be applied within a contemporary design context and work alongside other tools and practices to counter the current dominant linear textile system. The following provides a background to Te Ao Māori with a discussion around what it means to reclaim and embed traditional knowledge systems within a textiles and fashion context. Models of sustainability are also briefly discussed. Currently, such models are considered most useful in understanding the environmental impact

[1] Kaitiakitanga has been referred to as protection or guardianship. Tiaki's primary meaning is "guard," but depending on the context, it may also mean "preserve," "maintain," "conserve," "nurture," "protect," and "watch over." The word "kai" before the verb "tiaki" signifies the cause of the action. As a result, a kaitiaki is a keeper, protector, conservator, or guardian. The addition of "tanga" stands for protection, preservation, and conservation. (https://www.sciencelearn.org.nz/resources/2544-understanding-kaitiakitanga)

[2] This fund supports regional projects that bring together communities and science and technology to investigate locally important research problems, and to help the region Taranaki to achieve its strategic goals of prosperity, restored/regenerative environment, and inclusive growth.

of textile and garment life cycles while leaning towards an indigenous lens of regenerative and interconnected relationships with nature.

Te Ao Māori

Te Ao Māori quite simply translates to 'The Māori World.' Despite having a simplistic definition, it is significantly comprehensive in both scope and depth. Te Ao Māori in its broadest form embodies a way of knowing and being (mātauranga Māori). It is an environment connecting us to all elements of Māori knowledge and culture. These include oral traditions (waiata, ruruku, karakia, whakapapa, and kōrero[3]), rituals, technology, literary works, visual and performing arts, historical and archaeological sites, artefacts, flora and fauna, medicines, and other past, present, and emerging manifestations of indigenous knowledge (United Nations, 2007).

Te Ao Māori is also the lens through which to examine, analyse and comprehend the world using tikanga (cultural principles) and kawa (cultural practices). Dr. Charles Royal, a scholar of Māori culture and indigenous knowledge, characterises this in the following statement, '...he whakaatu, he whakamārama hoki i ngā ahuatanga o te Ao. Mā reira e mōhio ai te tangata ki te Ao, e mātau ai hoki ia ki ētahi whainga, ki ētahi tikanga. He mea ako, he mea whangai' (2005, p.9); in that observing, examining and analysing the natural world helps us comprehend and understand our place in it and helps determine how we interact with each other.

As we look to engage with Te Ao Māori, and more broadly mātauraga Māori, in the context of the fashion and textile sector, we lean into concepts within contemporary indigenous knowledge defined by Royal (2005) as three interconnected key themes: seeking greater connections with the natural world, transnational modes of thought and knowing, and revitalising traditional indigenous knowledge.

The first theme concerns the pursuit of more harmonious interactions between human groups and the natural environment. A theme that has direct significance in today's environmental crisis, and in the impact of current fashion and textile systems. This theme is deepened by the lived heritage of indigenous communities in particular ways of knowing, seeing and being. Royal (2005) describes formal indigenous culture as one that flips and reframes human consciousness by allowing the natural world to educate human thought and experience.

This whakapapa-based relationship with nature holds valuable data as evidenced in the cumulative historical and cultural ecology embodied within indigenous languages, practices, values, place names, songs, and stories. These are as relevant today as they were centuries past. Indigenous knowledge in the form of observations, innovations, practices, and beliefs continues to demonstrate a harmonious relationship with natural resources. Recio and Hestad (2022) note that while indigenous territories account for about 20 per cent of the Earth's area,

[3] Waiata/songs, ruruku/incantation, karakia/prayer, whakapapa/genealogies and kōrero/narratives and stories.

they hold 80 percent of the world's surviving biodiversity, "… evidence that Indigenous Peoples are the most effective environmental stewards" (p. 1).

The second key theme is the interdisciplinary and cross-boundary exchange of ideas and knowledge. Here, the interweaving of knowledge across disciplinary boundaries and knowledge domains is investigated. This stems from the notion that indigenous knowledge is "holistic"—that is, interconnected and relational—and that all life is interlinked. Comprehending relationships through this lens is the key to understanding the world from an indigenous perspective.

He Kura Toi, He Toi Hou seeks to apply and encourage a rethinking of the textile and fashion production model through a Te Ao Māori lens as described by Royal (2005). Furthermore, current values based sector models (LCA, C2C, S2S),[4] relate to this kaupapa that builds critical awareness of the interconnectedness of the world's limited resources and the knowledge sharing across sectors, people and geographical boundaries needed to understand the impacts of the textile supply chain. Engaging in traditional textile practices allows a different way of understanding the environment from which we rely on for our garments and through this, informs the choices and pathways we take in future.

The third and critical theme is the retention and revitalisation of indigenous populations' traditional knowledge bases, particularly knowledge that has declined due to colonisation. This theme is intimately related to the global aspiration of indigenous peoples to transcend their colonial history and restore and construct futures inherent in indigenous foundations. Royal (2005) situates cultural retention and revitalisation within a broader paradigm of cultural creativity and innovation, one that turns to the knowledge of the past to inspire answers and solutions to present and future issues. Specifically, Royal (2005, p. 4) states, "...the revitalisation of traditional knowledge is as much about understanding our future as it is about our past" (p. 4).

Models of sustainability

Models of production such as cradle-to-cradle (C2C) and soil-to-soil (S2S) take a holistic view to materials and material flows focussing on designing for next use rather than end of life. In C2C, nutrients (materials) are modeled to flow through two perpetual cycles; biological and technical. In the biological cycle, nutrients metabolise through regenerative cycles of growth and use such that they can be safely reintroduced into the environment after use—not as waste, but to act as 'nutrients' for new growth. In the technical cycle, materials are optimised during their design and production to allow them to be reintroduced to new technical cycles.

The framing of materials as nutrients immediately shifts the perception of materials as resources for consumption and waste, to that of an ongoing source of useful 'ingredients.' Rather than cradle-to-grave, which is a take, make, waste system, cradle-to-cradle follows a

[4] LCA: Life cycle analysis, C2C: Cradle to cradle, S2S: Soil to soil

take, make, retake and remake system. In this, the model also acknowledges the interconnected relationships and interactions between people and the ecology of Te Ao Māori. As Royal (2005) describes, “Knowledge is seen as an energy rather than a finite product, equivalent to the world rather than a representation of it” (pp. 3–4). Similarly, life cycle analysis, as a tool acknowledges the interconnectedness of the various phases of a garments life, such that one phase is not optimised at the cost of another as the total impact is measured across a garments lifecycle.

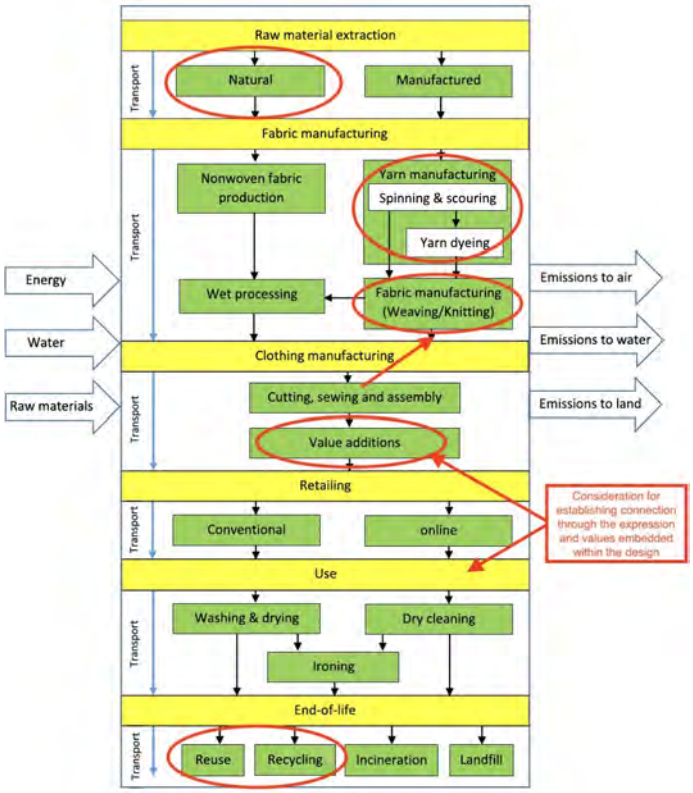


Fig. 1. A generic life cycle diagram for clothing.

Figure 1: A generic life cycle diagram for clothing (Munasinghe et al., 2021). Areas of focus within this research to date are marked in red.

For the purposes of this paper, the research narrows in on the development of knitted wool garments, outlining considerations, practice and findings at each stage. Of note:

1. Wool is not a native fibre to New Zealand. Smith and Te Kanawa (2008, p 128) note that, “Prior to European contact, NZ had no hair or fur-bearing animals apart from the Polynesian dog, kuri.” However, sheep, and sheep farming are now a prominent part of our local ecology.

2. Knit as a textile fabrication is not an indigenous practice.

3. The project was not linear in its investigation, with various phases being investigated in parallel.

That is, rather than this being a direct application of indigenous knowledge, the research seeks to draw from the value set contained within mātauranga Māori and its practices in applying indigenous knowledge and principles of kaitiakitanga to locally sourced and manufactured fibre and fabrication processes. In this, it starts to investigate potential, with the intention to map findings against a model of regenerative and sustainable fashion and textile practice in the future.

Practice

Raw material extraction

Context / considerations	Locally, there has been significant investment in reducing the environmental impacts of wool production. Visible shifts have been seen in areas such as merino wool production, with programmes such as ZQ providing standards for fibre quality, animal welfare, care for the environment and social responsibility. A partnership established in 2022 between associated regenerative wool platform ZQRX and the Savory Institute's Land to Market Programme is targeted at accelerating regenerative agriculture and indicative of continued drive to reduce the environmental impact of wool production (The New Zealand Merino Company, n.d.). Of note, merino wool makes up about 20 per cent of New Zealand's wool clip and while the changes noted above are encouraging they are not representative of the wool sector as a whole.
Practice	No current practice in this area
Findings and/or future practice	The researchers are interested in further exploring the work of Fibreshed – a non-profit organisation that develops regional fibre systems and whose principles are closely related to Te Ao Māori perspectives. Fibreshed (n.d.). note, "Grazing sheep can restore soil health while processing wool from raw fiber to finished product can revitalize regional manufacturing." Their focus is on implementing climate benefitting agriculture, rebuilding regional manufacturing, and connecting end-users to the source of their fiber through education. Of particular interest is their Climate Beneficial™ Agriculture programme intended to contribute to the stabilisation of our climate, and their Soil to Soil (S2S) model similar to C2C's biological cycle.

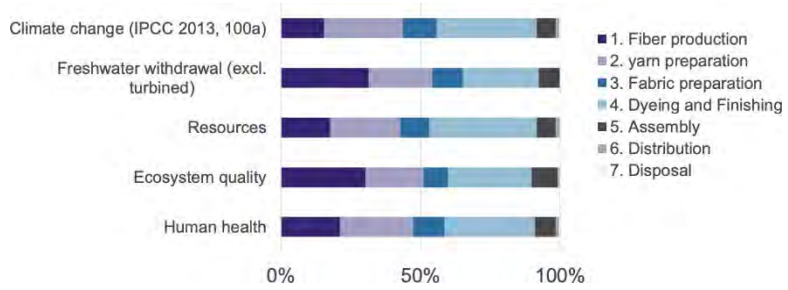
Fabric manufacturing > scouring and spinning

Context / considerations	Not as visible as in raw material extraction, but just as significant, are shifts in areas such as wool scouring and yarn spinning. Woolworks, New Zealand's only wool scouring provider, and the largest in the world, are committed to reducing their environmental impact having already implemented changes around recycling of water and waste streams, and are on their way to totally decarbonising their Timaru site. Woolworks are also committed to high standards of animal welfare, and support the traceability of New Zealand's wool (WoolWorks, n.d.) Similarly at WoolYarns, New Zealand's largest knitted yarn spinner, changes have been made to lower energy and water consumption, eliminate harmful chemicals in dyes and processing, and develop repurposed and recycled yarn programmes, alongside established standards such as ZQ certified fibre production (Woolyarns, n.d.).
Practice	In this practice, the worsted spun, undyed yarn from WoolYarns was spun offshore. However, the research recognised that local production was possible.
Findings and / or future practice	As for 'Raw material extraction' above, Fibreshed's Climate BeneficialTM Agriculture program and their Soil-to-Soil (S2S) model provide interesting insight that could be applied to future practice or modelling.

Fabric manufacturing > yarn dyeing

Context / considerations	When considering the environmental impact of today's fashion industry, raw material production and end-of-life are often perceived to be the biggest contributors, while the processing stage of the supply chain, including pre- treatment, colouration (dyeing and printing) and finishing, is sometimes disregarded. However, in the Quantis (2018) report[5] apparel baseline results showed that for all indicators, Dyeing and Finishing, Yarn Preparation and Fibre Production life cycle stages are the three main drivers of the industry's global pollution impacts. The table below (Quantis, 2018, p. 19) taken from the report, shows the contribution of each life cycle stage of the global apparel industry by each of the five impact indicators. This indicates the extent of work needed in the Dyeing and Finishing stages.

[5] This report conducted a detailed evaluation of the environmental implications across apparel and footwear industries' value chains based on the World Apparel Life Cycle Database (2016 baseline data).



Indigenous dyes are pigments that come from minerals, invertebrates, or plants in the local ecology. Indigenous people in different regions of the world have long held substantial and unique knowledge about the colouring characteristics of local plant and animal species. As Smith and Te Kanawa (2008, p. 127) note, "...we forget the ingenuity of our ancestors from many cultures who discovered how certain coloured natural substances could be fixed or bound to objects, to give a durable finish that resisted removal by water, wash-fast, or fading by exposure to light– light-fast." This traditional knowledge is inextricably linked to each culture's art, symbolism, and religious beliefs, as well as its medicine (the majority of dye plants and animals are also medicinal). However, such expertise is swiftly fading (Cardon, 2010).

Early literature references both indigenous dyes and early use of wool by Māori. A paper in the NZ Journal of Agriculture from 1918, references numerous dying experiments undertaken by the Department of Agriculture with bark and wood of various species of Coprosma. The author, B.C. Aston documents experiments dyeing woollen goods with Coprosma Grandifolia, (Kanono) and provides instruction (targeting home industries and spinning societies) for dyeing with both the bark and the wood of the kanono plant. It is assumed from the literature that Māori did not collaborate in, nor were a target audience of, the research.

Aston (1918) further notes that Māori unravelled the woollen yarn from the brightly coloured nightcaps or neckcloths for working into the ornamental borders of their most valuable kaitaka.[6] This demonstrates that the Māori valued European colours. In examples held in the Auckland and Wellington museums, the vivid red and blue woollen threads can be clearly distinguished from phormium.
More recently, there has been increased research in this area as shown in the work of Smith and Te Kanawa (2008).

[6] Kaitaka are the fine flax cloaks of chiefs, made from top-quality muka (flax fibre) and bordered with tāniko (geometric patterning). Woven into them is a story of great artistry and innovation. https://collections.tepapa.govt.nz/topic/3632

	This project adds to this kaupapa through an investigation into traditional indigenous dyes and pedagogies and whether these could reframe and influence current, textile and garment manufacture practices.
Practice	In this phase, the project engaged wānanga[7] based learning through intergenerational transmission of knowledge with rangatahi from Te Wharekura o Te Pihipihinga Kākano mai i Rangiātea Kura Kaupapa Māori and mātanga[8] Māori (holders of traditional knowledge). These included Whaea Mako Jones (mātauranga Māori – rāranga/tāniko/mahi toi) and Hemi Sundgren (mātauranga Māori – whakairo/tā moko/mahi toi/te reo Māori). Dye substrates were extracted from indigenous plants and pigments sourced locally. The value of indigenous knowledge was highlighted in Whaea Mako's instruction concerning the harvesting of native plants at varying time points within the project as aligned to maramataka Māori (Māori Lunar/ Stellar Cycles). These time points affect the hues that result; plant matter picked at one time of the year will not always create the same tones as harvesting from the same plant at a different time of the year. Similarly, climatic conditions and soil also influence hue results. The multiple colour variations one plant may hold was demonstrated during testing where the same harvested plant imparted hues and strengths of various colours. Principles of kaitiakitanga around the use and care of the dye sources ensured the future of the species was protected. Only readily available sources were used, karakia were recited before harvest, and harvesting was restricted to amounts that would not destroy the source. All plant extracts were regenerated and reused with new harvests and there was very little to nil water loss. While indigenous dyes were applied to plant-based fibres such as harakeke, this research tests the dyes on a range of other fibres (cellulose, protein and synthetic). The results indicated that muka had the best dyeing ability of all samples tested, with specific protein substrates responding best of all protein and cellulose fabric substrates, having the highest staining rates in both mordanted samples and non-mordanted samples with excellent dyeing ability imparting the maximum colour retention and wash-fastness properties.

[7] 'Wānanga based learning' refers to the transmission of tribal knowledge and lore including traditional cultural, religious, historical, genealogical and philosophical knowledge.
[8] 'Mātanga' refers to an experienced person, expert, specialist or practitioner.

	Raw merino wool (both with mordant and without) resulted in the least amount of imparted hue. Colour strength of all merino wool samples, shown in the image below, was significantly less than all other protein and cellulose fabric substrates. 
Findings	All indigenous dyes used contained zero hazardous chemicals being 100 per cent biodegradable and environmentally sustainable. The harvest, processing and application of these pigments with natural fibres is an integral part of the ecological and cultural legacy of ancestral Māori knowledge and offers an alternative to the health and environmental impacts associated with synthetic dyes and mainstream textile systems. The sharing of knowledge and practice also needs to be considered within the context of treating 'knowledge as a living energy', as discussed by Royal (2005, p. 3 – 4). Our interaction and engagement with knowledge holders and the natural ecology is akin to a whakapapa based relationship. This needs ongoing care and feeding, as opposed to the relationship and ecology being a finite product to be 'used' and 'taken' at will. A one-sided relationship without 'reciprocation' or 'giving back' will not be sustainable and is instead extractive. Limiting the sharing of knowledge to direct or established relationships also ensures the principles of kaitiakitanga are practised, alongside holistic considerations that draw from experiential knowledge of ecological impacts and cultural significance. For example, scaling production of plant based dyes would need to be done in relationship with the surrounding environment and people - indigenous-led.

	The sharing of knowledge between rangatahi and mātanga also acted as a revitalisation and retention tool, connecting a younger generation to ancestral knowledge alongside modern/western science works across disciplines and cultures as discussed in theme two. Within this sharing is not just the process of harvesting and dyeing fibre or cloth, but also the cultural significance of plants and hues. Further, this served to raise awareness of the environmental and ecological impacts of textile and fashion production, empowering a younger generation to make informed choices grounded in indigenous and cultural knowledge.

Fabric manufacturing + clothing manufacturing

Context / considerations	Advances in digital knit technologies and their associated software results in increasingly sustainable knitwear production. Design and construction processes such as fully fashioned and WHOLEGARMENT knitwear, in which fabric is knitted to the desired shape, provide a means for minimal waste production. Further, these techniques allow for fabric and form to be constructed simultaneously, essentially reducing the number of stages in a garment development, and potentially its environmental impact. Alongside the physical construction, the software allows for virtual design including 3D simulations on customisable avatars. With the haptic and visual aesthetics of a knitted textile being constructed in the same process as the garment form there are many variables at play. The effectiveness of the virtual interfaces in Shima Seiki's Apex design system is such that design details, down to a stitch level, can be reviewed and redesigned in the digital space as many times as required with minimal impact on the garment's LCA/impact and reducing the degree of physical sampling required.

Practice	The images below show a beanie/potae knitted using the WHOLEGARMENT construction technique, with no post-fabrication construction needed. Following fabrication this sample was dyed using traditional dyeing methods.   To date, WHOLEGARMENT shorts and jerseys with taaniko patterning have also been developed.  

Findings and / or future practice	Digital knit technology and WHOLEGARMENT knitwear is somewhat akin to traditional weaving techniques both as a practice and a values-based approach. When talking about an indigeneity of the future, we turn again to Royal (2005) who notes, “The task here is to think about indigeneity as a way of being in the world that may improve or at least contrast with current worldwide dilemma of humankind as consumer and exploiter” (p. 3). In this sense then, a further consideration is our level of consumption, returning to a philosophy of producing only what we need. For context – today we are eight billion people. Global demand for apparel is still rising significantly with the volume of clothing used worldwide expected to increase by 63 per cent by 2030, from 62 million tonnes to 102 million tonnes—or more than 500 billion extra T-shirts. Clean Clothes Campaign[9] estimate total apparel sales to reach 160 million tonnes by 2050, or approximately three times today's level (Clean Clothes Campaign, n.d.) Of note, New Zealand has retained an onshore knitwear industry allowing for local production and significant reductions in carbon footprint of offshore production. While the industry does not currently offer on-demand production, the minimal set-up required for digital knit technologies makes this a future possibility, and we have observed an increasing openness to small-batch production.

[9] A global network of over 235 organisations operating in over 45 countries

Use / End of Life

Context / considerations	In research investigating the environmental impacts associated with the production, use, and end-of-life of a woollen garment, Wiedemann et al. (2020) note that, "... the number of garment wear events and length of garment lifetime was found to be the most influential factor in determining garment impacts" (p. 1486). They further explain that consumers have the largest capacity to influence the sustainability of garments by maximising lifespan. As such, we draw on the traditional value of 'He Taonga Tuku Iho' which generally refers to the 'treasures passed down from our ancestors' and further embodies the guardianship—caring, nurturing and preservation of such heritage items. If we break this phrase down, taonga relates to something of immense value and tuku iho represents the action of passing down. This places a focus on a relationship-based understanding of heritage through distinct stories and narratives. Design for longevity and purpose, increasing the lifespan of a garment through the process of retaining with the intent of handing it down, and cultural identity connections are all considerations of indigenous design which creates an opportunity for a deeper connection between the wearer and the garment, transitioning roles from consumer to kaitiaki (guardian).
	Of note, Woolmark has referenced this report noting the need for a cradle-to-cradle approach to be included in LCA tools in order to truly account for the garments life cycle impact. They explain that many sustainability rating agencies do not account for all life stages in their environmental rating index. They quote author, Dr Steve Wiedemann, noting, "Several significant environmental impacts and processes are excluded from the MSI[10] including the use phase, recyclability, biodegradability, renewability of resource used, microfibres, abiotic resource depletion (minerals) and abiotic bioaccumulation" (Woolmark, n.d., para 8).

[10] Material Sustainability Index

Practice	A key consideration in this project was how to support the exploration and expression of traditional Māori forms and motifs, essentially engaging with digital design as a new tool for indigenous textile design application, retention and reconnection. The exploration of the virtual and digital design space has opened further dimensions of design form and technique, increasing the opportunity to create garments and grow textile designs that deeply connect and resonate with whānau. As discussed above, deep connections to garments that connect with the wearer's identity (either through material, design or function) are less likely to be discarded. Further, having a virtual space without the need for physical manufacture creates an easily accessible, more sustainable environment to explore both traditional knowledge and new knowledge applied to the fabrication of indigenous textile and apparel design.   
Findings and / or future practice	In reference to the discussion of 'He Taonga Tuku Iho' above, future practice in this area will work to explore the value that can be embedded within a garment's design through expressions of cultural elements and identity that allow for meaningful connections.

Discussion

This paper provides a summary of practice and considerations to date within the long-term aim of mapping indigenous and traditional value sets to an indigenous design framework. The intention of such a framework is to counter the current linear textile system and provide an alternate indigenous design life cycle for contemporary fashion and textiles. Further research into similar contemporary models that draw from indigenous knowledge will inform ongoing development of this framing.

Some areas of further research and practice have been identified in the tables above. Also of significance is how this learning is facilitated. As set out in the themes above, culture and knowledge sharing—and in this context—education, are intricately interwoven. The separation of these has proven devastating to indigenous peoples across the world, resulting

in cultural decline, identity loss, and disengagement from mainstream schools and institutions. As we look to a reframing of current sector practice for fashion and textiles, this same thinking should also be applied to dominant Eurocentric education systems. In this, it is essential to consider the kaupapa that questions, "What foundations and institutions do Māori require to address their cultural needs (Te Ao Māori) while also providing the skills and routes required in the pursuit of new knowledge and technologies?"(Hook, 2007, p. 2).

For Māori, honouring of ancestors through tikanga has transformative consequences that reach beyond the individual to the communal and intergenerational. Reclaiming mātauranga Māori as a way of knowing and being has the potential to be both transforming and empowering. The task is to come to a point where Māori and indigenous knowledge and practices are not merely strands woven into our experiences but are the bedrock of them (Simmonds, 2017).

Specifically, in the context of contemporary and digital design environments, the research will also examine how textile and design practices and knowledge that was traditionally held within whakapapa based models can be protected within a digital and easily replicable technological space. For example, an increasing use of Māori motifs and forms is seen in digitally printed textiles and three-dimensional printing, where design attributes can be easily replicated without knowledge of their cultural meanings or consideration for the customs of their use.

Practice to date has demonstrated that the digital knit medium allows for cultural exploration and connection, and in doing so the process can provide technologically-inclined rangatahi a more accessible means for connecting to their tīpuna (ancestory) and ahurea tuakiri (identity). Ideally, this would be framed within the indigenous value sets that are inherent in the knowledge sharing within the traditional whakapapa model, such that the knowledge is protected and the outcomes are sustainable.

Conclusion

This project is providing an opportunity for learning beyond the development of environmentally safe and sustainable textiles and zero waste fashion production. It also provides an opportunity to explore how kaitiakitanga and mātauranga Māori can inform, transform and innovate current practices through building critical awareness and key learnings around indigenous-led solutions.

Specifically, it prompts us to think critically about the positive contributions of indigenous knowledge systems and encourages a decolonisation of current sector practice to help inform and lead change within the fashion and textile industries; explores traditional technologies for the utilisation of flora and fauna as applied to textile production; and leans into new technologies as both a catalyst for sustainable textile innovation and as a tool for revitalisation of indigenous knowledge systems.

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