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Real engagement in active problem solving for Māori boys: A case study in a New Zealand secondary school

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ABSTRACT

The REAPS model is a teaching and learning model that places students in real-world problem solving, engaging students in active learning. The Ruamano Project was funded by the Teacher Led Innovation Fund, a New Zealand Ministry of Education initiative that supports teams of teachers to develop innovative practices for improving learning outcomes. This article reports on the implementation of REAPS with the Year 9 science students who investigated solutions for a local waterway. The case study involved approximately 90 students, their teachers, and the local community in a decile 3 (low socio-economic) co-educational secondary school in a rural region of New Zealand. The study shows that the REAPS model can be implemented in the New Zealand context, but requires professional learning and support for teachers. The case study provides evidence that the differentiation principles, when applied to all learners, may increase engagement and identify potential.

KEYWORDS

Problem solving; REAPS; gifted; boys; indigenous; Māori; New Zealand

Introduction

Engaging secondary boys in learning can be challenging for any teacher, and when factors such as culture, learning differences, socioeconomic background, and locality come into play, the task becomes even more demanding. In New Zealand, adolescent Māori boys are often described as our most vulnerable, at-risk learners. Because of their different rates of achievement, there are concerns that this group of learners may be overrepresented in special education and underrepresented in gifted programs. However, we also have clear evidence that Māori learners can and do succeed, with the right educational conditions (Bishop, Berryman, Cavanagh, & Teddy, 2009; Macfarlane, Glynn, Cavanaugh, & Bateman, 2007; Webber & Macfarlane, 2017). These conditions are premised on a culturally responsive learning environment in which Māori students can experience and celebrate success as Māori.

Learning environments that are culturally responsive are differentiated in the sense that teachers facilitate learning that responds to individual and group differences. Bevan-Brown (2009) described three key ingredients for a culturally responsive environment: teachers who embrace cultural diversity; curricula that incorporate cultural knowledge, skills, and values in design and implementation; and culturally preferred teaching and assessment practices. Bevan-Brown further elaborated that culturally inclusive and relevant content should be enriched in depth and breadth, so that gifted Māori learners' cultural abilities and qualities develop. Based on a holistic approach to identifying, nurturing, and growing Māori learners' abilities and qualities, Bevan-Brown suggested a variety of differentiation strategies, and hypothesized that some international models for differentiation may be appropriate for New Zealand.

One of the models Bevan-Brown suggested (DISCOVER) is part of the Real Engagement in Active Problem Solving (REAPS) model, which has developed through the collaborative work led by Professor June Maker with researchers and practitioners from around the world (Maker, Zimmerman, Alhusaini, & Pease, 2015). REAPS is an evidence-based teaching-learning model that is not limited to gifted learners, but extends to students in a variety of learning environments, cultures, and curricula. REAPS ensures content, process, and product differentiation through bringing together three models for teaching and learning:

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(1) DISCOVER: Discovering Intellectual Strengths and Capabilities while Observing Varied Ethnic Responses provides a framework for a continuum of problem types that acknowledge learner differences.
(2) TASC: Thinking Actively in a Social Context provides a sequenced way of structuring and organizing creative solutions to problems.
(3) PBL: Problem-Based Learning integrates content in relevant, practical, and real-life applications (Maker et al., 2015).

The REAPS model has the potential to improve engagement for Māori learners, especially adolescent boys. This article describes one New Zealand secondary school's implementation of the REAPS model as part of a Ministry of Education Teacher Led Innovation Fund project. Teachers and researchers collaborated in the development and implementation of a Year 9 ecology unit investigating a local community problem, which this article describes.

The REAPS model

Differentiation—"being responsive to students' individual strengths and needs" (Ministry of Education, 2012, n.p.)—is a vital task for teachers in New Zealand classrooms. Differentiation aligns to the New Zealand Curriculum's inclusion principle that "[all] students' identities, languages, abilities, and talents are recognised and affirmed and that their learning needs are addressed" (Ministry of Education, 2007, p. 9). While differentiation is not an unfamiliar concept in gifted education, it has only more recently "become a mainstream concept in education, considered key to raising student performance and closing the achievement gap" (Pappano, 2011, n.p.). In particular, a differentiated curriculum provides an important way to support all learners and minimize barriers to learning for New Zealand's priority learners.

Priority learners are groups of students who have not experienced success in education, including Māori and Pasifika learners, students from low socioeconomic backgrounds, and students with special education needs (including gifted; Ministry of Education, 2017). These groups of students have different ways of learning that require modifications to content, process, product, and the learning environment (Maker, 1982). In response to differences, teachers need to consider what content is important and relevant, how students can engage with that content, and ways they may express their learning. This requires teachers to identify and to plan core and complex content, basic and higher-level processes, and a variety of products (Roberts & Roberts, 2001). The principles of differentiation map well against the REAPS model (Maker et al., 2015).

The REAPS model intentionally combines three problem-solving models: DISCOVER, TASC, and PBL. As Maker and Zimmerman (2008, p. 178) explained, "The models used complement each other, with each one contributing a unique part, but all working together to accomplish the same goal." This goal is the ability to solve problems, relevant to the problem solver(s). Thus real, complex problems from communities should be the basis of PBL, in which students take on the roles of stakeholders, enabling them to better consider others' perspectives. In PBL, students are also encouraged to create real solutions to problems and present these to authentic audiences (Gallagher & Gallagher, 2013; Stepien & Gallagher, 1993). For PBL, the problems are really important, and DISCOVER's problem continuum enhances PBL (Maker & Schiever, 1991).

The continuum consists of six different problem types, which are distinguishable by the amount of information provided, or not provided, to the problem solver. Problems range from close-ended (Type I) to problems with multiple methods and solutions (Type VI). DISCOVER's premise is that the structure of a problem and the methods by which it is solved are as important as the solution itself. Coming to a solution is enhanced by TASC, which provides a structure for problem solving. TASC is depicted as a wheel to remind users that problem solving is structured, but not necessarily linear, and it has eight components: Gather and Organize; Identify the Task; Generate; Decide; Implement; Evaluate; Communicate; and Learn from Experience (Wallace, Bernardelli, Molyneux, & Farrell, 2012).

Perhaps the most important aspect of DISCOVER is that it recognizes and develops multiple strengths and abilities, as described by Maker and Anuruthwong (2003), using the structure of a prism. The prism has three sides: the

environment; competencies and outcomes of learning; and processes of learning. Human abilities, which are holistically conceptualized as social, emotional, somatic, visual, auditory, mathematical, linguistic, mechanical/technical, and scientific, are the center of the prism. Careful construction and alignment of the learning environment, outcomes, and processes enables the "full spectrum of abilities (to) be integrated and separated in the same way that a prism refracts light" (Maker & Anuruthwong, 2003, p. 1). What this means is that problem solving is different for different learners, and REAPS provides opportunities to develop multiple abilities by using a variety of problems to be solved through active, hands-on learning. Importantly, by focusing on students' strengths and interests, the REAPS model facilitates the integration of knowledge, skills, and values of local cultures and communities in the classroom, while also providing a structure that is flexible, yet rigorous enough, to adhere to curriculum standards (Maker et al., 2015).

The REAPS model is comprehensive, flexible, and valid, with practice and research showing that the model enables all aspects of differentiation in response to diverse students in a variety of contexts (Maker et al., 2015). The model, with its roots in three evidence-based and practice-driven approaches to problem solving, is also practical and adaptable, as has been evidenced in its implementation in schools internationally, with students from primary through to secondary. However, a review of literature by Bell (2010) concluded that it is also important to consider the adaptability of models for use cross-culturally and, specifically, within a New Zealand context for Māori learners. In other words, as Maker and Neilsen (1995) highlighted, it is important to determine the model's appropriateness to the situation.

Despite the strong, growing evidence base in terms of its implementation and effectiveness in the United States, Turkey, Saudi Arabia, Taiwan, Russia, Egypt, and Australia (Maker et al., 2015), the REAPS model had not been implemented in New Zealand's bicultural education system. This was the intent of our collaborative investigation. The educational and cultural context of New Zealand and, more specifically, for the case study school is important to explore before delving in to how the model was implemented. An important contextual factor for this study is the New Zealand secondary-education setting, in a rural, low-socioeconomic region, but, at the center of this project are the diverse students, many of whom are indigenous Māori learners.

The context

New Zealand is a bicultural country, whose *tangata whenua* (indigenous people) are Māori. The nation's founding document is the Treaty of Waitangi, which is underpinned by the principles of partnership, protection, and participation. These principles put students at the center of teaching and learning, with an expectation that they should be engaged, challenged, and affirmed in their cultural identity. New Zealand's secondary education system serves students from around age 12 or 13 for five years (Year 9 to Year 13), and schooling is compulsory until the age of 16. In 2017, the Ministry of Education reported that approximately 21% of the 275,873 students attending state secondary schools (Years 7–13) identified as Māori. (This does not include Māori students in other types of schools.)

The Ministry of Education (2007, 2013) strategy, *Ka Hikitia*, envisions Māori achieving educational success "as Māori," through quality educational provision and strong engagement with communities. Relatedly, inclusive education policies and practices in New Zealand aim to ensure that all students are engaged and achieve though their presence, participating, learning and belonging in school. Both of these strategies support teachers in identifying and responding appropriately to students, by recognizing different ways and rates of learning and achieving in school. These policy reforms have seen some shifts in outcomes for some students, but there is little documented evidence of system wide change (Controller and Auditor-General, 2016).

New Zealand's national curriculum is broad and comprehensive, with a scope and sequence that spans eight learning areas—English, the arts, health and physical education, learning languages, mathematics and statistics, science, social sciences, and technology—and five key competencies—thinking; relating to others; using language, symbols, and texts; managing self; and participating and contributing (Ministry of Education, 2007). A recent review of secondary education (Wylie & Bonne, 2016) included two findings of relevance to

our investigation: the exclusion of key competencies in many learning opportunities and a decline in learning experiences that make connections with cultures and life outside of school. These two findings potentially have a negative impact on Māori learners.

Schools in New Zealand had a decile rating that indicated the extent to which the school drew their students from low socioeconomic communities (ranging from 1 for the lowest-income areas to 10 for highest), and these ratings were proportional, with approximately 10% of schools identified in each of the ten ratings. Lower decile schools had higher proportions of Māori students, reported lower achievement data on standard measures of literacy and numeracy, and received higher Ministry of Education funding levels to support learners. Not surprisingly, lower decile schools were also reported to "face the deepest challenges in meeting their students' needs" (Wylie & Bonne, 2016, p. 4).

Rurality is another challenging contextual factor. Limited research on the rural secondary school experience in New Zealand is documented; however, two studies in gifted education have described benefits and challenges that may be generalized to all learners in rural schools. Colangelo, Assouline, and New (1999, 2001) concluded that while personalizing learning was naturally easier for teachers in rural schools, due to small, often multi-age classes, the isolation and lack of community resources stymied both student learning and ongoing teacher professional development. These findings were reiterated in a study undertaken by Riley (2003) in which New Zealand principals elaborated two other important benefits of small, rural schools: the safe and supportive family-like community and ease of access to the outdoor environment for learning. To place Riley's findings in context, around 500 of New Zealand's 2,700 schools are considered "isolated," serving approximately 14% of the population (Ministry of Education & New Zealand Government, 2017).

The Ruamano Project

As the literature shows, the challenges of identifying and responding to students' abilities and strengths can be magnified in rural, low-income secondary schools in New Zealand, and it was this complex problem that the Ruamano Project aspired to solve. The Ruamano Project is named from Māori myth of a *taniwha*, or sea creature, Ruamano, who took the form of a Mako shark and, though he looked fierce, protected the people. Like sharks, Māori boys are often misrepresented as intimidating and standoffish, but, like any young person, they are diverse and have much to offer. The Ruamano Project aimed to encourage their positive participation in learning by identifying and responding to their innate strengths, talents, and abilities, including those that are culturally valued.

The Ruamano Project was funded by the Teacher Led Innovation Fund, a Ministry of Education initiative that supports teams of teachers to develop innovative practices for improving learning outcomes for priority learners. The project was conceptualized by one of the authors, Katrina Sylva, a secondary school teacher and gifted education coordinator, who worked in partnership with the researchers to adapt REAPS in two schools in rural New Zealand. This article reports on the implementation of REAPS in one of the schools, with the Year 9 science students who investigated solutions for the Kaipara Harbour, a local waterway with declining seagrass and fish abundance, of great cultural, ecological, and economic importance to the region.

The case study involved approximately 90 students, their teachers, and the local community in a decile 3 (low socioeconomic) co-educational secondary school in a rural region of New Zealand. The school roll comprised approximately 45% Māori students. The school's most recent Educational Review Office report indicated that the school has actively taken steps to raise Māori achievement, including targeted strategies to work with students who may be achieving at different rates, and marked improvement has been made in recent years. This is attributed, in part, to the school's active consultation and engagement with Māori *whānau* (family) and local *iwi* (tribal group). The review also reported that whānau have aspirations for ongoing development of Māori language, culture, knowledge, and skills, as well as stronger connections with wider Māori development and initiatives in the region.

Methodology

Case study research enables the exploration of a phenomenon, within its context, using multiple lenses

that allow varied perceptions and facets to be revealed and understood (Baxter & Jack, 2008). Case study research answers how and why questions, according to Yin (2003). In this study, we wanted to understand how teachers in New Zealand might adapt and implement the REAPS model. We also were keen to understand the impact of the model on teachers, students, and communities, as this might begin to reveal why evidence-based models of practice developed in other contexts, with different learners, might be appropriate for adaptation. As a descriptive case study, the purpose is to describe the intervention and context as it occurred (Yin, 2003).

Case study is considered a qualitative method, distinguishable by its use of multiple data sources (Yin, 2003), but with the potential for integration of qualitative and quantitative data (Baxter & Jack, 2008). It is the convergence, or integration, of multiple data sources that "adds strength to the findings as the various strands of data are braided together to promote a greater understanding of the case" (Baxter & Jack, 2008, p. 554). Case study is, therefore, aligned with mixed-methods research in that it allows both inductive and deductive reasoning to be applied, yielding rich results (Kitchenham, 2010).

Yin (2003) identified six possible data sources in case studies: documents, archival records, interviews, direct observations, participant observation, and physical artifacts. Typically, data collection and analyses in case study research are iterative processes, allowing for careful descriptions of the data, which might be organized around topics, themes, or questions. Yin (2003) explained that data analysis consists of "recombining both quantitative and qualitative evidence to address the initial propositions of the study" (p. 109). He further explained that there are three analytic strategies for case study evidence: relying on theoretical propositions; thinking about rival explanations; and developing case descriptions.

This case study describes evidence collected through interviews, observations, documents, and surveys of teachers, students, and community members. The data were collected during all stages of the project, which included professional learning and development for teachers, designing the unit of study, and implementing it with students. The data collection and analyses were iterative, and ongoing, as the project evolved, enabling the development of a rich case description. The project adhered to ethical principles and practices, including informed consent, protection of vulnerable students, anonymity, and confidentiality, as outlined by the Massey University Code for Human Ethics. Following ethical review by the team, the project was lodged with the University and considered low-risk (Massey University Ethics Notification Number: 4000015654).

Findings

This project was developed with the expressed intention of implementing REAPS in two secondary schools to identify and respond to the needs of Māori boys. The project proposal included three teacher-developed inquiry questions:

- How effective is REAPS in increasing engagement and achievement of Māori boys?
- How can gifted potential be identified in Māori boys engaged in problem-based learning through the REAPS model?
- How can evidence-based, international curriculum delivery models, like REAPS, be adapted and localized within New Zealand's cultural and educational context?

Both schools worked together, as part of their professional inquiry, in a 3-step process:

(1) Engaging in 5 days of professional learning and development on REAPS, delivered by Maker and her colleagues, Zimmerman and Pease, in New Zealand.
(2) Planning, using the REAPS methodology, and adapting it to include the local context, community and iwi involvement, best practice policies from New Zealand, and cultural indicators of Māori giftedness and talent.
(3) Implementing the REAPS unit, concluding with student presentations to the school, whānau, and local community.

Each of these steps is described in the following sections, integrating data from a variety of sources, to share the journey of one of the schools involved in the Ruamano Project.

Professional learning and development

Ten teachers, alongside one of the research partners, Tracy Riley, participated in the professional learning and development designed and developed by Maker, Zimmerman, and Pease. The professional development put teachers in the role of learners as they solved a problem using the REAPS model. This method of professional development has been described by Maker and Zimmerman (2008) as active, hands-on learning. The purpose in the professional development was for the teachers to "experience and learn" (p. 163) by exploring a complex local problem, applying the three problem-solving methods of REAPS, and experiencing teaching and learning that is appropriate for increasing student engagement in real-world problem solving.

The beginning of the workshop for teachers introduced the REAPS model, in a lecture-style format, with time for questions and discussion, and complemented with a notebook of associated readings, sample units, and templates. The teachers, who were placed in stakeholder groups, were informed via instructions in their resources provided by Maker and her colleagues, on the afternoon of the first of three days:

> You will … learn about and develop a solution to the ecological problems in the Kaipara Harbour; in particular the decrease in seagrass and related fish abundance … you and your team will gather and organize information, identify and define the problem, generate solutions, decide on the best solution, develop and presentation about your proposed solution, evaluate your presentation and reflect on your learning.

The Kaipara Harbour, a local waterway with depleting sea plants and fish, provided a complex, real-world problem, as needed for problem-based learning. Adhering to PBL principles, the problem has multiple solutions and is ill structured. The teachers spent the next two days investigating their problem, following the outlined steps, and working together in the school library and on a field trip to the harbor environment, where they collected water samples for testing and interviewed local community members about their knowledge of the harbor problem. Importantly, each stakeholder group was designed to tackle the issue from a local perspective: the district council; the Ministry of Fisheries; the local iwi; a land-care trust; and an international dairy company.

Key questions revolved around factors such as the environmental health quality of the harbor, sources of pollution, the impact of the development of the seagrass beds and snapper population, and people's perspectives of the health of the Kaipara Harbour. The teachers' investigations followed the structure of the TASC wheel, with guidance from the facilitators on strategies related to each of the components, such as how to effectively gather and organize materials, brainstorm and evaluate solutions, and communicate their results. The final presentations were self- and peer-evaluated and included a range of products including a video, demonstration, role-played television interview, song, and poetry.

The 10 participating teachers were asked to evaluate the professional learning and development on a survey that included Likert scales and open-ended questions. The quality of the workshop, in relation to other professional learning, was rated exceptionally high and described positively, as shown on Table 1.

Teachers were also asked to rate their confidence levels for implementing REAPS in their classrooms, and while their enthusiasm for the model did not wane, with all teachers indicating that it would be easy to implement (4.0), their confidence was slightly lower. They felt fairly confident they could guide their students through solving the water quality problem (4.1), but they were slightly less confident in designing their own problems (4.0) and guiding students to devise their own problems (3.8). As one of the teachers explained, it would assist to "be able to ask questions and advice in implementing REAPS." Another teacher sought assistance with planning, and the coordinator commented that she needed "time to study, read, reflect on and discuss the REAPS model."

From the outset, it was expected that REAPS would require adaptations to be implemented in this school context, and so teachers were asked what those changes might be. Several key themes were identified by the teachers for adaptation of REAP: alignment with the curriculum; modification of the process based on student ability; and community and iwi engagement. Several teachers commented that their

Table 1. Teacher evaluation of professional learning and development on REAPS.

	Mean Rating (scale of 5.0)	Teacher Comments
Depth of knowledge	4.3	"Going through each step as a student helps to deepen the knowledge and understanding of how it is supposed to work."
Breadth of new ideas	4.3	"It would have been great if we could have had one more day …"
Facilitation of learning	4.7	"The most helpful aspects were the constant guidance as we were taken through the process, the freedom to ask questions and get clarification at any stage."
Practical value	4.7	"The practical nature was great. Experiencing the process first hand definitely helped with understanding."
Applicability in my classroom	4.3	"Fully enjoyed the learning experiences and developing strategies to deliver content to my students."

use of REAPS would be dependent on students, showing teacher understandings of differentiated teaching and learning. They applied these understandings by analyzing the REAPS model in relation to identifying and responding to the potential of Māori boys. The teachers described REAPS as creating an environment that "allows abilities/qualities that may not surface in the classroom to be demonstrated."

Describing how REAPS could help identify potential included references to its relevance, authenticity, meaningfulness, and hands-on learning. As one teacher explained, "Our boys tend to enjoy learning through doing, working with others to solve problems." Similarly, the teachers were able to identify how REAPS could support the achievement of Māori boys through differentiated processes—mainly, collaborative problem-solving that could extend to capable students—while engaging everyone in real-world problems that impact their lives. Culturally relevant content was described by one teacher as a way to "improve engagement and buy in," and another teacher stated that it was "culturally/practically relevant (therefore engaging)."

The professional development was just the first step. The teachers were not familiar with the approach of being immersed in the teaching strategy as a learner. We observed their active engagement in learning with the facilitators and one another, alongside an increased understanding in the factors impacting life in the Kaipara Harbour. The next step was to engage with their local community to begin adapting REAPS and planning for its implementation.

Planning REAPS

In consultation with local iwi, it was decided that the students would also explore the Kaipara Harbour problem. Fisheries are traditional sources of economic and cultural wellbeing for iwi, and being able to provide fish to feed whānau and manuhiri (guests) has always been important. The iwi expressed concerns about their ability to continue to fish, commercially, recreationally, and as part of their cultural, familial lifestyle. Geographically, the harbor is easily accessible to the school and is a waterway familiar to many students, teachers, and community members. Because the teachers had also explored this problem, they felt confident in their ability to design and plan the REAPS unit.

Although the teachers acknowledged that the problem was interdisciplinary, the unit was taught as part of Year 9 science. The teachers began by aligning the unit with achievement objectives from the New Zealand Science Curriculum (2007) levels 4 and 5, Nature of Science and the Living World learning areas. The learning objectives focused on understanding, investigating, communicating, participating, and contributing in science, within an ecology context. A unit plan was developed based on the structure of TASC, but with fluidity and flexibility built into the timetable, for moving back and forth between components, or spending more or less time on different problem-solving processes as needed. The teacher planning also included resources and activities, as well as vocabulary for development. The planning template did not follow the format recommended by Maker and her colleagues in that it did not include discipline-based, process, or product concepts, nor did it identify the PBL, TASC, and DISCOVER components of each activity. However, the planning elaborated what the teachers thought were the key elements needed to facilitate the problem solving by reflecting their typical planning guides. The plans were also translated into an online guide for students on the school's intranet. The harbor problem was mapped on to the TASC wheel for the students, so they could visually see each component and its related activities.

The school's project leader led the development of the unit plans and student website. Her

planning notes and reflections show the adaptations she made to the content and processes that had been used in the professional development. These included adaptations to content, processes, and products:

- An iwi planning meeting was facilitated to determine the most relevant problem for the local community.
- A karakia (prayer), pōwhiri (welcome), and acknowledgment of the local people was conducted on arrival to the harbor for the water quality experiment.
- A Māori pūtaiao (science) perspective was incorporated into the content materials.
- A stakeholder group for the local iwi was included in the unit.
- There was acknowledgment and consideration of traditional Māori practices regarding fishing.
- Māori methods of communicating information through waiata (song), whakatauki (proverbs), and haka (dance) were incorporated.

As the lead teacher's notes explained, "I like the idea of continuing the dialogue with iwi while we create the teaching activities and including the perspective of Maori scientists as otherwise the testing and the gathering of information was entirely Western Science oriented."

Following the guidelines for planning teaching units, developed by Maker, Zimmerman, and Pease as part of the professional development, the project leader and teachers determined that the best ways to gauge the students' previous knowledge was based on their performance on assessment on school entry, performance in Term 1, and their observations. These pre-assessment measures were not formally incorporated into the teacher planning, as is recommended. The teachers also decided that Māori participation and engagement might be measured through analysis of attendance data and representation in high-performing REAPS groups, based on self, peer, and community evaluations at the end of the project.

Implementing REAPS

The REAPS project was implemented by three science teachers over two school terms, with final presentations to the community as the culminating activity. Approximately 90 Year 9 students took part in exploring the harbor problem; 39% of this year group identified as Māori and 12% as Māori boys. The project leader reported that the implementation went smoothly, mainly because it was well planned and structured. During the implementation, she observed teachers' classes and provided informal feedback and support but chose not to record the observations. The key results of the implementation stage reflect greater student engagement and collaboration, which resulted in the identification of hidden talents and some shifts in achievement.

In a teacher focus group interview, all three teachers identified engagement in learning as the greatest observable change in their students. The teachers specifically discussed increased engagement of Māori boys. For example, one Māori boy was described as "a good boy but engagement, you know, away with the fairies. He's been just on, on, on and the quality of his submissions has been quite impressive for me, I'm seeing a side of him that I didn't think was there." Another Māori boy, who previously "would never engage in anything ever," had an increase in attendance and greater interaction with his peers. Toward the end of the unit, he was "kind of full on with it." The teachers talked about the boys increasing their participation as they "found other skills they were increasing, not just the academic side." One student, whose participation peaked during the preparation of the presentation, was seen by his teacher as suddenly having "all these ideas flooding out of him because now they've finally come to one solution."

Collaborating with peers to solve a problem as part of a randomly assigned stakeholder group also meant the students were working with different peers, with whom they might not normally interact. In the focus group discussion with Māori boys, they affirmed their preference for working in groups, or one-on-one with their teacher, especially for their presentation work. A teacher described one of her Māori boys thus: "He might not have been the key student leading the group, but he was interested. He was on card. He was engaged and he was interacting with students in the class because of how I grouped them." When asked what aspects of the REAPS model most

engaged the students, the teachers shared that it was the last step of preparing presentations that really brought the students together. Students were described as "rising to the responsibilities of being part of a team." The Māori boys agreed that working together for a purpose was meaningful, but also supportive: "By yourself would've been more nerve wrecking."

The stakeholder groups also enabled the students to see issues from different perspectives. As one of the iwi community members stated in the presentation evaluation, "This allowed the children to look at it from another perspective and challenge some of the theory behind the policies." A parent survey response reiterated the importance of taking "all points of view into account" and related this to the real issue of resource management. Surveys of community members, which included whānau and iwi, affirmed the value for the community in engaging young people in real local problems.

Their responses highlighted the importance of student engagement in the community now, as well as in the future. A whānau member summed this up: "Environmentally, educationally, socially, these generations will become aware of the huge responsibilities and benefits understanding our local resources are to them and future generations." Many community members commented that the student engagement in conservation was the greatest benefit of the project for students and the community. This was a noticeable shift from results the New Zealand Council for Educational Research Science Engagement Survey that showed only 30% of the students in Year 9 felt that they were able to "work on real life projects that make our school or community a better place."

The teamwork also involved experimentation offsite, another element of REAPS that the teachers reported as engaging. The experimentation increased their engagement with the science itself, as one teacher explained: "You know, it's not just that we talked about purification, we also tested for some of the chemicals involved in that and so they were asking questions about it and it was really cool seeing them on that day. It's probably one of the best engaged days I saw them was out there and doing it."

In a focus group discussion with Māori boys, they confirmed the teachers' views that the hands-on experimentation was different from their usual science activities. As one of the students explained, "We went out and actually investigated what the problem was instead of, you know searching it up on the internet and just viewing it from the computer." Another boy talked about the authenticity of the science learning: "'Cause you actually know it's true, 'cause we actually found it out ourselves."

As has been evidenced, and as one of the teachers verbalized, "abilities surfaced." The teachers began to notice abilities and qualities in students that had previously been overlooked. A teacher shared her experience with one of the Māori boys: "I did recognise he had talents that I hadn't seen before." Qualities related to contributing and participating became important during the collaborative problem-solving, perhaps even more so than more traditional academic abilities. Talking about one student, a teacher said, "Maybe, not so much in an academic sense but his ability to relate to the people in his group and to contribute and I hadn't seen that before." The final report to the Ministry of Education concluded, "A different range of students will be able to display their gifts and talents when group work is integrated into units and presentations are used as an assessment tool."

Following implementation of the REAPS model, some of the pre-implementation data were revisited by the teachers and showed some positive shifts. For example, an assessment of all Year 9 students against National Standards at the end of the previous unit, Kitchen Science, showed that on the achievement objectives, 63% were working at level 4, with 28% below and 9% above. For Māori, the pre-REAPS results showed lower rates of achievement, with 53% achieving at level 4, 40% below and 7% above. At the end of the REAPS project, 76% of all students were working at level 4, and 24% were above level; for Māori learners, there was a large shift in achievement, with 75% performing at level and 25% above level. In the school's entrance testing, one Māori boy was eligible for the top mathematics group, and two Māori boys were identified for the top English class. The project leader's notes stated, "Interesting and promising to see that whilst Maori represent 39% of the year group they represented 41% of the students put forward in the best REAPS groups, as selected by the teachers." Māori boys made up 15% of the top-performing REAPS students (but make up 12% of the year group).

Teacher reflections

The teachers reflected on what they might do differently in the implementation of the model in the future, and their comments reflected their ongoing, developing practice, as well as the model itself. The teachers said that the model had been effective, and they expressed interest in using it again, refining their own skills. For example, one teacher talked about the importance of the REAPS structure, particularly through TASC, and his need to be clear in his explanations for students: "'Cause it made sense in my mind but it didn't translate well to them." The teachers also discussed their roles as facilitators, with one explaining that in the REAPS experience she had come to learn that "Facilitating leads to results." She elaborated, explaining that allowing the students "to kind of run with it is best. They can and it's always amazing how many students can." Time to collaborate more with one another during the unit was a recommendation the teachers felt strongly about. They talked about collaboration; as one teacher expressed, "More time I also think, us sitting down together to talk about where our stages are going." Another teacher said, "more heads are better than one." The final report on the project also made reference to the need for more ongoing collaboration with iwi, perhaps through a newsletter. As it stated, "Collaboration and authentic partnerships are to the benefit of all involved."

In terms of any changes to their use of the REAPS model, teachers suggested inviting a member from each of the stakeholder groups to talk to the students about their role, the group, its goals, and so on as part of the information gathering. They also wanted to change some of the language to reflect New Zealand vocabulary and incorporate te reo Māori (language). They also shared that they would use the language of the New Zealand curriculum, especially its competencies. However, there was no urgency with which to make these changes, for as one teacher explained, "For learning something it's good to not change it too much initially." One of the concerns raised in the final report related to the sustainability of the approach in terms of new staff accessing professional learning and development on how to use the model.

Discussion and conclusions

The Ruamano Project set out to determine the adaptability and effectiveness of the REAPS model in raising achievement and engagement in a rural secondary school, specifically seeking to identify and respond to the abilities and qualities of Māori boys. This was an ambitious project, using a new methodology for teacher engagement in research in New Zealand. Therefore, any conclusions drawn must be considered against the backdrop of the limitations of this case study. Perhaps the most significant limitation is the lack of sufficient empirical pre- and post-intervention data to demonstrate changes in achievement. Where data were available, it was general achievement data, rather than measures specific to the goals of the project. This points to another limitation, even more generalizable to all research, and that is a lack of appropriate assessment measures for the knowledge and skills being developed. Therefore, we relied strongly on the perspectives of the teachers, students, their whānau, and the community to inform the case study.

Although the findings cannot be generalized, this case study does confirm earlier research by Maker and Zimmerman (2008) that showed the professional learning and development model to be effective. Teacher immersion in REAPS activities, as learners, cemented their understandings of complex, real-world problem solving, enabling them to see the value, practicality, and applicability of REAPS in their classrooms. The professional development also boosted their confidence in facilitating REAPS to deliver the New Zealand science curriculum, which, in turn, eased its implementation. Although their planning did not adhere to the guidance provided by Maker and her colleagues, the teachers did carefully plan and structure their implementation of REAPS using local curricula, resources, and planning frameworks, and these adaptations proved effective for their purposes.

Planning adaptations incorporated other changes made by the teachers, which mainly were related to culturally relevant content and processes. As Bevan-Brown (2009, p. 14) explained, "inclusion of Māori content … contributes to creating the all-important culturally responsive environment where gifted Māori students feel comfortable enough to reveal and develop their

particular strengths whatever these may be." The REAPS model is flexible enough to enable culturally specific adaptations to be made, as the case study shows, and these adaptations, in turn, created a culturally responsive learning environment where abilities and qualities bubbled up to the surface. While the study does not focus exclusively on gifted learners, the application of a model deeply rooted in the principles and practices of gifted education demonstrates the value of creating responsive learning environments for the identification of all learners' abilities and qualities, as well as the transferability of gifted education principles to mainstream practice.

The principles of content, process, and product differentiation for gifted learners have been mapped against REAPS and shown to be comprehensive for their special needs (Maker et al., 2015). This case study demonstrates that some of those principles for gifted learners are also applicable to all students. Specifically, this case study provides evidence that the following principles, when applied to all learners, may increase engagement and identify potential: the complexity of localized content; thinking processes; open-endedness; group interactions; and the development of a variety of self-selected products derived from real problems and delivered to appropriate audiences. Bringing these together through the REAPS model showed that collaboratively working to solve a real, local problem, identified by the community as relevant and meaningful, not only tapped new knowledge and skills but also increased student engagement in learning, participating, and contributing. The REAPS model raised teacher awareness of the special abilities and qualities of Māori boys, which, in turn, increased their engagement in science, collaboration with their peers, contribution to their culture and community, and participation in learning.

Disclosure statement

No potential conflict of interest was reported by the authors.

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