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# CULTURALLY RESPONSIVE PEDAGOGY: CONNECTING NEW ZEALAND TEACHERS of SCIENCE with THEIR MĀORI STUDENTS

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## ■ Abstract

This paper illustrates how important changes can occur in science learning and teaching if teachers take the trouble to understand and respect the cultural worlds of Indigenous students, and incorporate something of this understanding within their teaching practice. Ten teachers participated in a specially-designed one-year university postgraduate course, which encouraged them to incorporate into their classroom learning two Māori pedagogical principles, *ako* and *whakawhanaungatanga*. *Ako* is a responsive and reciprocal process, through which both teaching and learning roles are shared. *Whakawhanaungatanga* is the process of constructing relationships in the classroom between people, between students' cultural knowledge and domain knowledge. This paper draws on co-constructed narratives from four of the teachers, two Māori and two Pākehā (New Zealanders of European descent). The teachers built trusting and respectful relationships with their Māori students by facilitating connections between Western and Māori worldviews of science. They shared their teaching role with Māori elders (*kaumātua*) and members of the extended family of their students (*whānau*). The teachers learned a great deal from their Māori students who became highly engaged and agentic in their science learning. Students took collaborative responsibility for asking learning questions, and sought information on science topics from both Western and Māori worldviews.

## ■ Introduction

The out of school social and cultural contexts in which children grow up, and the values, beliefs and behaviours they acquire impact on how they "make sense" of the learning contexts they find themselves in at school. New Zealand mainstream primary classes increasingly include many students from diverse cultural, linguistic and experiential backgrounds that differ from those of their teachers. Among these students are Māori students whose Indigenous language and culture are rooted in the landscape and history of New Zealand. However, although the language, knowledge and cultural backgrounds of Māori students are just as rich as those of Pākehā (New Zealanders of European descent), and just as truly *belong* in this country, they are seldom affirmed or incorporated into the culture of teaching and learning within mainstream classrooms. Many Māori students struggle to find ways to engage and participate and "be themselves" in classrooms where their traditional knowledge bases and worldviews may be marginalised or ignored. Success for many Māori students in mainstream education has to come at the cost of their language and culture. This struggle is especially evident within the domain of science.

In New Zealand, student participation and achievement in science are equity and social justice concerns because science and technology play an important role in defining opportunities for future success (Ministry of Education, 2007). Although many New Zealand students scored highly in the OECD Programme for International Student Assessment (PISA) for scientific literacy, a significant proportion achieved below the minimum prescribed by PISA for scientific literacy, with Māori and Pacific Island (Pasifika) students over-represented in this group. In addition, the National Education Monitoring Project (NEMP) science studies have also reported that Māori and Pasifika students are achieving, on average, lower scores than Pākehā students (Crooks et al., 2007). Much deficit theorising has been engaged in by New Zealand educators and politicians to "explain" the underachievement of students from minoritised cultures such as Māori and Pasifika (Bishop et al., 2003; Bishop & Glynn, 1999; Hunn, 1960; Prochnow & Kearney, 2002). Deficit theorising routinely blames

minoritised learners for failing in educational contexts over which they have little or no power, and within which their cultural knowledge and lived experiences have little or no value. Much has been made also of the reported “achievement gap” between Māori students and majority culture students in New Zealand (Bishop & Glynn, 1999), just as it has in the United States, between African-American, Latino, and Indigenous native American students on the one hand, and white American students on the other (Ladson-Billings, 2006; 2008). Fortunately, these dominant culture discourses about the *achievement gap* between mainstream and minoritised cultures have been recently disrupted by discourses which talk instead about a *quality-of-service-gap* (Nasir et al., 2008), or about a cumulative *national debt* owed by successive governments to students and communities whose education has been “short-changed” by restricted access, underfunding, and denial of agency, over many generations (Ladson-Billings, 2006, 2008).

The funds of cultural knowledge of students from Indigenous and minoritised cultures have long been ignored or considered inferior, and of little worth, in mainstream classrooms. Nasir et al. (2008) argue that while *all* knowledge is cultural, there are important boundary and power differences to be addressed in the classroom and school, between cultural knowledge (knowledge commonly understood to be learned between students’ homes and communities) and domain knowledge (knowledge that is valued and prescribed within particular curriculum domains). While Nasir et al. (2008) write within the context of culture and *mathematics*, their rationale holds just as well for the context of culture and science (the words in brackets are ours):

... any discussion of boundaries between mathematical [or science] knowledge and cultural knowledge must respect that these issues of power are implicated in our definitions, issues of concern, and the very conversation in which we are engaged through our scholarship. Furthermore, knowledge is fundamentally tied to the kinds of people we [and others] view ourselves to be and the trajectory we [and others] view ourselves to be on. In other words, issues of identity are critical to understanding both the development of mathematical [or science] knowledge for individuals and communities but also to considering how we draw lines between cultural and domain knowledge (Nasir et al., 2008, p. 187).

When students continually find little or no evidence of their culture being reflected in the curriculum and pedagogy of the classroom and school, and find that the knowledge they do have is never called upon, there is a concern that they might experience the classroom

and school as alien, uncaring and unsafe places, where they do not belong, and for these feelings to be reflected in their challenging or disruptive behaviour, and truancy.

However, it is not only the funds of knowledge and experience of Indigenous and minoritised cultures, and their peoples’ identities that are so often ignored or undervalued in mainstream classrooms and schools. So too are their understandings of what constitutes effective *pedagogy*. Increasingly, the reported underachievement of Māori students in New Zealand is being understood as an outcome of classroom pedagogies that do not *respond* to Māori cultural identities and lived experiences (Bishop & Glynn, 1999; Bishop et al., 2003; Glynn et al., 2006; Bishop & Berryman, 2006).

In this paper we illustrate how four mainstream teachers were able to incorporate two Māori pedagogical concepts, *ako* and *whakawhanaungatanga*, into their teaching, to improve the engagement and understanding of their Māori students in science lessons. The first concept, *ako* (Pere, 1982; Metge, 1983; Glynn & Bishop, 1995), can be understood in terms of its meaning within the two words *kaiako* (teacher) and *akonga* (learner). *Ako* encompasses the collaborative and reciprocal nature of the learning process, where the roles of teacher and learner are fluid and interchangeable, and where both parties expect to benefit and learn from the culturally validated relationship and its associated responsibilities, to support and care for each other. *Ako* as an integrated process of teaching and learning, remains embedded in the life of the community and serves to maintain and enhance the knowledge and wellbeing of the community.

The second concept, *whakawhanaungatanga*, can be understood as building and maintaining cultural interconnectedness and collective identity with other people in one’s *whānau* (extended family), *bapū* (sub-tribe), and *iwi* (tribe). *Whakawhanaungatanga* is also understood as building and maintaining interconnectedness with one’s ancestors in terms of *waka* (confederations or groupings of different tribes). A person’s historical *waka* connects them to many others who descend from a particular traditional canoe on which defining ancestors voyaged to Aotearoa (New Zealand). A person’s *waka* connects them also with specific locations and landscape features (such as mountains, rivers, lakes and forests). A Māori person’s collective identity is very strongly defined both by association with others who affiliate with particular geographic locations and landscape features, and by association with others who descend from particular important ancestors.

Building and maintaining these relationships is all-important. Traditionally, acquiring and maintaining this knowledge was central to one’s very safety and survival. In the present, knowing and being able to identify or

construct these connections continues to be central to one's status and wellbeing. When Māori students are able to "be who they are" in the classroom, processes of *whakawhanaungatanga* naturally occur. Even where students may not know of historical or current blood relationships among themselves, they will soon form strong working relationships with each other, and take responsibility for each other's well-being and learning, especially through a commitment to sharing their knowledge freely among members of the group. These cultural relationships-based learning strategies can present major challenges to mainstream teachers whose teaching embodies the majority culture values of individual competition and individual achievement, and who assess student learning solely in terms of these values.

Ladson-Billings (1995) carried out a landmark two-year intensive observational and ethnographic study of the transformative work of eight highly successful teachers of African-American students. Her careful analysis led her to identify three pedagogical principles as clearly underpinning the work of these teachers. These principles are:

- 1 *The conceptions of self and others* held by culturally relevant teachers. These teachers totally avoided deficit theorising about their students (referred to by Ladson-Billings as the language of lacking), and they maintained high academic expectations of their students.
- 2 *The manner in which social relations are construed* by culturally relevant teachers. In these eight teachers' classrooms, teacher-student relationships were equitable and reciprocal. She states that "all of the teachers gave students opportunities to act as teachers ... all of the students were made aware that they were expected to excel at something and that the teacher would call on them to share that expertise with their classmates" (Ladson-Billings, 1995, p. 480). The teachers also shared their own out-of-school learning experiences with the class, and all were highly visible within their students' communities during out-of-school hours.
- 3 *The conceptions of knowledge* held by culturally relevant teachers. The work of these teachers indicated that they viewed knowledge as constructed, (not static), as being re-cycled, shared, and needing to be viewed critically. They were passionate about knowledge and learning, and they scaffolded and built bridges to facilitate their students' learning. Their approach to assessment was multi-faceted and reflected multiple forms of learning.

Hale et al. (2008) also carried out an intensive study of the personal narratives and ethnographic case studies required of ten teachers undertaking an Masters of Education degree in bilingual education. The transformational power of the pedagogical

knowledge and expertise these teachers gained from this particular combination of learning experiences was impressive. Qualitative analysis of the teacher narratives and their ethnographic case studies revealed three generative themes, which clearly overlap with the three principles identified by Ladson-Billings (1995). The first theme, *awareness of self and others* (consistent with Ladson-Billings' first principle) involves teachers becoming aware of how one's own identity enters the classroom and impacts on others. The second theme, *consciousness of educational issues and their implications* involves teachers engaging in critical reflection on broader issues such as race, ethnicity, gender, first-language status and poverty. This theme connects well with Ladson-Billings' second principle of how classroom social relationships are construed by culturally relevant teachers. The third theme, *transformative action and pedagogy* involves an emerging commitment to action and advocacy to confront and change social injustice issues in education, such as the continuing patriarchal and colonising impact of local school systems. This theme also connects well with Ladson-Billings' third principle of passionate teachers who view knowledge as constructed (not "given"), shared, and open to critical analysis.

Interestingly, it appears that Indigenous Māori cultural pedagogical principles of *ako* and *whakawhanaungatanga*, which have ensured the safe and effective transmission of knowledge and expertise for generations, closely anticipate principles and themes identified as *culturally relevant pedagogy* by Ladson-Billings (1995, 2006, 2008) and as *transformative education for culturally diverse learners* by Hale et al. (2008). Clearly, Indigenous cultures do not have to look beyond their own cultural knowledge and expertise to ensure educational success for their students. Incorporation of such principles by majority-culture teachers into their classroom practice surely ought to benefit their Indigenous students.

Science, however, is one learning domain where Indigenous students bring to the classroom world-views that are *very* different from those of Western/European science (Aikenhead, 2001; Deloria & Wildcat, 2001; Hipkins et al., 2002). Nevertheless, Western/European science has the potential to engage Indigenous students when it incorporates culturally authentic learning contexts and activities that make connections between home and school, for example when exploring issues of environmental protection and sustainability. Such connections enable students to relate this knowledge to their own lives and cultures and to make informed decisions about what are the important questions to be researched, what are the important information sources for finding solutions to these questions, and how to access these. Western/European science also deals with the need to understand the natural world, specifically the physical

environment, and one's relationship to it. Current recommendations for science teaching in schools welcome such an inquiry learning approach. However, teachers of science need to be aware of the need to acknowledge and respect, within their teaching of science, students' cultural identities, beliefs, values, and learning and experiences.

## ■ Methodology

In 2007, in the Waikato-Bay of Plenty region of New Zealand, 10 primary school teachers in mainstream classes with high proportions of Māori students volunteered to participate in a University of Waikato (School of Education) one-year Masters course titled "Collaborative Inquiry Quality Teaching (Science) Research Project". Across the 10 classes, a total of 250 students ranging in age from six years to 13 years also participated in this project. Of these 250 students, 167 (67 percent) were Māori, 10 (4 percent) were Pasifika (students of families from a number of different Pacific Island nations), and the remaining 73 (29 percent) students were from other cultural backgrounds, chiefly Pākehā (New Zealanders of European descent).

The university course was supported and subsidised through the New Zealand Ministry of Education's national "Quality Teaching Research and Development Exploratory Project". The course provided opportunities for teachers to undertake collaborative inquiry research focused on engaging their Māori and Pasifika students in natural science topics. The course aimed to expand teachers' understandings of science education learning, culturally responsive pedagogy, and practitioner research.

This paper focuses on findings concerning *the culturally responsive pedagogy* goals within this "Quality Teaching Research and Development Exploratory Project". Findings concerning the science education learning goals and practitioner research goals are reported elsewhere in a report to the Ministry of Education (Glynn et al., 2008). The specific culturally responsive pedagogy goals for these teachers required them to implement an inquiry learning approach to teaching science that demonstrated a clear understanding of the values, beliefs, and worldviews of their Māori and Pasifika students, through employing culturally-based learning strategies such as *ako* and *wbakawhanaungatanga*.

On completion of the university course, the teachers submitted for assessment a written report of what they and their students had learned from their engagement in the course, and from implementing culturally responsive pedagogy. From information supplied in these teacher reports, and from field notes and discussions during individual school visits, the first author collaborated with each teacher to produce a narrative (co-construction) of teacher and student experiences in using learning inquiry approaches to teaching science with their Māori and Pasifika students.

These 10 co-constructed narratives provided a rich source of text that was explored to search for evidence of the principles of *ako* and *wbakawhanaungatanga* in action, and for evidence of teacher conceptions of self and others, how relationships were construed by teachers, and teacher conceptions of the nature of knowledge, as identified in the research of Ladson-Billings (1995).

## ■ Findings

This paper presents findings from four of the 10 co-constructed narratives. Two are from Māori teachers, and two are from Pākehā teachers. Summaries of the specific natural science inquiry learning topics undertaken by each of these teachers are now presented.

*Teacher A (Pākehā): Class: 21 Year 2 and 3 students (age 6 to 7), all Māori*

Teacher A, who was in her second year of teaching, employed a culturally responsive and narrative inquiry approach to support her Year 2 and Year 3 Māori students to raise questions and to explore their understandings of two aspects of life in sea-shore rock pools. The first was the form and function (support and protection) of skeletons, particularly exoskeletons for crabs, snails, and shell fish. The second was the concept of the spiral, as both a record of, and a metaphor for, continual growth. The study began with the students' rocky shore visit, accompanied by their teacher and a group of volunteer parents. This was an unfamiliar experience for these children who lived in an inland, predominantly rain forest location.

As their inquiry progressed, students' questions became more focussed and more challenging of their own initially naïve understandings of the world around them. Knowledge was accessed by students from books, from *wbānau* members, and from the internet. This knowledge was then shared through *tuakana-teina* (the more informed and more skilled teaching the less-informed and less skilled) oral and visual presentations. Students' knowledge and understanding of skeletons as support and protection, and of the concept of the spiral, elaborated and deepened as they were able to connect their new learning to new but culturally salient contexts. One example was linking the spiral on the shell to the spiral on the *punga* and *pikopiko* ferns. Another example was, "understanding the spiral as representing an ever-increasing and unbroken curve, as distinct from a series of concentric circles". Some students were able to understand the spiral as representing growth in their *whānau*. This Pākehā teacher was able to show her respect for Māori-preferred beliefs and practices, as being central to the lived experiences of these children. She was able

to build a caring and trusting relationship with them so that they felt comfortable to ask questions, to gather information, and to use that information to expand their understanding. Comparing the charts from successive class brainstorms demonstrated the extent of the gains in knowledge these children made. So too did their *tuakana-teina* presentations. When children's knowledge is not constrained by assessment that privileges the written word, they have much greater freedom in demonstrating what they know and what they have learned.

*Teacher B (Māori): Class: 26 Year 4, 5 & 6 students (age 7 to 10), all Māori*

Teacher B, an experienced Māori teacher employed culturally responsive teaching approaches that incorporated Māori worldviews and understandings into a study of local geology and landforms. She was responsible for the management of the school's bilingual unit, and in this role had worked closely with the children, teachers, teacher aides (*kaiawhina*), extended family members (*whānau*) and elders (*kaumātua*).

The six-week study followed an inquiry learning framework where students formulated their own questions and devised the process they needed to go through to answer those questions. The teacher supplied her students with the resources they identified and requested (e.g., websites and library books). Throughout the unit she also provided opportunities for them to share and discuss their ideas and findings with fellow students and herself. She invited her students to assist with preparation of a combined trip to *Whakatāne* (a town in a neighbouring tribal region) for themselves and a junior class, to view inland and off-shore island land forms of great importance to the tribes of that region.

In an initial brainstorm the students suggested that it was important to learn about the *iwi* (tribal) stories that explain the existence of important mountains (*maunga*) and other landforms in the Whakatāne area, as distinct from those stories that pertain to the mountains in their own tribal area (*Tauranga Moana*). It was important to learn that different *iwi* may have quite different stories about the same mountain or harbour. Data were collected in a variety of ways including: (a) anecdotal notes of student questions, responses, ideas and planning, (b) field notes of observed interactions between the students themselves, between the students and the teacher, and between the students and their elders and other community resource people, (c) notes of students' use of material resources (e.g., books, internet), and (d) samples of students' work (planning/brainstorm charts and project booklets) were also collected as well as digital photos of group work. The students demonstrated interest in

and respect for *iwi* stories and science explanations for *maunga*.

*Teacher C (Māori): Class: 24 Year 5 & 6 students (age 9 to 10), 12 Māori, 12 Pākehā*

This teacher employed an inquiry learning approach to investigate the medicinal and dyeing properties of a range of New Zealand plants. An initial brainstorm indicated that one question students wanted to answer was whether and how you could get dye from different plants. Others wanted to compare the colour, strength and durability of chemical and natural dyes. A second brainstorm identified more specific questions breaking down the main topics, as well as what particular activities and learning experiences could be undertaken. The teacher engaged students in a range of different preparatory experiences and activities.

Five students went with her on a night walk around the base of Pirongia (a local rain-forest clad mountain). A New Zealand Department of Conservation staff member helped them to observe plants, animals and insects in their natural habitat. These students shared this knowledge and expertise with the rest of the class. The whole class also walked through the bush (patches of regenerating rain forest) surrounding their school, once to orient and familiarise themselves with the bush habitat, and later to sketch plants and collect samples for identification and classification. Some students visited the local Environment Centre, in their own time, out of school hours, and brought back pamphlet information. Others spoke with their *kaumātua* and *whānau* members to access their knowledge of native plants and any stories relating to the topic. Later in the year, the class made a visit to the local Harbourcare group. As their second brainstorm indicated that students thought some answers might come from the science laboratory, the teacher and class visited the science lab at their local area school (catering for students from Years 1 to 12). Here, they were assisted by the science teacher and their class teacher to investigate the various plant samples they had collected.

*Teacher D (Pākehā): Class: 20 Year 7 to 9 students (age 11 to 12), 8 Māori, 12 Pākehā*

This study reports on a collaborative inquiry approach to enhance students' understandings of both Indigenous (Māori) and Western/European science worldviews on environmental ecology and sustainability. The teacher recognised the validity of knowledge held within all cultures, but also came to realise and address concerns about how the privileged position of Western/European culture can marginalise or alienate Indigenous knowledge. Such alienation can threaten the safety of students'

engagement with classroom and school science activities. This experienced teacher assisted her students to work with members of one of four local community organisations devoted to caring for the environment. Students selected organisations with which family members or friends were already connected. Students interviewed members of the organisations, visited field work sites and participated in the various activities of these organisations. Together with their teacher, they co-constructed understandings of Western/European practices of environmental protection and sustainability in ways that acknowledged and respected the knowledge and values within traditional Māori epistemologies and practices. Assessment strategies included pre and post activities such as students rating their agreement with various statements about the nature of science and the work of scientists, ratings of their understanding of sustainability concepts, a “draw a scientist” task, and a question about their prior knowledge of community organisations. Students gathered data through interviews, photo journalism, display boards, and chose to present their findings with a power point slide show to their classmates.

#### ■ Overall findings from the four collaborative stories

Analysis of the four collaborative stories established that all teachers created multiple opportunities for inquiry learning, whether in-class, in the community or out in the field. All four teachers encouraged children to ask their own learning questions, and provided them with access to physical and on-line resources. All teachers facilitated access, either in-class or on-site, to members of *whānau* and *iwi* communities who had Māori knowledge and expertise and to community members who had appropriate Western science knowledge and expertise. All teachers endeavoured to build relationships between cultural knowledge and domain knowledge, and to ensure that Indigenous cultural knowledge was respected and affirmed both within the classroom and at community sites.

Assessment of student learning in all four classes frequently took the form of repeated collaborative brainstorming sessions that indicated elaboration and deepening of student knowledge and understanding of their learning goals. Assessment also involved students collaboratively presenting and sharing oral and visual evidence of their learning to other students in different working groups within their class, or to students in more junior classes. Both forms of assessment reflect traditional understanding of collective ownership of knowledge and of its purposes, especially the understanding that knowledge should serve the needs of the people (*whānau*, *hapū* and *iwi*).

#### Examples of engagement of the four teachers with the principle of *ako*

##### Teacher A (*Pākehā*)

Teacher A states that:

From my reading and discussion during the course, the need to really take the time to *listen* to what my students had to say became glaringly obvious, especially at the point where they generated their own easier questions to try and answer the two “big” questions around which my whole research project evolved. Their ideas were quite amazing, seeing as the questions involved things that many of them had absolutely no prior knowledge about.

When the class revisited their earlier brainstorm, most of the students could provide a reasonable explanation of what a spiral is, and what it shows us, such as: “It shows how old it is and when it gets bigger, well that’s when it’s older. In a year it grows rings that tell how old it is”, “It is little. Then it grows older and it has spirals those look like rings”, “It goes round and round without stopping. It keeps getting bigger and longer. In a year a spiral on a shell grows big then bigger. A spiral looks like a *koru*”.

Within Māori culture, the spiral is a well-known image in traditional and contemporary art. It can be understood as representing the interplay between continuity and change over time. The teacher went on to report that considering the students had limited exposure to spirals on shells, their understanding had certainly expanded over the short time they had studied spirals. She was extremely pleased with the answer, “It goes round and round without stopping”. This reply suggested to her that this student did not confuse a spiral with concentric circles. Students’ responses also suggested to her that they were beginning to understand the spiral as an iconic Māori cultural metaphor for growth and development. When she asked the further question, “What else do you know that has a spiral, and how does it change?” she was also very pleased with their range of different responses. These included:

Spider webs, snails, hydrosides, tornados, caterpillars, korus, pipis, pikopiko plants, lollipops and they all keep getting bigger.

##### Teacher B (*Māori*)

An important finding for this teacher relates to the challenge of “letting go” – of being prepared to hand over power and let the students determine their own learning content and pathways. That is, “What students want to learn and how they want to learn it”. This

teacher reported that she found it very difficult to let the students embark on a learning journey and ask questions that she could not immediately answer, and also to let them, “seek knowledge that I did not readily have”. She felt really insecure about this until she came around to realise that her lack of answers and knowledge was not inhibiting student interest and participation. In some instances her acknowledgement that she had limited understanding of local cultural knowledge appeared to encourage interest and participation.

Teacher: I do not know the names of any of the *maunga* (mountains) and I do not know the stories of any of the *maunga* so I'm not going to be much help to you!

Student: We can find out and tell you.

Student: My *koro* (granddad) will know some of the stories and we can ask *Whaea* (aunty).

Student: I will ask my cousin. She used to live in Whakatāne.

A *kaiawbina* (a senior Māori woman, working as a teacher aide in the school's bilingual unit) also mentioned that one of the students had raced in to see her to ask her the legend of *Motubora* (Whale Island).

This letting go and handing over power to the students opened the door for *whānau* and members of the community to participate and to contribute to the students' learning on the basis of their local knowledge and expertise. This was an important finding which really excited the students, and at every opportunity they wanted to tap into and draw on the Māori knowledge that these *whānau* and community members possessed.

#### Teacher C (Māori)

Teacher C reported that, for her, the research project was “a timely reminder” to trust her own instincts and experiences, believe in her students, and persevere with her personal belief in the advantages of power sharing with students. Within the inquiry learning frame, students were motivated to ask focussed and worthwhile questions about plant dyes and to suggest practical and effective ways of answering them. For example, they wanted to know *how* you could get dye from native plants.

Teacher: That's a good question. How do you think you might find this out?

Student: I suppose we would have to soak the plants or beat them. We could ask the science teacher what experiment we should do to get the dye out?

Teacher: Yes we could organise some time with him in the science room, thanks for the suggestion.

Teacher C reported that her students were excited by this investigation since some of them didn't know whether that their plants could produce dye, whereas others had read or heard that their plants *would* produce dye but still wanted to see for themselves whether this was true. They made predictions, and made observations. Their initial thoughts, that you needed a science teacher to tell them what to do shifted as they began conducting their own tests.

Student: Mine is taking a long time to boil. I think I'll cut up more plant because the colour of the water isn't very strong.

Teacher: What colour do you think will come out of the plant T?

Student: Well it is a kind of yellow at the moment so maybe if I put more harakeke (flax) in, it will be a really good yellow. I'll see. Whaea, (teacher) do you think I should try a different part of the plant or just the leaves?

Teacher: I'm not sure T, what do you want to do?

Student: First I'm gonna add more leaves to see what happens. Then I might start again with a different part of the plant. Can I do that Whaea?

Teacher: Sure. I'll get you another beaker. Have you got another part of the plant?

Student: Umm, yes I have the seed things.

Here the student was obviously thinking carefully about the conduct of a trustworthy test of the dye producing qualities of the plants.

#### Teacher D (Pākehā)

This teacher reported that co-constructing the learning programme with her students, allowed for differences in learning approaches and meant that she could be more responsive to cultural differences. Some students shared with her their feelings of vulnerability concerning the presence of ancestral spirits on their walk in the rainforest along the shoulders of their local *maunga*:

I felt privileged to have been a part of this personal and very significant conversation. The difference in cultural perspectives over the place of ancestors, and “gifts” that are passed down was apparent to us all but accepted as having equal validity within our conversations. For me as a teacher, The first [pivotal way] of



facilitating learning and development [has] become very apparent. [This is] the fundamental importance of establishing relationships so that an environment conducive to learning is created.

### Examples of engagement of the four teachers with the principle of whakawhanaungatanga

#### Teacher A (Pākehā)

Everything I have read, studied or discussed ... in this course has really reinforced for me how as teachers of Māori or Pasifika students, it is paramount that we form a caring trusting relationship with our students. We are not just there to cater for their educational needs but to assist them to grow and develop socially, perhaps making up for needs that are unable to be met at home. In my case, many of my young Māori students need a person to talk to, a safe place to go, someone they can trust. They really need a *whānau* within the school.

I find that [effective] teachers are able to create a bond with Māori students that is quite different from what Pākehā students need. The significance of a holistic approach to pedagogy is often highlighted in our classroom with many students responding well to touch in the form of a quick cuddle or hug when things are not going well for them. This form of acceptance and friendliness which makes the students feel secure and valued certainly helps them participate with more focus on their learning.

Although the young Māori students in my class may not have homes rich in European literacy and numeracy tools, such as books and computers, they certainly were able to talk with their whānau about what they were studying at school, and return to school with wonderful ideas which they delighted in sharing with the class.

#### Teacher B (Māori)

A further important finding was that when the students in this study answered their questions or gained the information that they were seeking, they wanted to celebrate and share their discoveries with each other, with the teacher and with the younger students (Year 1, 2 and 3) in the syndicate (a group of classes). They were particularly excited about teaching the younger children (preparing and presenting their project booklets and posters) and this exercise gave their own learning another (cultural) purpose. The students were all keen to pursue the idea of sharing what they learn with others.

Student: Yeah we could do sharing circle time in Room 9 (the junior room).

Student: They will like the Māori stories – little kids like those stories.

This also suggested to Teacher B that these students were developing an awareness of the importance of the collective ownership of knowledge – if you have knowledge you have an obligation to share it with others.

#### Teacher C (Māori)

It takes time to build quality relationships with students, and vice versa, and time to understand students and their backgrounds. I feel this has to be at the forefront of learning for students, particularly if the teacher's background differs from their own. For my class, it is another instance where they have been given choice and a chance to take ownership of their learning and have an opportunity to speak up and share their knowledge.

#### Teacher D (Pākehā)

All my students, but particularly my Māori students, were more inclined to choose a community organisation they already had a connection with ... Having a sense of *connectedness* provided the students with a safe platform to work from where they felt boundaries/culture crossings were clear, safe and predictable ... Each group has established a strong connection to the organisation that they chose to investigate because they now have a personal relationship with a least one group member and a deeper understanding of what that organisation does.

#### Conclusion

The examples from the co-constructed teacher narratives illustrated in this paper demonstrate (1) that teachers were able to modify their classroom practice through their experiential knowledge of *ako* and *whakawhanaungatanga*, (2) that Māori students found their Indigenous knowledge was respected and affirmed in the classroom and in the field, and (3) that there were positive outcomes in Māori students' knowledge and understanding in the domain of science. The four teacher narratives have captured some useful insights into what the practice of culturally responsive pedagogy might look like in the contexts of four New Zealand mainstream classrooms in which there are high proportions of Māori students.

All four teachers, less-experienced and more experienced, Māori and Pākehā, succeeded in building trusting and respectful relationships with their Māori students and their communities. They all found ways to demonstrate their respect for Indigenous knowledge and expertise, and ways of incorporating this knowledge into their classroom practice. They all showed they were willing to adopt an “unknowing” position with respect to Indigenous knowledge and expertise, and to switch their role as teacher to that of learner, both with their Māori students and with elders and community experts. The four teacher narratives portray Māori students who were highly engaged in their science learning, who took collective responsibility for seeking new information from both Western/European science and from Indigenous science worldviews. Culturally responsive pedagogy has supported these Māori students in negotiating successfully across the boundaries between their home culture and the culture of science. The resonance between the Māori concepts of *ako* and *whakawhanaungatanga* and the principles of culturally relevant pedagogy and transformative education for culturally diverse learners suggest that these findings are of relevance to teachers working with Indigenous students in other contexts.

Finally, it is important to acknowledge that as researchers we experienced powerful synergies between the processes involved in inquiry learning in science, and the processes involved in learning and teaching within a *kaupapa* Māori worldview. We learned as much from the strategies of *ako* and *whakawhanaungatanga* through working collaboratively with the teachers, as they themselves learned from working collaboratively with their students. We learned that when we create spaces for our teachers to ask questions and initiate pedagogical strategies they became intensively engaged in the research process, just as they learned that when they created spaces for their students to ask questions and explore, they in turn became intensively engaged in inquiry learning and teaching science in their classrooms.

We found we were not always in control of the research process, just as the teachers found they were not always in control of the students' learning. Like the teachers, we found it challenging to share control over the research process and to acknowledge our limited initial understandings of *ako* and *whakawhanaungatanga* as authentic pedagogical strategies that make sense to Māori. Like the teachers, we were uncomfortable at first with making ourselves and our research and teaching responsive and accountable to cultural values and preferences that are grounded in a Māori worldview.

However, as this study progressed we came to appreciate that building and maintaining trusting and reciprocal relationships between students and

teachers, and between teachers and researchers, was not merely a matter of establishing rapport. Rather, building and maintaining these relationships was an essential and enduring process that underpinned the successful learning that occurred throughout this study. If we are to enhance Māori students' ownership and engagement in their science learning, then we need to make sure that their science knowledge and lived experiences as Māori, together with those of their *whānau* and communities, are acknowledged and affirmed in our classroom curriculum and pedagogy. *Ako* and *whakawhanaungatanga* offer a powerful means to make this happen.

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