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An Investigation into Differentiation in a Rural Aotearoa New Zealand Secondary Science Setting
He Waka Eke Noa

A thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy

at Massey University, Manawatū, Aotearoa New Zealand

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Abstract

Disparity in education is a problem confronting educational researchers and practitioners. Within Aotearoa New Zealand, science education inequity is evidenced in a gap - one of the widest internationally - between high and low performers on international assessments. Māori and students of other non-dominant cultural backgrounds are disproportionately represented at the bottom end of this performance scale. Literature indicates that differentiation – the modification of curriculum and instruction to support students with academically diverse learning needs through adaptations to content, process, or product – is an inclusive teaching and learning strategy with the potential to increase educators’ abilities to meet diverse students’ needs. However, little research or evidence exists to provide teachers with the framework to differentiate effectively in mainstream science classrooms. This mixed methods action research (MMAR) investigation enabled a rural, bicultural Aotearoa New Zealand school community’s years 9 and 10 students (ages 12-15), their science teachers and whānau (families) to firstly, share their perspectives on current classroom practice, and from these perspectives, collaboratively develop, implement and evaluate a differentiated science unit. The study utilised both quantitative and qualitative data collection strategies, including surveys, individual interviews, classroom observations, focus groups, and collaborative professional development and planning sessions. The objective was to expand the evidence base of effective teaching and learning strategies for all learners within diverse mainstream secondary science classrooms including those identified as at risk for under-achievement such as students with learning difficulties, exceptional science talent and of Māori or other non-dominant cultural backgrounds. Findings suggest there is value in teachers using differentiated materials designed for gifted learners when the gifted differentiation principles and practices are adapted and implemented in response to community input. Findings indicate that student engagement and learning in science – for Māori and non-Māori students from across the learning spectrum – improved in all aspects that teachers chose to differentiate, including: relevance of content, assessment and accommodation of student readiness, and variety and choice in process and product. From the research findings, a model of community-driven differentiation, he waka eke noa: differentiation in 3-D (teacher/student/whānau), has been conceptualised that could potentially be a strategy for increasing the quality of culturally responsive science teaching and learning that meets diverse students’ needs both within Aotearoa New Zealand and internationally.

Key words: Differentiation, Māori, Culturally Responsive, Secondary Science Education
Greetings to you all, and salutations to you
My mountain is Denali
My river is the Tanana
My ancestry is American, Dutch and Danish
I am from Alaska

However, I live in Aotearoa New Zealand today, so,
My mountain is Tauhara
My river is Waikato
Taupō is my home town

My parents are Kathleen DeVries and Jerry Vander Zwaag
I’m Carrie Vander Zwaag
And so, greetings to you all once again.
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Ehara taku toa i te toa takitahi, engari he toa takitini.

We cannot succeed without the support of those around us.

This thesis journey has been full of unforeseen changes within the research voyage as well as the accompanying adventure of life. I welcomed my first and second child into the world while also fare-welling the grandmother for whom I am named. Changes in supervisory panel, school enrolment, staffing, timetables, class structure and school initiatives also influenced what and how I collected and analysed my data. This PhD waka remained afloat and moving forward due to the support, flexibility and resilience of (a) supervisors and staff at Massey University; (b) leadership, colleagues and students at the school where I teach and conducted this research and (c) an incredible network of whānau and friends. As such, this section of the thesis acknowledges the contributions of key people and organisations who have made this research feasible.

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1 References question one of the Heidelberg catechism.
potentially evolve from it will serve as a koha, aligning with the spirit of Luke 12:48, “To whom much has been given, much will be expected.”

Mum (Mom) and Dad, you are the people who have most influenced my life, guiding and supporting me in so many tangible and intangible ways, including physically, spiritually, emotionally, academically and socially. Thank you for helping me discover my passions, challenging me to be a better person, and modelling life-long learning of compassionate teachers both in the classroom and at home. You have encouraged and supported me to achieve even the dreams you deemed crazy. It is no surprise, therefore, that you have been so instrumental in helping me realise this PhD dream. Thank you for listening, brainstorming, editing, and above all, actively loving my kids (“Play cars with me, Nana!”) while I converted your basement, travel trailer or any spare corner into a thesis research hideaway. I treasure the time you have dedicated to visit/stay with us in Aotearoa New Zealand during the PhD journey and hope we are able to continue the tradition long after this thesis is on the library shelf.

*Tangata ako ana i te whare, tūranga ki te marae, tau ana.*

A child who is instilled with meaningful values at home and cherished within family, will not only excel amongst the family but also within society and throughout his life.

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Adorn the bird with feathers so it can fly.

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Effective science differentiated teaching and learning presents many challenges
Differentiated science teaching and learning is implemented variably by individual teachers
A responsive learning environment is critical to effective differentiation

Increasing process variety: More hands-on, investigative learning
Increasing process variety: Improving teacher and student collaboration
Relevance of science teaching and learning
Improving relevance: Connecting to students’ lives

Determining and responding to student readiness
Readiness: Impact on scientifically talented students
Readiness: Impact on students with learning difficulties
Readiness: Variability in teacher assessment and accommodation
Readiness: Student and whānau suggestions for improving assessment and accommodation
Curriculum differentiation through process variety
Increasing process variety: More hands-on, investigative learning
Increasing process variety: Improving teacher and student collaboration
Relevance of science teaching and learning
Improving relevance: Foundation for upper secondary success
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A responsive learning environment is critical to effective differentiation
Differentiated science teaching and learning is implemented variably by individual teachers
Effective science differentiated teaching and learning presents many challenges
Differentiation should respond to teacher, student and whānau perspectives of student need

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<tr>
<th>Māori</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Āhua</td>
<td>physical demeanour, appearance</td>
</tr>
<tr>
<td>Ako</td>
<td>to teach or learn, reciprocal teaching and learning</td>
</tr>
<tr>
<td>Aotearoa</td>
<td>New Zealand/land of the long, white cloud</td>
</tr>
<tr>
<td>Aroha ki te tangata</td>
<td>respect for people</td>
</tr>
<tr>
<td>Hapū</td>
<td>subtribe</td>
</tr>
<tr>
<td>He kanohi kitea</td>
<td>the seen face, meeting face-to-face</td>
</tr>
<tr>
<td>Hiwi</td>
<td>hull</td>
</tr>
<tr>
<td>Hoe tere</td>
<td>steering paddle</td>
</tr>
<tr>
<td>Hourua</td>
<td>double hulled sailing waka</td>
</tr>
<tr>
<td>Hui</td>
<td>meeting(s)</td>
</tr>
<tr>
<td>Iwi</td>
<td>tribe</td>
</tr>
<tr>
<td>Ka Hikitia</td>
<td>Ministry of Education’s Māori Education Strategy</td>
</tr>
<tr>
<td>Kahokaho</td>
<td>railing</td>
</tr>
<tr>
<td>Kai</td>
<td>food, to eat</td>
</tr>
<tr>
<td>Ka Awatea</td>
<td>an iwi case study of successful Māori secondary students</td>
</tr>
<tr>
<td>Kaua e māhaki</td>
<td>do not flaunt your own knowledge</td>
</tr>
<tr>
<td>Kaua e takahia te mana o te tangata</td>
<td>do not trample the rights of the people</td>
</tr>
<tr>
<td>Kaupapa Māori</td>
<td>by Māori, about Māori, for Māori</td>
</tr>
<tr>
<td>Kia Eke Panuku</td>
<td>Ministry of Education’s Building on Success Initiative</td>
</tr>
<tr>
<td>Kia tūpato</td>
<td>to be cautious</td>
</tr>
<tr>
<td>Koha</td>
<td>a gift, an offering, donation</td>
</tr>
<tr>
<td>Kura Kaupapa Māori</td>
<td>Māori language immersion school</td>
</tr>
<tr>
<td>Māhaki</td>
<td>humble, humility</td>
</tr>
<tr>
<td>Mahi tahi</td>
<td>collaborate, work together</td>
</tr>
<tr>
<td>Mana</td>
<td>power, status, rights</td>
</tr>
<tr>
<td>Manaaki ki te tangata</td>
<td>sharing, hosting, generosity</td>
</tr>
<tr>
<td>Manaakitanga</td>
<td>respect, generosity and care for others</td>
</tr>
<tr>
<td>Mauri ora</td>
<td>wellbeing, flourishing</td>
</tr>
<tr>
<td>Mauri noho</td>
<td>weakening of one’s wellbeing</td>
</tr>
<tr>
<td>Māori</td>
<td>Indigenous Aotearoa New Zealanders</td>
</tr>
<tr>
<td>Mauri</td>
<td>life-force</td>
</tr>
</tbody>
</table>
Pākehā of European descent, originally applied to English speaking settlers to Aotearoa New Zealand

Papa noho deck

Pikorua greenstone pendant, twist design representing connectedness

Pou a post, pillar

Pou manawa mast

Pūtaiao science

Rā kei mizzen

Rā matua mainsail

Rangahau to seek, research, investigate

Rangatahi young people, teenagers, adolescents

Rangatira chief(s)

Rongoā Māori traditional Māori medicine

Tangata whenuataanga place-based, socio-cultural awareness and knowledge

Taonga treasure(s)

Tātaiako cultural competencies for teachers of Māori learners

Taura pā stay (mast support)

Te Kotahitanga education research and professional development programme

Te Kura The Correspondence School

Te reo Māori Māori language

Te Tiriti o Waitangi Treaty of Waitangi

Tikanga Māori Māori values

Tino rangatiratanga chieftainship or full authority

Titiro, whakarongo . . . kōrero looking, listening, speaking

Wairuatanga spirituality

Wānanga communication, problem-solving, to deliberate

Waka traditional Māori canoe, vehicle

Whānau family

Whanaungatanga relationships with high expectations

Whakamā to be ashamed, shy, bashful, embarrassed

Whakapapa ancestry, genealogy

Whakataukī proverb