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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

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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.

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## He Mihi

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Tēnā koutou katoa, he mihi nui ki a koutou  
Ko Denali te maunga  
Ko Tanana te awa  
Ko Amerikana, ko Tatimana, ko Teina ngā iwi  
Nō Alaska ahau

Heoi anō, ko Aotearoa tōku kāinga inaianei, nō reira,  
Ko Tauhara te māunga  
Ko Waikato te awa  
Nō Taupō-nui-a-Tia ahau

Ko Kathleen DeVries rāua ko Jerry Vander Zwaag ōku mātua  
Ko Carrie Vander Zwaag ahau  
Nō reira, tēnā koutou, tēnā koutou, tēnā koutou katoa

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.

First and foremost, I would like to dedicate this completed thesis to the memory of each my grandmothers, Esther Mae and Eileen Marie. Despite being two of the most intelligent, talented and capable women I have ever known, neither of my 'Grandmas' were able to attend secondary school due to whānau and financial circumstances. Their determination, however, to enable future generations, both within and beyond their whānau, to receive greater educational opportunities, fostered a value in and love for learning that influenced and bettered the lives of many, including myself. Thank you for the legacy you have provided; the values I hold dear and much of my worldview stem from your empathetic and pragmatic approach to helping others. I have no doubt that both of you would have been successful doctoral candidates had you had the opportunity.

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<sup>1</sup> References question one of the Heidelberg catechism.

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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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*Love received, demands love returned.*

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*Adorn the bird with feathers so it can fly.*

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## Te Reo Māori Glossary

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

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 whenuatanga	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