

CURRICULUM AND LANGUAGE IN AOTEAROA NEW ZEALAND: FROM SCIENCE TO PUTAIAO

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ABSTRACT. What becomes of knowledge when a language has been displaced through colonisation and is being recovered and revitalized? In the 1970s in *Aotearoa* (the Maori name for New Zealand), Maori began teaching their children through the medium of *te reo Maori* [Maori language] (L1) in an attempt to save it from extinction. This paper explores the translation work in relation to a new technical language development (L3) based on the language of instruction (L2) for a new Maori language science curriculum [*putaiao*]. We argue that the development of new terminology, no matter how culturally sensitive the process is, creates new problems. First, the new words can be perceived as representing traditional knowledge and, secondly, traditional Maori knowledge will be erased with the new language. The challenge presented to all concerned is how students will develop a more authentic experience of Maori language, knowledge and culture. The paper argues that the journey between science and *putaiao* is an ongoing transformation based on language and the epistemology held within and is made more complex by the relationships that exist between L1 (home), L2 (school), and L3 (discipline specific) in a language revitalization context.

KEYWORDS: curriculum, indigenous L2 education, Maori-medium education, Maori science, *putaiao*, science education

Dutch

Samenvatting [Translated by Tanja Janssen]

Wat gebeurt er met kennis wanneer een taal verdronken is door kolonisatie en dan herwonnen wordt en nieuw leven ingeblazen? In de jaren 70 van de vorige eeuw begonnen Maori in *Aotearoa* (de Maori naam voor Nieuw-Zeeland), hun kinderen les te geven in *te reo Maori* (Maori taal) (L1) in een poging om de taal te behoeden van uitsterven. In deze bijdrage onderzoeken we het vertaalwerk in verband met de ontwikkeling van een nieuwe technische taal (L3) die gebaseerd is op de instructietaal (L2) voor een nieuw curriculum voor de natuurwetenschappen in Maori taal (*putaiao*). We betogen dat het ontwikkelen van nieuwe terminologie nieuwe problemen veroorzaakt, hoe cultuurgevoelig men ook te werk gaat. Ten eerste vertegenwoordigen de nieuwe woorden traditionele kennis, en ten tweede zal traditionele Maori kennis met de nieuwe taal worden uitgewist. De uitdaging is hoe leerlingen een meer echte ervaring met Maori taal, kennis en cultuur kunnen krijgen. We betogen dat de uitwisseling tussen wetenschap en *putaiao* een doorgaande transformatie inhoudt, gebaseerd op taal en de epistemologie, die nog complexer

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wordt door de relaties die bestaan tussen L1 (thuis), L2 (school) en L3 (vakspecifiek), in een context waarin een taal herleeft.

Keywords: curriculum, inheems L2 onderwijs, onderwijs met gebruik van Maori, Maori wetenschap, *putaiao*, (natuur)wetenschappelijk onderwijs

French

Résumé [Translated by Laurence Pasa]

Qu'advient-il de la connaissance quand une langue a été déplacée par la colonisation et lorsqu'elle est récupérée et revivifiée ? Dans les années 70, en Aotearoa (le nom maori de la Nouvelle Zélande), les maoris ont commencé à enseigner aux enfants en langue *te reo Maori*, ou langue maorie (L1), afin de tenter de la préserver de l'extinction. Dans le cadre du nouveau programme d'enseignement des sciences en langue maorie (*putaiao*), cet article s'intéresse au travail de traduction lié au développement récent d'un langage technique (L3) basé sur la langue de l'enseignement (L2). Nous arguons du fait que le développement d'une nouvelle terminologie, quel que soit le bien-fondé culturel du processus, crée de nouveaux problèmes. D'abord, parce que les nouveaux mots peuvent être perçus comme des représentations de la connaissance traditionnelle. Ensuite parce que, avec l'apparition d'un nouveau langage, la connaissance maorie traditionnelle sera effacée. Le défi présenté à tous porte sur la manière dont les élèves pourront développer une expérience plus authentique de la langue, des connaissances et de la culture maories. L'article suggère que le passage entre la science et le *putaiao* engage une transformation continue basée sur le langage et l'épistémologie qu'il renferme et qu'il est rendu plus complexe par les rapports existant entre L1 (langue de la maison), L2 (langue de l'école), et L3 (spécificité disciplinaire) dans un contexte de revitalisation linguistique.

Mots-clés : programme d'enseignement, éducation indigène en L2, instruction en maori, science maorie, *putaiao*, enseignement des sciences

Italian

[Translated by Manuela Delfino]. Cosa accade alla conoscenza dopo che una lingua è stata rimpiazzata dalle colonizzazioni e si trova nel mezzo di un processo di recupero e rivitalizzazione? Negli anni '70, in Aotearoa (nome Maori per Nuova Zelanda), i Maori hanno iniziato a insegnare ai loro bambini per mezzo del *te reo Maori* (lingua Maori) (L1), nel tentativo di salvarla dall'estinzione. Questo articolo indaga l'opera di traduzione in relazione allo sviluppo di una nuova lingua specialistica (L3), basata sulla lingua dell'istruzione (L2), per un nuovo curriculum scientifico in lingua Maori (*putaiao*). Sosteniamo che lo sviluppo di una nuova terminologia crei nuovi problemi, indipendentemente da quanto il processo sia sensibile alla dimensione culturale. Prima di tutto le nuove parole possono essere accolte come rappresentative della conoscenza tradizionale e, quindi, la conoscenza tradizionale Maori sarà cancellata dalla nuova lingua. La sfida che si propone a tutti riguarda il modo in cui gli studenti svilupperanno esperienze autentiche di lingua, conoscenza e cultura Maori. L'articolo sostiene che il percorso tra la scienza e il *putaiao* (scienza/e, in Maori) sia basato su una trasformazione progressiva della lingua e dell'epistemologia che la contiene e che sia reso più complesso dalle relazioni esistenti tra L1 (casa), L2 (scuola) e L3 (specifiche discipline), in un contesto di rivitalizzazione linguistica.

Parole chiave: curriculum, educazione linguistica in L2 indigena, educazione in Maori, scienza Maori, *putaiao*, educazione scientifica

Polish

Streszczenie Translated by Elżbieta Awramiuk]

Co się dzieje z wiedzą, kiedy język znika podczas kolonizacji, a następnie jest odkryty i przywrócony do życia? W 1970 w Aotearoa (maoryjska nazwa Nowej Zelandii), Maorysi zaczęli uczyć swe dzieci za pośrednictwem *te reo Maori* (języka maoryjskiego) (L1) w próbie ocalenia go przed zagładą. Niniejszy artykuł bada pracę translacyjną w relacji do rozwoju nowego języka technicznego (L3) opartego na języku nauczania (L2) dla nowego maoryjskiego programu nauczania przedmiotów ścisłych (*putaiao*). Twierdzimy, że rozwój nowej terminologii, bez względu na to, jak bardzo kulturowo wrażliwy jest to proces, stwarza nowe problemy. Po pierwsze, nowe wyrazy mogą być postrzegane jako reprezentujące tradycyjną wiedzę, a po drugie – tradycyjna wiedza maoryjska będzie wymazywana wraz z nowym językiem. Wyzwanie, jakie stoi przed wszystkimi zainteresowanymi, polega na tym, jak uczniowie będą rozwijać bardziej autentyczne doświadczenia z językiem maoryjskim oraz maoryjską wiedzą i kulturą. W artykule dowodzimy, że podróż między nauką a *putaiao* jest nieustającą przemianą opartą na języku oraz zawartym w nim obrazie świata i jego swoistych strukturach poznawczych. Komplikuja ją relacje zacho-

dzące między językiem L1 (domowym), L2 (szkolnym) i L3 (właściwym danej dziedzinie) w kontekście odrodzenia języka rodzimego.

Słowa-klucze: program, lokalna L2 edukacja, edukacja za pośrednictwem języka maoryjskiego, maoryjska nauka, *putaiao*, nauczanie przedmiotów ścisłych

Portuguese

Resumo [Translated by Paulo Feytor Pinto]

O que acontece ao conhecimento quando uma língua deslocada através da colonização está a ser recuperada e revitalizada? Nos anos 1970, em *Aotearoa* (designação maori da Nova Zelândia), os maoris começaram a ensinar os seus filhos em *te reo Maori* (língua maori) (L1) na tentativa de salvar a língua da extinção. Este texto analisa o trabalho de tradução relativo ao desenvolvimento técnico da língua (L3) para um novo currículo de ciências em língua maori (*putaiao*), baseado na língua de ensino (L2). Argumentamos que o desenvolvimento de novas terminologias, independentemente da sensibilidade cultural do processo, cria novos problemas. Em primeiro lugar, as novas palavras podem ser encaradas com representativas do conhecimento tradicional e, em segundo lugar, a nova língua pode eliminar o conhecimento tradicional maori. O desafio para todos os implicados é saber como terão os estudantes uma experiência mais autêntica da língua, do conhecimento e da cultura maori. No texto, defende-se que a passagem da ciência para a *putaiao* é uma transformação gradual baseada na língua e na sua epistemologia

Palavras-chave: currículo, educação indígena em L2, educação em língua maori, ciência maori, *putaiao*, educação científica

Spanish

Resumen [Translated into Spanish by Cintia Ortiz from Benemérita Escuela Normal Veracruzana, Mexico]

Currículo y lenguaje en *aotearoa*, nueva zelanda: De la ciencia a *putaiao*

¿Qué pasa con el conocimiento cuando una lengua ha sido relegada a través de la colonización y después es recuperada y revitalizada? En los años setentas en *Aoteroa* (Nueva Zelanda en idioma maorí), las personas empezaron a enseñar a sus hijos mediante el *te reo maorí* (lenguaje maorí) (L1) en un intento por salvarlo de su desaparición. Este estudio explora el trabajo de traducción con relación a nuevas técnicas de desarrollo de la lengua (L3) basados en la enseñanza de la lengua (L2) para un nuevo currículo del lenguaje maorí y las Ciencias (*putaiao*). Nosotros argumentamos que el desarrollo de una nueva terminología, sin importar que tan culturalmente sensible sea del proceso, crea nuevos problemas. Primero, las nuevas palabras pueden ser percibidas como representaciones de saberes tradicionales, y segundo, el conocimiento tradicional maorí será eliminado por el nuevo lenguaje. El reto para todos los involucrados es analizar cómo los estudiantes desarrollarán una experiencia más auténtica respecto a la lengua, conocimiento y cultura maorí. El estudio argumenta que en la transición entre la Ciencia y *Putaiiao* es una transformación en curso basada en el lenguaje y la epistemología que la sustenta y se vuelve más compleja por la relación que existe entre L1 (casa), L2 (escuela) y L3 (la disciplina misma) en un contexto que tiene una lengua revitalizada.

Palabras clave: currículum, educación indígena (L2), educación en lengua maorí, ciencia maorí, *Putaiiao*, educación de las Ciencias

1. INTRODUCTION

The decline of Maori language since the turn of the twentieth century has led to efforts to revive or revitalize the language and culture through education, particularly schooling and curriculum. Early post-contact schooling was in *te reo Maori* [Maori language] but quickly changed to English by the mid eighteenth century and lasted until the 1970s. The emergence of Maori language schools and bilingual education has led to the development of some Maori language terminology for school science in a very short period of time. The creation of Maori language curriculum documents in the 1990s became the site for the development of large amounts of science terminology. This paper explores the issues that arose during this development. We argue that the transition from English to a technical terminology in Maori language

cannot be interpreted simply as a one-to-one translation because the construction of new words in any language inevitably involves a transformation of the underlying epistemology. Furthermore, after over 100 years of Maori language subjugation, the complex relationships between L1 (home), L2 (school), and L3 (discipline specific) are also politically driven. The writing of the Maori language science curriculum [*Putaiiao*] in the 1990s provides the context for the paper to explore the interactions: Who is authorised to develop new terminology? How do you go about developing a new terminology? What tensions do the new terms, and their effects on syntax and language, create with traditional Maori knowledge? And how does the new science language play out in classrooms and schools? In conclusion, we discuss two scenarios regarding the future of a science education in *te reo Maori*.

2. REINTRODUCING THE MAORI LANGUAGE TO THE CLASSROOM

Maori as a language of instruction was re-introduced into New Zealand classrooms in the late 1970s (Benton, 1981). In addition to reviving Maori language as the indigenous language of the land, the teaching of Maori has always been regarded as a means of promoting Maori cultural beliefs and practices, which are integral to each other. Bilingual programmes were initially set up in rural areas where a reasonable proportion of the Maori population was still Maori speaking. One of the many problems facing these programmes — and subsequent immersion education developments such as *kohanga reo* [language nests], i.e., Maori-immersion early childhood education institutions aimed at children under six years old, and *kura kaupapa Maori* [Maori-immersion schools based on Maori principles and philosophies] established in 1981 and 1985, respectively — was a lack of established vocabulary for classroom use. There were the expected problems of a dearth of resources and understanding of appropriate pedagogies for teaching an endangered language to students of whom the majority were English dominant with little exposure to Maori outside of the classroom setting. Maori teachers in these programmes were often native speakers of Maori who had been trained to teach in English classrooms; they simply coined their own terms when the need arose.

In 1986, Huirangi Waikerepuru and Nga Kaiwhakapumau i te reo Maori (a Maori-language, political-pressure group based in Wellington) lodged a successful claim to the Waitangi Tribunal arguing that Maori language was a *taonga* [treasure] and, therefore, guaranteed protection under the Treaty of Waitangi (Waitangi Tribunal, 1989). The government, acting on the recommendations of the Waitangi Tribunal report, established a Maori Language Act in 1987 and a Maori Language Commission that was subsequently known as Te Taura Whiri. The commission's task is to initiate, support, and develop policies that give substance to the status of Maori as an official language and, more broadly, of doing whatever it sees as appropriate to promote and maintain Maori as a living language (Harlow, 1993a). One of the commission's early activities was to alleviate the proliferation of existing vocabulary and create new vocabulary where gaps existed (see Harlow and Keegan, 2000, 2005, for details of processes and issues involved). Te Taura Whiri has also over-

seen the quality of Maori language used in the seven new Maori curriculum statements that appeared throughout the 1990s.

Kura Kaupapa Maori (KKM) was instigated in 1985 by parents concerned at the lack of state support for *kohanga reo* graduates; it received official recognition in 1989. By 1990, there were six KKM in existence. In 2004, there were 60 KKM, 20 of which have *wharekura* [can teach all subjects in the medium of Maori in the secondary school of years 9 to 13 (ages 13-18 years)] status. Initially, KKM differed from existing bilingual units in two ways: they are primarily based on Maori principles and philosophies, and they teach all subjects through the medium of Maori at all year levels. A number of bilingual schools were re-designated as KKM, some continued as bilingual schools, while some English-medium schools followed KKM practices and began offering immersion classes through the medium of Maori. Students learning through the medium of Maori attend bilingual/immersion classes or KKM. The bilingual/immersion classes operate within the structure of English-medium schools but the students are taught in English and Maori (bilingual) or in Maori only (immersion).

In 2004, approximately 14% of all Maori students (22,639) were enrolled in some form of Maori-medium education. The New Zealand Ministry of Education (NZME) classifies students learning through the medium of Maori by the percentage of curriculum instruction (i.e., classroom time) undertaken in Maori. Level 1 is 81-100% of instruction through the medium of Maori, Level 2 is 51-80%, Level 3 is 30-50%, and Level 4 is <30%. Of all Maori-medium students, 43% receive instruction at Level 1. The majority of students (85%) undertaking Maori-medium education are in the lower year classes (i.e., years 1-8) with the remaining 15% in years 9-13. This means that the vast majority of students who begin their education in Maori-medium settings complete their high school years (9 to 13) in English-medium schools. This illustrates the potential complexity and magnitude of the three languages (L1-home, L2-school, L3-discipline specific) for learning disciplinary discourse.

3. ISSUES IN DEVELOPING A MAORI LANGUAGE CURRICULA

Powerful political lobbying groups used the KKM philosophy of teaching all subjects through the medium of Maori to convince the Ministry of Education to provide a complete Maori version of its new curriculum framework of seven learning areas (NZME, 1993a, 1993b). New English language curriculum statements were progressively introduced to schools throughout the 1990s. Maori language versions of the statements were produced after the English versions and followed the structure of their English equivalents. Furthermore, the developers of *Putaiiao* were directed to maintain the achievement outcomes of the English science curriculum document, which meant that restructuring the document to any great extent was virtually impossible given a development time of six months (see McKinley, 1996, for a more detailed discussion). In many cases, the writers of the Maori language versions attempted to incorporate further Maori perspectives or viewpoints. The basic premise was each statement was not simply a literal translation but would incorporate Maori

perspectives that would be more relevant for students learning through the medium of Maori.

Providing a full curriculum in the medium of Maori was an extremely ambitious and unusual undertaking. Maori, as with most indigenous languages, is still a highly endangered language and lacked the technical language and vocabulary required for a modern curricula. As the language is spoken by less than 20% of the Maori population, the vast majority of students in Maori-medium education have little access to Maori language outside the classroom. Even for those students who have Maori at home, it is highly likely given the ubiquity of English in New Zealand that these students are also English-dominant; in other words, English is their primary language by the time they enter the compulsory school sector. It is well known that many immersion programmes around the world tend to teach technical/scientific subjects, especially in the higher year levels through the medium of a majority or increasingly an international language, especially English. Minority or indigenous languages are often still used for teaching subjects such as the humanities and arts. Indeed, New Zealand has tertiary institutions successfully teaching these subjects in Maori. However, it is argued that teaching technical subjects in the higher year levels requires specialist teachers familiar with appropriate pedagogies for indigenous immersion settings. Such teachers have always been in short supply in Maori-medium education; and coupled with a material resource shortage in the area, they are contributing factors to the low number of Maori-medium students in the higher year levels.

New school developments or systemic reforms, such as curricula, need to be disseminated widely and often require targeted professional development before teachers feel comfortable using these innovations. Such reforms also require supporting resources and activities that are based on the curriculum and can readily be used in classroom environments. Furthermore, teacher educators must familiarize themselves with such developments in order to adequately prepare beginning teachers for Maori-medium programmes. The preservice education of *putaiao* teachers poses a number of issues not seen in English-medium preservice education. At the primary (elementary) level of schooling, where *putaiao* is not a main focus of the integrated curriculum in New Zealand, the issues predominantly revolve around suitable classroom resources. A number of Maori-medium teacher education programmes produce a significant number of primary trained teachers. However, at the secondary (high) school level, the issues involve not just suitable classroom resources but also attracting students who have a 'two ways' education — that of western science and Maori language and culture, and a teacher education programme that can bring everything together in the medium of Maori (construction, resources, and delivery). While the number of *wharekura* teachers required is not large, getting a suitable teacher for KKM *putaiao* classes is extremely difficult. Currently, there are no Maori-medium *putaiao* teacher education programmes in Aotearoa New Zealand.

Developing a Maori language curriculum based on an existing English language framework provided many challenges and issues, many of which are still being contested at this writing. To our knowledge, no other indigenous group has attempted anything even remotely similar. The next section of this article highlights these issues using insights gained by direct involvement in the preparation of one curricu-

lum statement, *Putaiiao i roto i te Marautanga o Aotearoa* [Science in the New Zealand Curriculum] (NZME, 1993c, 1996), often referred to as *Putaiiao*. It is important to note that the actual production of a curriculum statement is only one phase of implementing a new curriculum.

3.1 *Putaiiao Language Development*

Language development for the first *putaiiao* document was the responsibility of the writing team and Te Taura Whiri. At that time, Te Taura Whiri followed loose guidelines for developing new vocabulary (see Keegan, 2005, for more recent changes): the new word must be short, transparent in its meaning if possible, and not a loan from the English language. While the first two guidelines are perhaps self-evident, the third guideline refers to the social, economic, and political position of Maori in Aotearoa New Zealand. In a time when many languages make use of an international terminology in scientific and other technical areas, Maori language seems to be avoiding them. Harlow (1993b: 129) argued that the position taken by Te Taura Whiri is directly related to the whole enterprise of education in Maori and that “to preserve the language as a living means of communication entails preserving it in opposition to and distinct from English.” In linguistic terms, this attitude is called purism. However, it is only purist with respect to English because of its strong impact in Aotearoa New Zealand; and loans from other languages (German, French, etc.) are admitted. Of disadvantage to Maori is that the language development for *putaiiao* (as with a number of other learning areas) took place over six months, an incredibly short period of time, in order to keep up with the demands of the education system.

The development of language for *Putaiiao i roto i te Marautanga o Aotearoa* presented an opportunity to develop a systematic approach to align scientific discourse (L3) by developing scientific terminology and to take into account some of the science education research that had already been carried out with respect to children’s understanding of science concepts. In the past, an ad hoc approach had been taken as new vocabulary was being developed without the wider relationships necessarily being known. As a result of this focused development process, some scientific vocabulary that had been published prior to the statement being written was changed. In order to write the *putaiiao* statement, approximately 600-700 new words were developed. It was decided by the writing team that one should be able to teach to the end of year 11 (15-16 year olds) through the medium of Maori. The science curriculum content over these years loosely guided what new words needed to be developed. Some specialized words used at this and lower levels were not translated, for example, the names of the elements in chemistry — although a word for oxygen already existed in the *lingua franca*.

The word-development process involved a number of steps. First, the *putaiiao* writing team identified English words, phrases, or meanings that required translation. Following identification, the team directors decided if the linguists or tribal contacts among the team could come up with a word (to be ratified or changed by Te Taura Whiri) or if it was recorded and went directly to Te Taura Whiri for cri-

tique and review. An appointed team at Te Taura Whiri began work on the list, gathering meanings and suggesting possible new words. About two weeks after the writing meeting and prior to its next meeting, the team directors and Te Taura Whiri representatives met frequently over two days and discussed scientific meanings and possible words. Decisions were made, and the words came back to the writing team for use – sometimes with comments about whether it was suitable or not. The result was a new *putaiao* dictionary for use in schools. The dictionary has since been revised, as teachers have tested the new language; and a new dictionary is underway. We must stress that the generative process of this language is ongoing, as with any other language. One of the main differences is that this process occurred in a very condensed period of time.

There are a number of recognized ways in which new vocabulary can be developed that were used in the *putaiao* development. These include:

- 1) Circumlocution. This is where the term is the meaning of the word. For example, the word mordant, meaning to ‘fix a dye’, is translated as *whakau kano*, literally translated as ‘to fix colour’.
- 2) Calquing. This is an accepted practice where words are made up of their indigenous morphemes, but their composition follows a model in some other language. For example, *waikawa* [acid] is based on the same concept as the German word for acid, Saure, being derived from sauer (bitter).
- 3) Separation of Everyday and Technical Words. The Learning in Science Project, carried out by a research team at the University of Waikato, Aotearoa New Zealand, found that sometimes children get confused between everyday meanings of words and their specialist meanings in science. For example, with words such as ‘force’ and ‘power’, children often brought the everyday applications to science, which often led to confusion. In developing a language after this research, we decided to distinguish between the different meanings by developing new words for science. In everyday language, *kaha* is used to mean strong, power, or force. In science, we developed *ngoi* for power and *topana* for force.
- 4) Specialisation of Existing Words. Some words have fallen out of use or changed over time. In these instances, the old words can be resurrected for specialised meanings. For example, *toke* and *noke* are commonly used to mean worm. *Ngunu* is a term for worm that has fallen out of use and now represents the genus of annelid.
- 5) Shortening Words. Some expressions became too long to explain the meaning of scientific terms and so words were shortened to form new words. For example, the expression for catalyst was translated into *whaka-* (causative prefix) *kokiki* [quick] and got shortened to *whakoki*.
- 6) Consistency. Many words were inconsistent in their translations as Maori-medium schools began 12 years before a Maori-medium curriculum was developed (Harlow, 1993b). Individual teachers often asked Te Taura Whiri for words as and when required for teaching, which led to an ad hoc development process. For example, solvent had been translated only in the sense of solvent abuse [*hongia kapia*], there was no word for solute, and solution was translated as *wairewa*. The development of curricula enabled a more consistent approach to word development so that solvent, solute, and solution became *whakarewa*,

rerewa, and *wairewa*, respectively (cf. *rewa* means melt, *wai* means water, solution).

3.2 *Putaiiao and Traditional Maori Scientific Knowledge*

Aotearoa New Zealand has included Maori language and knowledge, mainly through the use of Maori activities, in national school curriculum statements for the last 30 years. In the 1970s, curriculum developers included some Maori knowledge in classrooms, mainly in the subject areas of music, physical education, and arts. In Aotearoa New Zealand, Maori names have always been used as the common names of native trees, for example, *rimu* [red pine] and *kahikatea* [white pine]. These tree names are common throughout the country and have always been used by the scientific and school science communities alike. In addition, Maori contexts became relatively common in classrooms to act as a vehicle for science. For example, the in-ground method of cooking food using volcanic rock, fire, and steam practiced in many Maori communities (named *hangi*) came to be used to introduce concepts of heat transfer. This use of Maori contexts to introduce students to school science became known as *taha Maori* (literally, Maori side). *Taha Maori* approaches were criticized for being ill-implemented, providing non-Maori students with views of Maori perspectives but having little if any appreciable benefits to Maori students or validating Maori knowledge. While the amount of Maori contexts and language and the resources to support them have increased significantly in the science curriculum, our focus in this paper is on the *putaiiao* curriculum.

Leaving aside the issue of the extent that traditional Maori knowledge can be regarded as scientific in a modern western sense, real concerns are often expressed on the effects and changes the *putaiiao* statement may have on traditional Maori nomenclature (the term *nomenclature* appears in the *putaiiao* document; surprisingly, no Maori equivalent is given). For example, many traditional Maori species classifications, as with perhaps all indigenous languages, often do not directly match their English equivalents. The Maori word for fish [*ika*] traditionally referred to all creatures living in the sea or waters. Fish, classified according to a western science notion of structure and function, refers to vertebrate animals living in water with fins and gills. There are a number of traditional Maori terms for whales, thought to have applied to only specific species; however, the term *ika nui* [big fish] can also refer to whales. Again, in modern science, whales are not fish but rather mammals. The term *ngarara* or *ngangara* is the *putaiiao* term for insect; however, traditionally this term can refer to crawling entities that are much larger than insects, such as reptiles. The traditional term *aitanga pepeke* [insect family or perhaps jumping insects] is also used and glossed over in the curriculum statement. Presumably, *aitanga pepeke* are insects in a *putaiiao* sense; however, they are not always *ngarara* in a traditional sense. From a very young age, children are introduced to concepts of living and non-living and the subsequent classifications within each. Whilst this may not be problematic for many Maori children, its unproblematic use by science teachers could have cause for concern when young Maori children brought up with Maori as a first language suggest *pounamu* [a form of jade found in rivers] is a fish.

There is also danger that the *putaiao* statement attempts to authenticate itself as deriving from a traditional Maori knowledge base. Listed as one of the benefits on science is the following:

kia mau nga tikanga me nga taonga tuku iho a kui ma, a koro ma (to retain the traditional values, practices, and knowledge passed down from previous generations). (NZME, 1996: 8)

In addition, there are extensive references to Maori mythology, cosmologies, proverbs, and sayings throughout the document. However, what is often promulgated is not seen within the structure and content of the document. The contradiction is that, whilst traditional Maori is acknowledged but not always followed through, some aspects of traditional nomenclature are abandoned. Modern technology has caused us to close chapters on our knowledge through a loss of language associated with activities. For example, supermarkets supplying vegetables far more economically than was previously possible means most of us no longer practice *mahinga kai* [food growing]. Eliminating the need to cultivate, plant, weed, harvest, and store garden produce has resulted in the loss of language associated with such activities — and this loss of language means a loss of knowledge. Furthermore, when Maori terms are still available, they lack meaning without the associated experiences and activities. We are struggling at times to hold onto the remnants of our cultural heritage.

The obvious concern is that traditional Maori terminologies are not part of the curriculum; and if students and their teachers are not taught about traditional nomenclature, then it is both devalued as unscientific and lost. There is no place in Aotearoa New Zealand that is so isolated such that knowledge of a world untouched by others exists. Knowledge, like our language, has adapted with contact and continued to change along with our existence. Hence, leaving aside the idea of an authentic Maori knowledge from another era, it has been difficult to fully comprehend the implications of language use and knowledge in developing *putaiao* given our history of subjugation. While much knowledge exists in early ethnographic accounts of Maori at the time of European contact and some traditional knowledge continues to exist and be practiced in communities, it is difficult to work out how to research and develop *putaiao* so that students will develop a more authentic experience of Maori knowledge, language, and culture of the world.

3.3 Research on Putaiao and Language

In a recent research project regarding Maori students and science education, parents or caregivers, teachers, and students in a *wharekura* were interviewed about their experiences and expectations of *putaiao* (McKinley, Stewart, & Richards, 2005). The issue of language and knowledge did not feature highly among parents of an urban KKM. Their most pressing concern was that their children have competency in Maori language and understand *tikanga* [culture]. However, they were not convinced that learning science or *putaiao* in Maori at senior levels of school was desirable or required. Parents wanted their children's science related to their Maori heritage but were content with using Maori contexts in English. Examples cited were using the Maori calendar for fishing and gardening or *karakia* with *rongoa* [prayers

associated with using Maori medicine]. They had little to comment on regarding a Maori worldview of nature apart from it being holistic. This is not unexpected, as the circumstances mentioned at the beginning of this article have produced several generations of Maori who have missed out on intergenerational learning within the context of Maori culture and language.

Part of the challenge is that secondary school brings with it high stakes in the form of credentials. Parents and teachers are less willing to take risks as their children/students near real-world scenarios that involve mainly the economics of getting a job. For teachers, issues of translation for assessment or examination purposes at secondary school were the biggest concern. This debate is about whether examinations should be bilingual (Maori/English) or only in Maori. The problem is not about isolated scientific words but about deriving meaning and inference from words in context as some terms are polysemous (i.e., having multiple senses of the same form). The teachers at this KKM were not so concerned with language and traditional knowledge issues but more with language and science concepts for assessment purposes.

Students were not interested in learning science in Maori at the senior levels of school. Many saw science as an international and universal subject; as such, it did not require learning through Maori. The discourse of the global citizen in student interviews (evident with teachers and parents as well) dominated senior students' talk. The students interviewed had their entire schooling through the medium of Maori and were very proficient and articulate in both languages. However, the students of this single school spoke about senior biology (the only science offered in the school) being taught in English but not mathematics. The researchers suggested that this derived mainly from the difficulty the school experienced in getting qualified Maori-medium teachers of science but not mathematics. The students continue to learn mathematics in Maori through the end of secondary school and do not consider it in the same global citizen frame that they do science. In mathematics, they have a qualified teacher who is very proficient in the use of Maori language and has been deeply involved with the development of a mathematics lexicon.

The development of senior level assessment regarding science and *putaiao* reflects current capacity and practice. In the current senior assessment regime, called the National Certificate in Educational Achievement, all science assessment is directly translated into Maori. This provides a Maori-medium form of science — ostensibly to be used for *putaiao* but tends to exclude the use of Maori examples or contexts. Education providers outside the compulsory school sector have developed assessment standards that are sometimes used by *putaiao* teachers that do include Maori knowledge. These standards can be credited towards a national education qualification for the students. Topics include, for example, native freshwater and marine plant species used for *kai* [edible food], comparing western medicine with *rongoa* [Maori medicine] in relation to prevention and treatment, and knowledge of *tikanga Maori* [Maori protocols] of *rakau Maori* [indigenous trees] used for *kai*. These *putaiao* standards are available in English and Maori.

Unfortunately, to date, there has been no research done on what is happening in classrooms regarding what students are learning — science in Maori or *putaiao*. The reason for this is that the Ministry of Education does not see *putaiao* as a priority.

They are more interested in Maori students succeeding — in Maori or English — than seeing science change or Maori knowledge survive through schooling structures. From the beginning of the development of Maori-medium curricula, the Ministry of Education saw it as an exercise in translation — not one of the transformation of curriculum for Maori students through the medium of Maori language. This raises the last issue we wish to mention and that is the utility of *putaiao* beyond the *wharekura*. When the University of Waikato introduced *Tohu Paetahi* [a degree that could be taken through the medium of Maori], it was hoped that science departments would offer subject minors taught through the medium of Maori. However, this has not been realized as only two departments (computer science and linguistics) had this capacity; and it is unlikely to improve in the near future. This is not surprising as the *wharekura* themselves are having difficulty in staffing their *putaiao* programmes. As previously mentioned, there is no specific Maori-medium teacher education programme for *wharekura* teachers in the country. Hence, the *putaiao* teachers in *wharekura* have been educated in English-medium science classes and have also taken Maori language teaching classes. This form of teacher education assumes that the individual teacher can just add the two programmes together and come up with being teachers of *putaiao*, which contributes largely to what is constructed as *putaiao* currently in classrooms.

4. CONCLUSION

This paper focuses on the transformative role the production of new Maori terminology for science education plays on the underlying epistemologies of a language. The use of *te reo Maori* in schooling in asserting sovereignty, after an extended period of Maori language and knowledge being subjected to the hegemony of English, brings with this language initiative a political drive. As a result, complex relationships are set between the language domains of L1, L2, and L3 that affect the smooth and successful transitioning between them. In producing a technical terminology for learning science, New Zealand has found that new problems emerge. Maori have not been overwhelmed by the enormity of the task; we realize it will take more than our generation to complete this ambitious project. Furthermore, we understand that we have not covered all the issues that need attention for this project to succeed, such as syntax and its effects on epistemologies. This paper focuses on the practice of developing Maori language science terminology — rightly or wrongly. Driven by our desire to keep our language, culture, and knowledge, we have placed it into an institutional frame that we hope will help perpetuate it.

We believe there are two possible scenarios for the future of *putaiao*. Under current practices, *putaiao* will most likely be relegated to something done in *wharekura* and possibly forgotten. In this scenario, we will most likely continue with ad hoc developments, often based on anecdotal evidence. In addition, with little or no coordination in the production of resources, we will end up with uneven resource support for teachers to use in classrooms. Professional education opportunities for teachers will be sporadic and will tend to be short and ineffectual. We will continue to have concerns with translations and knowledge issues, given the current lack of interest

from most parties. Under this scenario, the future of *putaiao* — if it has one — will be difficult to predict.

The best case scenario would see the Ministry of Education, Maori communities, and schools working together to develop a programme where Maori would feel secure in the appropriate intergenerational exchange of knowledge. This would require regular reviewing of the curriculum document with various forums for debate between versions. These reviews and debates would be supported by research evidence in order to target what students, teachers, and Maori communities would need and like to have developed. Furthermore, there would be appropriate teacher education courses, appropriate resources developed, and ongoing professional development for teachers. To support it, universities would develop undergraduate and graduate papers in *putaiao* in collaboration with Maori communities, and they would be delivered in Maori. From this would arise new literacies in ecological sciences, resource management, and traditional ecological knowledge.

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