James Cook University: Australian Aboriginal and Torres Strait Islander Studies; and the College of Arts, Society & Education.

Engaging Diverse Young People with Science Education: Articulating a Framework of Practice

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Thesis submitted by partial publication in fulfilment of the requirements for the degree of Doctor of Philosophy

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Statement on the Contribution of Others

To the best of my knowledge and belief, the thesis contains no material previously published by any other person, except where due acknowledgement has been made. The research described and presented in this thesis was undertaken by the author under the supervision of Professor Sue McGinty and Professor Brian Lewthwaite, who provided professional mentoring, ongoing academic guidance and editorial advice. The contribution of Professor McGinty and Professor Lewthwaite in supporting the completion of my thesis is greatly appreciated. I also wish to acknowledge the contribution of Dr David Lake, who was my original primary supervisor, and lead investigator of the Australian Research Council Linkage project, in which this thesis forms a part, until his departure from JCU in 2010. Dr Lake developed the original design of the larger project and provided significant intellectual support in the early stages of the study.

In relation to financial assistance, I have received the following:

- Financial assistance from the School of Education[1] and the School of Indigenous Australian Studies[2] in accordance with the James Cook University Minimum Resources Policy;
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- Financial assistance from the industry linkage partner (Youth+) to fund travel associated with the project.

As the research presented is formed, in part, by co-authored publications, there is a need to make clear the nature and extent of each author's contribution, including my own as lead author on all included publications. This information is provided in Table 1 which follows.

[1] Now subsumed within the College of Arts, Society and Education.

[2] Now known as Australian Aboriginal and Torres Strait Islander Studies.

Table 1: Author Attribution Statements and Signatures

Chapter No.	Details of publication on which chapter is based	Nature and extent of the intellectual input of each author including the candidate	Extent of Contribution	I confirm the candidate's contribution to this paper and consent to the inclusion of the paper in this thesis
Chapter 2	**Wilson, K.,** Stemp, K., & McGinty, S. (2011). Re-engaging young people with education and training: What are the alternatives? *Youth Studies Australia, 30*(4), 32-39.	Wilson & Stemp co-developed the original idea for the shape of the paper. Wilson completed the literature review and the writing of the first draft. Stemp assisted with editorial review. McGinty performed a supervisory review.	Wilson 70% Stemp 20% McGinty 10%	Name: Kellie Stemp Signature: Name: Sue McGinty Signature:
Chapter 6	**Wilson, K.,** & Stemp, K. (2010). Science education in a 'classroom without walls': Connecting young people via place. *Teaching Science, 56*(1), 6-10.	Wilson & Stemp co-developed the original idea for the project described within the paper. Wilson completed the literature review and the writing of the first draft. Wilson collected and analysed the data. Stemp assisted with the description of the project, with fact checking and with editorial review.	Wilson 70% Stemp 30%	Name: Kellie Stemp Signature:

Chapter 7	**Wilson, K.,** & Alloway, T. (2013). Expecting the unexpected: Engaging diverse young people in conversations around science. *Australian Educational Researcher*. 40(2), 195-206.	Wilson & Alloway co-developed the original idea for the project described within the paper. Wilson completed the literature review and the writing of the first draft. Wilson collected and analysed the data. Alloway assisted with the description of the project, with fact checking and with editorial review.	Wilson 70% Alloway 30%	Name: Todd Alloway Signature:
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Declaration of Ethics

This research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council (NHMRC) National Statement on Ethical Conduct in Human Research, 2007. The proposed research study received human research ethics approval from the JCU Human Research Ethics Committee Approval Number # H3025

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Works Published in the Course of the Research

Book Chapter

Wilson, K., & Lewthwaite, B. (2013). Engaging Diverse Learners in Science. In A. Fitzgerald (Ed), *Learning and Teaching Primary Science*. Port Melbourne, Victoria: Cambridge University Press.

Refereed Journal Articles

Wilson, K., & Alloway, T. (2013). Expecting the unexpected: Engaging diverse young people in conversations around science. *Australian Educational Researcher*. 40(2), 195-206.

Wilson, K., & Boldeman, S. (2011). Exploring ICT Integration as a Tool to Engage Young People at a Flexible Learning Centre. *Journal of Science Education and Technology, 21*(6), 661-668.

Wilson, K., Stemp, K., & McGinty, S. (2011). Re-engaging young people with education and training: What are the alternatives? *Youth Studies Australia, 30*(4), 32-39.

Wilson, K., Lake, D., & McGinty, S. (2010). Re-Engaging Disadvantaged Youth Through Science: Developing a Framework of Practice. *International Journal of Interdisciplinary Social Sciences, 5*(6), 237-248.

Wilson, K., & Stemp, K. (2010). Science education in a 'classroom without walls': Connecting young people via place. *Teaching Science, 56*(1), 6-10.

Conference Papers and Seminars

Wilson, K. (2013, August 27-28). *Framing a Flexible Approach to Youth Education and Engagement*. Stepping Out, Breaking Through: Choices and Challenges in Education Conference, Deakin University, Geelong, Victoria.

Wilson, K. (2013, April 27-May 1). *Re-engaging Culturally Diverse Young People Through Science: Developing a Framework of Responsive Teaching Practice.* Refereed Symposium Paper (Practices Contributing to Changes in Teacher Actions Towards Culturally Responsive Science Teaching in Indigenous Settings in Australia, Aotearoa-New Zealand and Canada) presented at the American Educational Research Association (AERA) Conference, San Francisco, California.

Wilson, K. (2012, November 13-15). *Re-engaging Culturally Diverse Young People Through Science: Developing a Framework of Responsive Teaching Practice.* Paper presented at the Culturally Responsive Research and Pedagogy Symposium, University of Waikato, Hamilton, New Zealand.

Lewthwaite, B., & **Wilson, K.** (2012, June 27-30). *Citizenship Science Education? Responding to the Voices of Aboriginal Communities.* Paper presented at the 43rd Annual ASERA Conference, University of the Sunshine Coast, Sippy Downs, Queensland.

Wilson, K. (2011, November 24-25). *'Teach us how to think about science': Developing a Curriculum Framework for a Flexible Learning Centre Context.* Paper presented at the Contemporary Approaches to Research in Mathematics, Science and Environmental Education Symposium, Deakin University, Burwood, Melbourne.

Wilson, K., Lake, D., & McGinty, S. (2011, June 30 – July 2). *Reframing Science Education for a Flexible Learning Centre Context: Making Science Matter.* Paper presented at the Australasian Science Education Research Association (ASERA) Conference, Adelaide, South Australia.

Wilson, K., & Stemp, K. (2010, November 28 –December 2). *Learning to Live and Be Together: A Sustainability Orientated Approach to Engaging Diverse Young People*. Paper presented at the 2010 AARE International Research in Education Conference, University of Melbourne, Melbourne.

Wilson, K., Lake, D., & McGinty, S. (2010, August 2-5). *Re-engaging Disadvantaged Youth Through Science*. Paper presented at the 5th International Conference on Interdisciplinary Social Sciences, Cambridge University, Cambridge.

Wilson, K., Lake, D., & McGinty, S. (2009, July 1-4). *Sustainable science for a non-traditional schooling context: Developing a framework of practice.* Refereed paper presented at the Australasian Science Education Research Association (ASERA) Conference, Geelong, Victoria.

Wilson, K., Lake, D., & McGinty, S. (2009, May 3-6). *Re-engaging Disadvantaged Youth Through Science.* Knowledge Sharing Session presented at the Dream-Catching 09 Conference, University of Manitoba, Winnipeg, Canada.

Wilson, K., Lake, D., & McGinty, S. (2009, April 17-20). *Science education for disengaged youth: Developing a framework for best practice.* Refereed Symposium Paper (Approaches to teaching and learning science that foster interest and understanding: Examples from Australia and New Zealand) presented at the National Association of Research in Science Teaching (NARST) Conference, Los Angeles, California.

Wilson, K., Lake, D., & McGinty, S. (2008, July 1-4). *Science education for disengaged youth: Developing a framework for best practice.* Paper presented at the Australasian Science Education Research Association (ASERA) Conference, Brisbane, Queensland.

Wilson, K., Lake, D., & McGinty, S. (2009, May 29-30). *Re-engaging Disadvantaged Youth Through Science.* Teacher Workshop presented at the CONSTAQ Science in the Tropics Conference, James Cook University, Townsville, Queensland.

Wilson, K., Lake, D., & McGinty, S. (2009, April 13-17). *Sustainable science for a non-traditional schooling context: Implementing a framework of practice.* Graduate Invited Poster Presentation to Professor William Ayers at the American Educational Research Association (AERA) Conference, San Diego, California.

Abstract

Science can be seen to exist as an icon of prestige, power and success in Western society with the potential to marginalise those who differ in their epistemology (Aikenhead, 2006). Science education itself is often understood by both teachers and students as a 'pipeline' process that filters 'apt' students towards tertiary education and professional careers (Tytler, 2007). While much policy attention is direction towards improving mainstream secondary students' engagement with science, the needs of those who might be considered 'non-mainstream' (Lee & Buxton, 2011) appear to have been sidelined. There is a wealth of literature in regards to science, science education and effective teaching and learning strategies, yet little that explores the specific needs of non-mainstream young people, particularly in Australia. This thesis makes a contribution to this field in the context of working with an alternative or 'flexible' secondary schooling system - the Edmund Rice Education Australia[3] Youth[4]+ Flexible Learning Centre (FLC) network.

The FLC network operates within a social inclusion framework to 'walk with' young people who have found themselves outside of the mainstream schooling system. Like other similar educational systems, the network aims to offer a broad array of educational experiences in order to cater to the academic, social and emotional needs of the young people who select to attend. The place of science education in flexible or alternative settings is at best tenuous, in that it is perceived as a difficult subject for young people who often present with numerous academic challenges including large gaps in schooling and low levels of basic literacy and numeracy skills. In these circumstances, science education can seem a poor fit for addressing the immediate needs of young people experiencing complex educational and life circumstances. However, the argument of this thesis is that science education is a necessary component of a socially just education, but it must be reframed to meet the needs of disenfranchised youth. A humanistic approach to science education is advocated for due to its transformative potential in remaking science teaching and learning into a form that is both personally and socially meaningful for diverse young people. Central to this approach is a focus on both the intellectual resources of the learner and their

[3] Edmund Rice Education Australia (EREA) administers an independent system of Australian schools and educational entities, within the umbrella of Catholic education.

[4] Branch of EREA dedicated to the delivery of flexible educational initiatives (www.youthplus.edu.au).

cultural funds of knowledge (Gonzalez & Moll, 2002), resulting in an emphasis on student capitals rather than deficits.

The methodology of the project has involved working in close partnership with the EREA Youth+ FLC network, in order to establish the needs of the organisation in terms of promoting the teaching and learning of science. The project has embraced a generative orientation through working outwards from developing an understanding of the context, to capturing the practice of innovative teachers of science through use of a case study research strategy (Simons, 2009), and then refracting these understandings against the literature to develop a framework to guide future practice. Data sources have included classroom observation notes acquired through extended time in the field, semi-structured interviews with teaching and support staff and a review of key organisational, policy and curriculum planning documents. Data analysis has been grounded in the contextual and the holistic (Mason, 2002), and has been further supported and validated through the process of co-authoring the case study accounts with the key teacher participants of the study.

The culminating output of this thesis, the 'Thinking About Science' framework, has been designed as a pedagogical reflection tool and highlights the value of inclusiveness, diversity and place within the broader conceptualisation of science for everyday life (Aikenhead, 2006). It is intended to provide a basis for establishing an ongoing dialogue around science curriculum across the FLC network, and to act as a platform for professional development. While this particular framework has been developed to respond to the specific needs of an Australian flexible learning context, it may have wider significance in relation to reframing science education to meet the needs of non-mainstream young people more generally. To date, addressing the needs of marginalised students has taken the form of developing more generic science curriculum and proposing increased standardised testing (Masters, 2009), purportedly to improve the educational outcomes of marginalised students in the form of greater accountability and 'equity of experience'. However, the overall results of this study support the notion that the engagement of diverse young people occurs not through delivery of a homogenous science curriculum, but rather through innovative pedagogical practice that responds to the needs of individual young people and their wider communities.

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Chapter 1: Introduction and Background

1.1 Overview

This chapter presents a rationale for the study described in this thesis which examines the issue of engaging diverse youth with science in an Australian flexible learning context. It firstly delivers an introduction to the topic of engagement in science and problematizes the lack of consideration of the needs of diverse and disenfranchised youth within this domain. A background to the project is then provided and the study is explained as an output of an Australian Research Council (ARC) Linkage Project, involving a partnership with the EREA Youth+ Flexible Learning Centre (FLC) network[5], a provider of alternative or flexible learning options for young people experiencing disenfranchisement from the mainstream schooling system. The three driving concerns of the network, which underpinned the development of the project, are then detailed and linked to ongoing areas of debate within the field. This then leads to the introduction of the research focus and research questions which clarify the purpose of the thesis element of the study within the larger ARC project. The significance of the project is then discussed before an overview of the thesis is presented. The chapter concludes with a brief description of the background of the researcher that influenced the choice of participation in this project, and a signaling of the intent of Chapter 2.

1.2 Introduction

Student engagement in science education is a topic of both national and international significance. The well-documented 'crisis' in science education refers to declining rates of interest and engagement in science education for the mainstream population of secondary students (Tytler, 2007). What remains on the margins of this discussion of a 'crisis' in science education, particularly in the Australian context, is consideration of the needs of 'non-mainstream'[6] (Lee & Buxton, 2011) young people in terms of accessing the opportunities afforded within the discipline of science. The significance of this issue is made evident in the results of international testing regimes that paint a

[5] The organization was formerly known as the EREAFLC Network (EREAFLCN), which is indicated in references to some organizational documents within the thesis, and within the case study publications of Chapters 6-8. The current preferred title of the organization is EREA Youth+ FLC network, which is abbreviated at times within the thesis to the shorter 'FLC network'.

[6] Used in reference to students' cultural, linguistic and social class backgrounds, that are seen to impact on the privilege experienced within mainstream institutions (Lee & Buxton, 2011).

disturbing picture of entrenched inequity that sees a sizeable proportion of Australian students realizing limited success in science and continuing to fall behind their peers.

The Program of International Student Assessment (PISA) provides evidence that nearly one quarter of Australian students from low socio-economic circumstances, and nearly one half of students who identify as Aboriginal and/or Torres Strait Islanders, are not achieving even a basic level of scientific literacy proficiency (Thomson & De Bertoli, 2008). The gaps in proficiency between these groups of students and their peers of the same age can be equivalent to several years of schooling. This situation has remained unchanged over time, with comparable results occurring in each three yearly cycle of PISA testing (Thomson, De Bertoli, Nicholas, Hillman & Buckley, 2010). Similarly, the Trends in International Mathematics and Science Study (TIMSS) signposts significant disparity in performance amongst groups of students in Australia, particularly between Indigenous and non-Indigenous students. This situation has remained unchanged since testing commenced in 1995 (Thomson, Hillman & Wernert, 2012). Thomson & De Bertoli (2008, p.xiii) make note that the low achievement of Australian Indigenous students "continues to be a concern" but little advice is provided in relation to how this might be ameliorated. While Australia "remains committed to the principle of equity and social justice education" (Thomson, De Bertoli, Nicholas, Hillman & Buckley, 2010, p.21), it is evident that there is room to improve the science education outcomes for young people from diverse backgrounds.

Internationally, movements such as the 'Science Education for All' paradigm have brought to the fore issues related to both the need for widespread equitable access to a high quality science education as well as questions around what exactly constitutes a science education of value to *all* students (See, for example, the foundational work of Rutherford & Ahlgren, 1991, grounded in the American Association for the Advancement of Science Project 2061 initiative). In rationalizing the utility of a science education for all, the dominating theme is one of enabling the citizenry to make wise decisions about modern day issues related to science and technology (Osbourne, 2006). This drives an imperative to ensure that all youth are provided with the opportunity to become 'productive citizens' with the skills and wherewithal to contribute to a scientifically and technologically advanced democratic society (Calabrese Barton, 2003, p.25). Pushed aside from this discussion in most instances is consideration of the perspectives and needs of diverse groups of people in relation to the discipline of science. An example of this omission is evident in a quote from the paper by Osbourne (cited above) which states:

> *…science is one of the greatest cultural achievements of Western society, if not the greatest. Any education in science must attempt to communicate, therefore, not only what is worth knowing, but also how such knowledge relates to other events, why it is important, and how this particular view of the world came to be (Osborne, 2006, p.3).*

In the context of a discussion of a 'Science Education for All', it is to be wondered how the diverse worldviews and scientific practices of peoples not included in the construct of 'Western society' are indeed encouraged by this paradigm to participate more, rather than less, in science education.

In the Australian context, there is a similar emphasis on scientific literacy as necessary preparation for engaged citizenry (Goodrum, Hackling & Rennie, 2001). However, the Science For All movement appears to have had much less of an influence in the Australian context, with only piecemeal investigations into the participation and engagement of students from diverse backgrounds with school science education. Tytler's (2007) seminal report "Re-imagining Science Education: Engaging Students in Science for Australia's future" provides detailed insight into the general issue of student engagement in science education, yet it contains little reference to the needs of diverse students. As such, it would seem that the problem of equity in science education in the Australian context remains under-explored, with very little research into how science might be framed to better meet the needs of Australian students from a range of backgrounds. This need to explore how science teaching practices might be more inclusive of those groups of students who appear to remain on the margins of mainstream science education forms part of the broad rationale for this project, the background to which is described in the following section.

1.3 Background to the Project

The study to be described in this thesis is an output of a larger ARC Linkage project[7] titled 'Re-Engaging Disadvantaged Youth Through Science'[8]. The aim of the project in its entirety has been to build a framework for guiding science teaching practice in the context of working with young people with complex needs and diverse backgrounds

[7] ARC Linkage projects are a federally funded initiative to support long term strategic alliances between higher education organisations and other industry organisations and end-users (ARC, 2014).

[8] Identifier – LP0669656.

who attend an alternative or 'flexible'[9] secondary schooling system known as the EREA Youth+ Flexible Learning Centre (FLC) network.

The FLC model of schooling was instigated in south-east Queensland, Australia, twenty-five years ago with the aim of providing an alternative learning pathway for young people who had, for a variety of reasons, found themselves completely disengaged from the mainstream education system. As a result of high need and corresponding invitation from communities, the operation expanded from a single site in Brisbane, to a network of 11 sites across urban, regional and remote areas of Queensland. The network today, operating within the umbrella organization of Youth+, continues to expand nationally to cater for young people in disadvantaged areas of Western Australia, Victoria, New South Wales, South Australia and the Northern Territory. A more detailed explanation of the role of Youth+ as a key provider of flexible learning options within Australia is provided in Chapter 2 of the thesis.

Young people attending FLCs have often experienced complex life circumstances including homelessness, contact with juvenile justice and child safety systems, young parenting and disability (EREA, 2010). They have also generally experienced large gaps in their schooling due to school absence, suspension and/or expulsion. Young people across the network come from diverse cultural backgrounds and those who identify as Indigenous Australians comprise a large percentage of the student cohort in regional and remote locations. To cater for the needs of diverse and disenfranchised young people, the network aims to provide a holistic and integrated program that allows students full access to a broad and comprehensive curriculum. Science, recognized as a key learning area in both state and national curriculum documents, is considered integral to the provision of a well-rounded educational program.

The ARC project, within which this study is situated, was developed to address three particular concerns identified by the network in relation to science education in the Flexible Learning Centre context. These concerns are detailed and expanded upon below.

[9] Flexi-school or Flexible Learning Option is a preferred term for many alternative education providers in the Australian context (Te Riele, 2012).

1. Science education delivery appeared to be ad hoc across the network and often lost out to teaching concerns considered more pressing, such as the development of young people's basic literacy and numeracy skills;

Science education has had little exposure in the flexible or alternative learning context, perhaps due to the fact that it is often perceived as a 'difficult' subject for students who are already experiencing academic struggles with the 'basics'. In fact, an over-emphasis on the teaching of 'basic skills' and vocational education training forms the basis for criticisms leveled at alternative schools in relation to a perceived lack of academic integrity within curriculum programs. While basic skill development is necessary for meeting the requirements of everyday life, in relation to improving educational outcomes for 'at-risk'[10] students, Luke notes that "basic skills acquisition is necessary but not sufficient for sustainable engagement and achievement" (2010, p.61). This over-emphasis on basic skill development is not limited to alternative schooling settings, but has become increasingly endemic to teaching and learning practices designed to address achievement gaps between disadvantaged students and their more advantaged peers (Luke, 2010; Fogarty & Schwab, 2012). Increasing pressure through standardized testing regimes to improve literacy and numeracy outcomes for students experiencing disadvantage has, in many instances, relegated more substantive forms of learning to the margins of both traditional and alternative classrooms. In relation to the education of Indigenous students in Australia, Fogarty & Schwab (2012) note that an extraordinary focus on improving literacy and numeracy outcomes for these students has encouraged teachers to increasingly narrow the curriculum options on offer, at the expense of providing learning opportunities that might engage students in meaningful and intellectually challenging tasks.

2. Curriculum materials available to support science education delivery were not tailored to meet the needs of young people attending FLCs, particularly in relation to competencies expected at prescribed age levels;

In mainstream Australian schools, science is a mandated core curriculum subject through grades Preparatory-Year 10. To support the provision of science education, schools have access to the recently implemented nation-wide *Australian Curriculum*

[10] The term 'at-risk' is one of contention in that it is associated with a pathological focus on the individual rather than a wider consideration of systemic processes that contribute to student disenfranchisement from schooling. This is further taken up in Chapter 2.

v7.3: Science, however there are complexities in interpreting this newly developed framework within a flexible learning setting. The *Science* curriculum in its current form evidences a predominant focus on year level content descriptors, with the underlying presumption that students have the necessary skills and abilities to progress lock-step from one stage to the next. While there is a certain logic in ensuring that students accumulate knowledge incrementally and at levels appropriate to their age, there appears to be a failure to consider how the curriculum might meet the needs of students who have experienced gaps in their schooling or who may be significantly behind their peers. In the case of the FLC network, the mandated *Science* curriculum is too tightly scripted to be of pragmatic use to teachers working with students with complex needs and irregular educational histories.

In addition, the content of the curriculum itself does not reflect common understandings of best practice for young people from diverse backgrounds. The lack of emphasis on context in the most recent version of the science curriculum sits in direct opposition to the body of national and international scholarly work that highlights the importance of contextualized and localized curriculum in facilitating the engagement of diverse students (Brayboy & Castagno, 2009; Fogarty & Schwab, 2012). While early documents associated with the development of the national curriculum demonstrated an orientation towards context-based learning (see, for example, National Curriculum Board, 2009), this emphasis was lost through the extended process of consultation and revision that marked the course of developing a science curriculum required to please a wide variety of stakeholders[11]. This lack of mandate to contextualize science teaching and learning is symptomatic of a curriculum document that provides little real guidance to teachers in relation as to how science teaching and learning might be framed to engender the successful participation of all students.

3. *School science education, as a narrowly defined construct, was considered problematic in the FLC context. Student's evident interest in science, but not school science, justified the need for an inquiry into how science education might be better framed to meet the needs of FLC young people.*

[11] The history of the consultation process that occurred in the development of the Australian Curriculum: Science is available at the ACARA website - http://www.acara.edu.au/curriculum/consultation.html

Despite global curriculum reform efforts, the practice of teaching and learning science in schools remains relatively unchanged from the practices of the last century. According to Lyons (2006), traditional school science practices are characterized by transmissive pedagogies, decontextualized content and unnecessary difficulty. Set within tight disciplinary boundaries, Aikenhead (2006, p.14) notes that the goals of school science continue to reflect "the ideologies of pre-professional scientific training, of mental development through learning abstract concepts, of dismissing practical utilitarian outcomes, and of screening students for university entrance." This 'pipeline' approach to science education continues to position science as a subject for some, rather than a subject for all. Roth & Calabrese Barton (2004) build on this argument by depicting the traditional school science class as having become a "mechanism for controlling what it means to "know and do science" rather than an empowerment zone where students are valued for their ability to contribute to, critique and partake in a just society" (p.5). In the case of students from diverse backgrounds, it is clear that there is often a substantial disconnect between the values, interests, and life experiences that these young people bring to the school science classroom and the recognition of such within traditional science curricula. Overcoming this disconnect requires an exploration of alternative approaches to science education that place the needs of young people at the centre of the science teaching and learning process.

1.4 Research Focus and Questions

These three concerns highlighted above informed the original ARC project brief which detailed a research design incorporating the development of a model to both stimulate and inform the practice of science education at selected Flexible Learning Centre sites in Queensland. The Principal Investigator (PI), Dr David Lake, was primarily involved with the development of an initial model of science education and subsequent refinements of the model through a process of trialling and modification. The PI created a final version of the model known as SPEAR (Stimulus, Prototype, Experiment, Analysis, Reflection) which was disseminated and published (see, for example, Lake & McGinty, 2011). My PhD project was integral to the larger project as a primary source of data but was also defined on its own terms. My particular interest was in exploring the meaning-making of participants in this unique schooling context and in investigating the potential of reframing science education through the lens of an alternative perspective. Exploring the particular dynamics of the intersection of FLC teaching staff, disenfranchised young people and science education was my primary focus, with the intention of using such information to articulate a more open-ended framework to guide science education that would find resonance within an alternative

philosophy of education. The aim of the thesis study was then determined to be:

> To work with FLC staff to generate a framework to guide science education practice that would demonstrate responsiveness to the context.

The research questions developed to guide the project and contribute to the overall aim of the study were as follows:

1. How does the FLC context shape science education?
2. How do teachers work to engage diverse young people in science education within the FLC context?
3. How can science education be better framed to meet the needs of diverse young people?

1.5 Significance of the Project

The significance of this work lies in its contribution to understanding how science education might be reframed to meet the needs of disenfranchised youth within an Australian flexible learning setting. The importance of investigating this topic is reflected in the evidence of increasing numbers of young people seeking out flexible learning options (te Riele, 2012), which comes with a concomitant responsibility to ensure that these young people have access to an education of equivalent breadth to their mainstream peers. With the flexible learning sector in Australia being relatively new, there is at present only a thin body of research literature that captures the philosophy and practice of these settings (as detailed in Chapter 2), and science education has yet to be a focus of dedicated scholarship in this area. This study then was designed to address this gap and contribute to both a wider understanding of the practices of Australian flexible learning settings, as well as to a deeper understanding of the needs of disenfranchised young people in the context of science education.

This study is also significant in contributing to the international body of work that focuses attention on meeting the needs of diverse youth. The fields of Urban Studies in Science Education and Multicultural Science Education have evidenced substantial scholarly effort towards articulating, implementing and promoting forms of practice responsive to young people with diverse needs and complex life circumstances (see, for example, Atwater, 1996; Aikenhead & Jegede, 1999; Calabrese Barton, 2003; Calabrese Barton & Yang, 2000; Gonsalves, 2010; Rahm, 2010; Seiler, 2001; Seiler, 2011; Tobin, Elmesky & Seiler, 2005;). While situated on the margins of the

mainstream discourse of science education, educators in this field have continued to work to draw attention to the needs of diverse youth and this study similarly seeks to highlight the requirement for more responsive forms of practice to support disenfranchised Australian youth to experience success with science.

1.6 Overview of the Thesis

This thesis is organized into ten chapters. Following this introductory chapter, Chapter 2 locates the EREA Youth+ FLC network as a flexible learning option within the Australian educational landscape that has arisen in the context of a broader societal concern regarding the disengagement of young people from education and training. The significance of catering to disengaged young people is explored, and elements of best practice in alternative settings are highlighted. Chapter 3 seeks to find a theoretical meeting point between the educational philosophy and practice of alternative educational settings and documented responsive approaches to meeting the needs of diverse youth in science education. A humanistic approach to science education is advocated for within this chapter. Chapter 4 presents the methodological design as a collaborative enterprise, and details the case study research strategy used within the project. The design phases of the study are outlined, and linked to the findings chapters of the thesis. Chapter 5 highlights contextual considerations of the setting, and lays the groundwork for Chapters 6, 7 and 8, which are dedicated to the presentation of the case study findings of the project. The case studies of Chapters 6-8 take the form of publications co-authored with three key teacher participants, and represent 'snapshots of practice' that highlight unique pedagogical approaches to science education that work to engage diverse young people within flexible learning settings. Chapter 9 synthesizes the findings of the case studies, through presentation of a practice framework that incorporates the contextual, theoretical and practical learnings of the project. Chapter 10, as the concluding chapter, revisits the concerns highlighted within the introduction to the thesis, and considers how the findings of this project may contribute to addressing the ongoing concern of engaging diverse young people in science.

1.7 Researcher Background

My involvement in this research project commenced in response to an advertised position for an Australian Postgraduate Award Industry (APAI) scholarship[12] attached to the larger ARC Project previously described. While being unfamiliar at the time with the exact nature of the EREA Youth+ FLC schooling system, I was drawn to the notion

[12] APAI Scholarships are a funded component of ARC Linkage Projects.

of engaging disenfranchised young people through the medium of science. I attribute this to my own experiences of being a 'high school drop-out', an experience that always puzzled me as I was considered an academically gifted student yet, somehow, I failed to achieve within the mainstream system. After disengaging from secondary school at the age of 15, I drifted through a series of low paid jobs but sporadically re-engaged with education through pursuing (but never fully completing) a number of science related vocational qualifications ranging from Certificates in Aquaculture and Laboratory Skills, to a Diploma in Science Education. My own experiences of turning towards science as a disengaged young person contributed to my belief in the potential of science education as a pathway to re-engagement.

Later in life and as a mature aged student, I enrolled at James Cook University (JCU) in order to complete a Bachelor of Education. It was during this process of study that I began to realize for the first time that perhaps the educational system had contributed to my disengagement from schooling rather than the fault being entirely based on my own inadequacy. I developed an interest in researching barriers to equitable educational outcomes and was particularly interested in exploring the experiences of working class students, as my own background was that of being both working class and economically disadvantaged. I found considerable gaps in relation to the theoretical understanding of effective practice in improving outcomes for students from disadvantaged backgrounds and the dominant practices of mainstream schooling and teaching. This was reinforced by my teaching practicum experiences in schools which led to a sense of despair in relation to the transformative potential of mainstream schooling. While I was fortunate to interact with a number of dedicated teachers, the system itself appeared immutable.

At the completion of my degree, I made a choice to work for a charity that specifically focused on assisting young people from disadvantaged backgrounds to complete their schooling, in the hope that I might have more chance of making a difference in this context, rather than that of a classroom. My work at this charity was focused within a local geographic area of significant disadvantage and involved working closely with families to support their children through the stages of schooling. My experience of engaging with over 100 disadvantaged families was that, contrary to public perceptions of disinterest, the majority of families desperately wanted a good education for their children but were experiencing barriers on many fronts. Schools themselves were challenged to meet the complex needs of disadvantaged families and students as their ability to respond was bounded by constraints of time, resources and the schooling

mandate. Part of my charitable role was to assist families and schools to navigate this difficult terrain to ensure the best outcomes for the students involved but this enabled only individual rather than systemic change.

This inability to enact change propelled me towards community development in the hope that empowering people from a grass roots perspective would enable real and lasting change. I enrolled in a postgraduate certificate of community development and commenced work with a community renewal organization working in the same local area of disadvantage. My new role involved working with families to support the early years of education through building community capacity to initiate and maintain networks that would bring families together to support each other and their young children's healthy development. It was at this meeting place of community development and education, where the intention was that of placing power back in the hands of those experiencing disadvantage that I first encountered the transformative potential of education.

Upon completion of this particular project, I came across the advertisement for the APAI position and was instantly intrigued by the possibilities that might lie within. I was in some sense astounded that everything I was interested in could be neatly tied up in one package – science, working with disadvantaged students and the potential of transformative education. After an initial interview with the (then) Principal of the FLC network[13] (Mr Dale Murray) and the chief investigators of the ARC project located at JCU (Dr David Lake and Professor Sue McGinty), I knew that this project represented a unique opportunity to reimagine science education in an environment where doing things differently was the norm rather than the exception. I was successful in my application for the APAI position and fortunate to receive the systemic support from the FLC network that both initiated and carried the momentum of the research project.

1.8 Chapter Conclusion

This chapter has provided an introduction to the thesis and grounded the project in the practical concerns of the linkage partner, the EREA Youth+ FLC network. The following chapter takes the form of a publication[14] produced in the course of the thesis titled "Re-engaging young people in education and training: What are the alternatives?" (Wilson, Stemp & McGinty, 2011), which provides further information in relation to the

[13] Now the Director of Youth+.

[14] Elements of this article have been expanded to reflect more recent literature available in the field.

EREA Youth+ organization, and positions the work of its main arm, the FLC network, within the wider context of Australian alternative education provision. The exploration of the philosophy and practice of alternative and flexible learning settings provided within this chapter contributes a greater understanding to the context of the study, and affords the necessary background information to understand the rationale for the science education perspective presented in Chapter 3.

Chapter 2: Youth Disengagement and Alternative Education Approaches

2.1 Introduction

The intention of Chapter 2 is to situate the EREA Youth+ FLC network (introduced in Chapter 1) within the wider context of alternative educational provision within Australia. The chapter consists of an updated and revised version of the article "Re-engaging young people with education and training: What are the alternatives?" which was published in the journal of Youth Studies Australia[15]. The original post-print version of the article is included in Appendix A.

This chapter highlights the significance of alternative or flexible learning provision in meeting the needs of disenfranchised youth. It also works to synthesize current understandings in relation to what might constitute best practice in these types of settings. This lays the groundwork for understanding the context of the thesis study, the specifics of which are further explained within the findings chapters of the thesis (Chapters 5-9).

[15] Full reference: Wilson, K., Stemp, K., & McGinty, S. (2011). Re-engaging young people with education and training: What are the alternatives? Youth Studies Australia, 30(4), 32-39.

2.2 Article Abstract

Alternative education programs are one way of responding to the disengagement of young people from mainstream schools. While there are a great variety of programs, those where young people experience success have incorporated a number of elements of best practice (Mills & McGregor, 2010). This article reviews the attributes of effective alternative programs with a particular focus on those programs situated in Queensland, Australia. Establishing what constitutes a successful alternative program becomes increasingly important in an education climate that includes rapid movement toward a standardized educational experience, with the attendant potential to further alienate those young people already existing on the margins of mainstream schooling.

2.3 Disengagement as a Social Concern

Engagement in schooling is a key factor in producing equitable social and employment outcomes for all young people. Hence, school retention is an issue of growing concern, highlighted in international social inclusion agendas, and prioritised at a national and state level through educational reform policy targeted at the senior secondary phase of learning. In 2009, the Council of Australian Governments (COAG) responded to concerning low national rates of Year 12 completion by mandating participation in school until completion of Year 10, with a further requirement for young people to remain in full-time education, training or employment until the age of 17 (COAG, 2009). Substantial funding has been allocated to support the implementation of these school retention reforms yet a significant and growing proportion of young people continue to disengage prior to achieving their Senior Certificate or equivalent.

In 2012, 15% of teenagers (15-19 year olds) nationally were identified as not fully engaged in work or study and nearly one third of school leavers had not transitioned to either full-time study or work (Robinson & Lamb, 2012). Young people who identify as Indigenous, are from low socio-economic circumstances and/or experience geographical remoteness, are over-represented in the cohort of young people identified as disengaged (Muir, Mullan, Powell, Flaxman, Thompson & Griffiths, 2009). The consequences of youth disengagement from education for young people and their communities are significant. Long-term effects include marginal participation in work, further education and training, and skill development (Zyngier, 2003), with a requisite higher likelihood of future reliance on government assistance (Peace, 2006). This in turn increases the risk of extended social dislocation and physical and mental health

problems. The consequences of disengagement are magnified for Indigenous communities in that the proportion of Indigenous young Australians not fully engaged in work or training is almost three times that of non-Indigenous teenagers. The unemployment rate for Indigenous young Australians is twice that of non-Indigenous youth, and Indigenous young people face a greater range of difficulties in finding secure and meaningful employment opportunities (Mission Australia, 2006). Walsh, in writing the foreword for the national 'How Young People are Faring' Report' (2012, p.8) notes with concern that "For many, disengagement and ongoing social exclusion is not a stage in life, but a way of life."

2.4 Factors Related to Youth Disengagement

It is common to find in any discussion centred on youth disengagement a list of individual factors that predispose a person to being "at risk" of early school leaving. Curtis & McMillan (2008, p.8) identify "not having an intention to complete school, coming from a non-nuclear family, being a below average academic achiever, being male, having an unfavourable attitude towards school and perceiving student-teacher relations as unsympathetic" as personal attributes associated with a greater likelihood of non-completion of school. Low-skilled parental occupation and non-completion of post-secondary education and training are also considered to be contributing factors.

In relation to individual relationships with school, Lange & Sletten (2002) highlight three influential factors that impact upon engagement in the school context, namely – academics; relationships with teachers and peers; and school size. The academic aspect takes into consideration suspensions, missed classes and academic failures that leave some students "weary of the school experience and distrustful that the education system can be a tool for their success" (Lange & Sletten, 2002, p.11). The relationship dynamic in the school setting is related to the strength of students' connections to their peers and adults as well as to the overall school climate which has a significant impact on the academic investment of at-risk students. School size as a factor is linked to research that consistently demonstrates that large school size is an important dimension contributing to student alienation from the traditional schooling system (Lange & Sletten, 2002).

In the context of this discussion, it is important to note that, "disengagement" in the educational setting is often seen as a failure of the individual to enact participation rather than a failure of the schooling system to cater for those students who do not experience success with the traditional form of mainstream schooling (Hirst &

Vadeboncoeur, 2006). Discussion of school-based disengagement often centres upon the failure of students to engage with a process that is without question deemed "right" (Grandin, 2008, p.1). Wallace notes that educational institutions legitimise only certain or "approved" types of learning and social practices that can either affirm or challenge the identities of learners, meaning that "students who share the same ways of learning succeed and those who do not can be seen as different or difficult" (2008, p.6). While a point of contention, it can be put forth that mainstream schooling pushes out young people who "don't fit".

Young people facing complex life circumstances are the most likely to struggle to fit into the mainstream schooling system. These include those experiencing homelessness, being in the care of the state, students with disabilities, young parents and young carers. Additionally, young people who have different sexual orientations (such as gay and lesbian youth) are susceptible to leaving school early due to discrimination (KPMG, 2009). Indigenous young people continue to experience lower levels of educational attainment and school completion than non-Indigenous students (Purdie & Buckley, 2010). It is interesting to note that in the case of factors related to the disengagement of Indigenous young people, Purdie & Buckley (2010, p.1) report that: "parents and students tend to stress school-related factors (for example, poor teaching and failure to engage students); educators tend to stress parental attitudes and the home environment (for example, poor parental attitudes to school)."

A number of authors (see, for example, Smyth, 2002; Croninger & Lee, 2001) find a middle ground between the concepts of student/family contextual risk factors and school inadequacy, in putting forward the idea that students who experience complex life experiences may be further disadvantaged by a lack of "school" capital. Some young people struggle to connect with the culture of the traditional school, and therefore require an empathetic and supportive school response to ensure both academic success and social well-being (Mills & McGregor, 2010). It is suggested that schools could mitigate disengagement risk factors by transforming relationships for learning to those that are inclusive of students' families and communities and, as such, holistically support and enable young people to build social capital (Leadbeater, 2008). However, this is not the typical education experience for many young people, with the result that many are disengaging from education completely without the resources required to fully participate within their community.

2.5 Addressing Disengagement Through Alternative Approaches

Alternative education is a term used to broadly encompass educational activities that fall outside the traditional schooling system (Aron, 2006), and is most commonly used in the Australian context to reference programs serving disenfranchised youth who are no longer enrolled in mainstream schools. According to a recent report commissioned by the Dusseldorp Skills Forum, approximately 33 000 young people in Australia are being catered for by alternative or 'flexible learning' initiatives and programs (te Riele, 2012). Catering to a diverse clientele, the flexible learning sector has developed as a heterogeneous kaleidoscope of programs spanning the nation and most concentrated in recognised areas of social, economic and geographical disadvantage. As the sector burgeons, there is an increasing amount of research directed at mapping the extent, nature and reach of flexible learning provision (see, for example te Riele, 2007; te Riele, 2012). The following section investigates the landscape of flexible learning option provision in the state of Queensland, Australia.

2.6 Re-Engagement and Flexible Learning Options in Queensland

Reforms to the senior phase of learning designed to improve student engagement and retention gathered momentum in the state of Queensland in 2002, under the influence of the Queensland "Smart State" strategy which incorporated a renewed emphasis on education, employment, training and youth affairs (Harrevald & Singh, 2011). The Education and Training Reform (ETRF) agenda saw the passing of the "Youth Participation in Education and Training Act 2003", enacting a legal requirement for young people to remain formally enrolled in education and training until the age of 17, with a concomitant promise to "*enhance learning options that provide greater flexibility to meet the needs of even more 15-17 year olds*" (State of Queensland, 2002)**.** The enactment of this agenda saw the provision of sizeable funding to support strategies and programs catering for those students considered at serious risk of disengaging from education or training.

In 2003, the Queensland Department of Education and the Arts (DETA) conducted the *Flexible Learning Services Survey* in order to undertake a scan of the education services that were, at that time, responding to young people who were formally disengaged, or considered at risk of disengaging, from mainstream schooling (DETA, 2004). A total of 121 services were identified and indicated a diverse range of flexible learning services being offered in Queensland including; services within state schools, annexes to state schools providing long-term education programs; flexi-schools (government and non-government), community based youth services; short and long-

term education, training and employment preparation programs; TAFE and other vocational training providers, and behaviour management programs (DETA, 2004).

In 2009, The Youth Affairs Network of Queensland (YANQ) provided an updated snapshot of Queensland's re-engagement services, which involved a survey of 128 services that were then categorised into a few different types based on their focus and aims. Services related specifically to the provision of educational support include Flexi Schools (Government), Flexi Schools (Non-government), Community Based VET, TAFE-School Linkage, and In-School Support. Additional services identified included Mentoring, Teaching Culture, Wilderness, Youth Justice and Community-Based Learning programs (Powell & Shafiq, 2009).

Emerging as a key provider of flexible learning provision in Queensland, was the Edmund Rice Education Australia Flexible Learning Centre Network (EREAFLCN), which in 2010, consolidated their small group of non-government flexi-schools into the broader Youth+ organisation. Growth of the organisation over time has seen the establishment of 11 Flexible Learning Centres (FLCs) in Queensland, and a further 6 FLC sites across the states of Western Australia, Victoria, New South Wales, South Australia and the Northern Territory. Additional initiatives delivered by Youth+ include tailored programs specifically for young people in care, and transitional programs to support young people to move on to further education and training (EREA, 2010). The Youth + suite of programs currently cater for the following young people:

- Those who have had contact with the juvenile justice system;
- Those in the care of the Department of Child Safety;
- Those with a history of extended periods of unexplained absences;
- Those who are Indigenous;
- Those who are highly mobile;
- Those who have had repeated difficulty conforming to the behaviour requirements of mainstream education and training;
- Those with mental illness or at risk of engaging in self harming behaviours or substance abuse;
- Those with chronic illness leading to extended absences;
- Those who have been excluded from school;
- Those who are homeless;
- Those who are young parents;

- Those who have repeatedly suffered from severe negative schooling experiences;
- Those with a generational history of early school leaving; and
- Those searching for a different educational experience (EREA, 2010, p.3)

While providing a comprehensive and growing suite of programs, Youth+ have highlighted concerns in meeting the current demand for flexible learning options with more than 2000 young people on waiting lists in Queensland alone (EREA, 2010). There is unquestionably a need for further expansion of quality flexible learning programs to cater for an increasing number of young people who find themselves disenfranchised from the mainstream schooling experience.

2.7 Principles of Good Practice in Flexible Learning Approaches

Continuing expansion of a wide range of flexible learning options in the local educational landscape results in diversity rather than homogeneity in relation to the goals of programs, student demographics, program resources and facilities, management and administration models, and relationships with mainstream education and community agencies. This makes problematic a concise definition of "what works" but a number of authors have attempted to highlight elements of good practice that both engage and improve the educational and social outcomes of diverse young people. Spielhofer, White, O'Donnell & Sims (2005) have identified the following characteristics as being best practice in the delivery of projects and activities for disenfranchised young people:

- Offering activities that are meaningful and relevant that they can participate in voluntarily.
- Delivering learning in an environment that is not like school.
- Providing one-on-one support for young people, tailored to individual needs and circumstances.
- Employing staff with the skills and qualities necessary to develop meaningful and supportive relationships with young people.
- Establishing strong links with school and other agencies to support transition of young people into further education or training.

In relation to alternative programs that operate formally as schools, some of the traits historically attributed to successful educative programs have been identified as that of:

- Choice - Voluntary participation by teachers, students and families.
- Autonomy and Control - Horizontal rather than vertical hierarchy of authority and decision-making.
- Curriculum and Skills - Curriculum relevant to students' needs and life experiences.
- Spirit of Common Enterprise - Purposeful emphasis on school as community (Raywid, 1982, 1994).

A recent Queensland study by Mills & McGregor (2010) examined best practice from the perspectives of the young people who actually attend alternative education settings, and found that students consistently identified the following as of key importance:

- Learning Programs – Opportunities to undertake traditional subjects and curricula as well as workplace training and access to vocational qualifications;
- Learning Environment – Relaxed school climate, flexibility, staff-student dialogue and negotiation, voluntary attendance, sense of community;
- Teaching Relationships – Accepting students for who they are, respect between staff and students, young people feeling 'celebrated', receiving sufficient time and assistance to complete work, 'conversational' and 'connected' teaching strategies.

In light of their findings, Mills & McGregor (2010, 2014) note the importance of the following factors, in terms of their constitutive nature of good practice within alternative education settings:

- Provision of appropriate curricula that suits the needs of students and provides them with pathways towards work and further education;
- Flexible and responsive pedagogy that takes into account the complex life circumstances of disenfranchised young people;
- School structures that provide appropriate support to enable the conditions for re-engagement with education;
- Development of a school community ethos that celebrates diversity and is inclusive of all young people and their families.

The following section provides a brief snapshot as to how the principles guiding good practice within alternative education settings, as highlighted above, have been translated within a local context.

2.7.1 Exemplar – The Practice of the EREA Youth+ FLC network

As a local Australian exemplar, the education model that underpins the Youth+ approach can be seen to integrate the characteristics of successful alternative education provision, as evidenced within a democratic orientation towards the delivery of flexible and inclusive educational pathways to support the educational re-engagement of disenfranchised youth. The practice of the EREA Youth+ FLC network can be understood within four key areas of emphasis: Relationship and Care; Voice and Choice; Relevant and Responsive Curriculum; and, Community and Belonging.

2.7.1.1 Relationship and Care

The practice of the FLC network is understood as being framed within a relational model of working with young people. An emphasis on relationships is embodied through staff-student interactions based on a foundation of mutual respect, where both parties seek to understand and connect with the perspectives, interests and capabilities of the other (Morgan, 2012a). Relationships are further characterized as being embedded within an ethics of care (Noddings, 2005), realized through a genuine and holistic concern for students' well-being, and respect for the dignity of each individual (EREAFLCN, 2008). Facilitation of a relational model of working in these settings occurs through small class sizes, with a high teacher-student ratio, that allows for the in-depth knowing of young people that is fundamental to the building of quality relationships. Holistic care is supported through the provision of wrap-around services such as "the provision of creches, housing support, advocacy services, meals and physical and mental health counselling" (Mills & McGregor, 2010, p.9), that recognises that addressing the needs of disenfranchised youth involves more than paying attention to solely academic concerns.

2.7.1.2 Voice and Choice

As different to mainstream settings, the 'power-over' model of adult authority in schools is replaced, in the FLC setting, with a democratic orientation to allowing young people to have a say in issues of significance to the school community. This occurs through a process of whole school meetings, where young people's voices are positioned as equally significant to those of adult teaching and leadership staff. Decision-making then is a shared process, where adults provide guidance, but do not dominate

proceedings. Central to this approach is the concept of common ground where “adults and young people alike commit to participate in a learning environment that is democratic, safe and inclusive” (Morgan, 2012b, p.1). In day to day practice, this is actualised through an operation by principles model, where four key principles – Respect, Participation, Safety and Honesty – are used as a tool for negotiation and dialogue in relation to resolving conflict and tensions, deciding upon courses of action, and upholding the rights of all to a safe and harmonious learning environment. As with all other aspects of the ways of workings of FLCs, adherence to these principles is a choice that staff and young people make when they choose to engage with the flexible learning program.

2.7.1.3 Relevant and Responsive Curriculum

As is common to other programs of this type, a learner-centred curriculum model underpins the organization of teaching and learning activities within the settings of FLCs. Authors such as Lange & Sletten (2002), and Leadbeater (2008), emphasize the importance of providing integrated, relevant and individualised learning experiences for disenfranchised young people attending alternative education settings, and this is recognised in the FLC context through an emphasis on flexible pedagogy and incorporation of a learning framework which is relevant and responsive. This learning framework “emerges from openness, negotiation, experimentation and the interaction of mindsets which seek the common good of the young person within a context of individual skills and potential” (EREA, 2010, p.5). Learning choices within the framework are expected to encompass the whole of the young person’s needs and incorporate literacy and numeracy skills, humanity studies, vocational and employment focused outcomes, sport and recreation activities, relationship development and community participation. The intention is to enable young people to develop an appropriate skill base that will empower them to fully participate in community life (EREA, 2010).

2.7.1.4 Community and Belonging

Fostering strong and durable connections with community is considered of key importance in meeting the needs of disenfranchised young people in the FLC setting. Raywid (1994) notes the significance of generating and sustaining community as a key factor of successful alternative education provision, and this is realised in the FLC context through attention to community as a core value guiding the strategic work of the organisation. The stated goal of this core value is to “build strong and vibrant communities involving young people and their families/carers within the FLC network,

and between the FLCs and their local community" (EREAFLCN, 2011, p.8). The pragmatic work of integrating a community emphasis occurs through the processes of: fostering a positive and tangible sense of school community (further enabled by small overall school size i.e. <100); engaging with parents, carers and family members in the extended school community; and, forging strong and durable connections with the wider community through partnerships with local agencies and community-based organisations. In this way, "the community becomes integral to all facets of student learning…the school is open and inviting to the community and the community welcomes student learning occurring in many dimensions" (Powers, 2004, pp.17-18).

2.8 Critiques of Flexible Learning Approaches

While there is an increasing realisation that flexible and socially inclusive education services are a necessary component of engaging all young people in education, the academic integrity of flexible learning programs continues to be questioned, primarily as a result of a perceived over-emphasis on the attainment of 'basic skills' and vocational education training. There have been calls for long-term studies of student outcomes to ensure that students are transitioning from alternative type programs to either further education or meaningful employment (KPMG, 2009). With little data available in this area, it is indeed difficult to measure the success of these programs, aside from anecdotal reports from those working in the field. However, it is also important to note that notions of 'success' may be interpreted differently from the perspective of the student, the student's family, the school or local community. Well-being outcomes are often difficult to assess yet can have significant impacts on the life trajectories of young people experiencing complex life circumstances. A key challenge for flexible learning programs is to enable a balanced approach that meets both the academic and social needs of diverse young people.

Establishing the integrity of flexible learning programs is essential to ensure their very survival, in that many programs (particularly in the public sector) rely heavily on government funding to meet operational costs and in such, must demonstrate the ability to operate within an accountability framework (Department of Education and Early Childhood Development (DEECD), 2010). In addition, and perhaps most importantly, the learning experiences of students will be invalidated if community members and potential employers question the academic integrity of the alternative program. If these types of programs are conceptualised by the wider public as 'second best' to mainstream schooling (te Riele, 2008), there is a strong likelihood that students

themselves will become aware of this deficit view and will devalue their own educational experience as not comparable to that of mainstream schooling.

2.9 Conclusion and Recommendations

Available data indicates that youth disengagement remains a significant social concern and this is verified by the experiences of alternative service providers who find themselves unable to meet the growing demand from young people which at times results in extensive waiting lists such as that experienced by the Youth+ organisation (EREA, 2010). While it is highly concerning that many young people are currently not engaged in either education or training, the creation of a successful alternative program is one that cannot be rushed for the sake of expediency. Successful flexible learning programs are built on the foundation of a well-defined philosophy that integrates the principles of best practice alternative approaches, and clearly articulates to both staff and students the nature, purpose and intent of the program. A potential representation of the 'ideal' alternative school, based on this review, is represented below:

The ideal alternative school, in the modern education context, would, in the first instance, be physically located within the place of the young people it intended to serve. This would enable strengthening of the ties between school and community and make possible an exchange of resources and capital. If possible, the school would employ teaching and non-teaching staff from the same community in order to further strengthen local bonds. Student numbers would be limited to a maximum of 100 students (preferably less) to enable the development of a cohesive inner school community, and the fostering of personalised relationships between staff and students. Teaching staff would be highly qualified professionals with experience in working with young people from disadvantaged backgrounds. They would have the necessary skills to identify the strengths that each young person brings to the educational setting, and would be able to develop individualised learning experiences to ensure that each young person reached their full potential. Teaching staff themselves would be supported by a range of qualified support staff, such as Youth Workers and Guidance Counsellors, to ensure that young people might achieve both academic and social outcomes. Diverse cultural backgrounds and other dimensions of difference would be celebrated as a rich component of the cultural fabric of the school. The school itself would operate in an open and democratic manner that would invite participation by disenfranchised young people and their families. This would then fulfil the primary criteria of the successful alternative school – to create optimum conditions for young people to choose to attend and to actively re-engage with the learning process.

The unique and singular nature of the alternative education approach is further reinforced by Mills & McGregor's (2010) assertion that alternative or flexible learning schooling sites are not aspiring to mainstream models, and neither are they behaviour management centres or 'dumping grounds' for troublesome students. The authors in fact state that "the alternative practices of flexible learning centres should be supported as models of effective teaching and be used to inform practices within mainstream schools" (Mills & McGregor 2010, p.10). Maintenance of the flexible learning model then necessitates continuation of a holistic and integrated approach to teaching and learning that encompasses the entire needs of the disenfranchised young person. Community support is also critical to the long-term success of flexible learning programs as "education is, at its essence, learning about life through participation and relationship in community" (Cajete, 1994, p.25). Participation, relationship and community must always remain central to the alternative approach.

2.10 Chapter Conclusion

The article presented in this chapter located the EREA Youth+ FLC Network within the burgeoning sector of Australian flexible learning provision. It highlighted key aspects of practice that have been found to be effective in re-engaging disenfranchised youth with education, including an emphasis on voluntary, democratic, relevant, relational and community orientated learning experiences. While highlighting the important role of flexible learning settings in providing inclusive and socially enfranchising educational pathways for diverse youth, the article also drew attention to critiques of these programs, in terms of questions raised around the academic integrity of the curriculum on offer. It can thus be seen that a challenge for alternative education programs is to continue to work within a framework of flexible and responsive pedagogical practice, while maintaining concern with learning that is intellectually challenging.

The following chapter (Chapter 3) seeks a meeting point between the principles of practice of alternative or flexible learning settings, and the domain of science education. Science education is conceived within this study as having the potential to both contribute to the engagement of diverse youth, and strengthen the academic integrity of alternative education programs. However, in order to meet the complex needs of disenfranchised young people, science education must be reframed to be more porous, and encompass a wider range of learning and socio-emotional outcomes than would be expected in a traditional school setting. It is this more expansive notion of science education that will be theoretically developed in Chapter 3.

Chapter 3: Engaging Diverse Young People with Science Education

3.1 Introduction

The intention of Chapter 3 is to find a meeting point between the key principles of an alternative education philosophy of practice, as introduced in Chapter 2, and those approaches to science education that demonstrate responsiveness to the needs of diverse youth. As suggested in Chapter 1, traditional school science has not been conducive to facilitating the engagement of diverse youth in science, which underlines the need to explore more inclusive approaches. Within this chapter, a humanistic approach to science education is advocated as a potential avenue for better engaging diverse youth in a manner that is authentic to the key tenets of an alternative education approach. Pedagogical orientations that support a humanistic approach are subsequently outlined. Challenges to fully realizing a humanistic approach are also described and linked to the relatively thin research base in the field. The chapter concludes by positioning the intention of the research project within the gaps and areas for further exploration highlighted in the literature.

3.2 The Problem With School Science

Chapter 1 introduced the notion that school science as a narrowly defined construct can be problematic for diverse youth and can contribute to low levels of affect towards traditional science curricula. Tytler (2007) reports the attributes of the common experience of school science as being an emphasis on "conceptual knowledge, compartmentalised into distinct disciplinary strands, the use of key, abstract concepts to interpret and explain relatively standard problems, the treatment of context as mainly subsidiary to concepts, and the use of practical work to illustrate principles and practices" (p.3). Fensham draws from a range of national and international studies to more bluntly describe school science as "a) knowledge transmission of correct answers, b) irrelevant and boring content, and c) difficult in comparison with other subjects" (2004, p.2). Engaging in a deeper critique, Roth & Calabrese Barton characterise school science as a process whereby:

> *Students from all types of backgrounds arrive at science class and are subject to a homogenous body of knowledge upon which they are tested at the culmination of the school year. Science is defined not by how one manages,*

> *alone or collectively, to use or produce science by way of this knowledge at home or at school, in response to a need or concern or practically toward their own or their community's future. Rather, success takes the form of a pre-determined response to a cooked-up problem, an abstract set of ideas, predicated upon an imposed ideology" (2004, p.8)*

Authors such as Wood, Erichsen & Anicha (2013, p.131) draw attention to the dehumanizing practices of school science that see students treated as "essentially inert" beings that are subject to, rather than active within, the teaching and learning of science. Such practices reflect a 'banking' model of education, where "knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing" (Freire, 1968, p.58). While many students learn to 'deal' with the alienating practices of school science (Wood, Lawrenz & Haroldson, 2009), those who do not feel comfortable in taking on a school science identity often find themselves on the margins of mainstream science education. This is particularly the case for students who hold worldviews that do not necessarily harmonize with the "well-defined system of norms, beliefs, expectations and conventional actions" that constitute the culture of school science (Aikenhead, 1997, p.219). Lemke (2001, p.300) draws attention to the potentially exclusionary nature of traditional interpretations of school science based on a dominant ideology by asking:

> *Our goal is science for all, but what does this mean if our particular view of science is too aggressively masculine to sit well with many students' identities? Too narrowly rationalistic to accommodate spiritual longings? Too technicist, abstract, and formalist for a wide range of humanistic, aesthetic, sensualist, and pragmatic dispositions?*

Calabrese Barton has called for a shift from "the traditional paradigm where science lies at the center as a target to be reached by students at the margins, to inclusion, where students' experiences and identities remain in tension with the study of the world" (1998, p.537). Such concerns necessitate consideration of what might constitute an inclusive model of science education that respects, and is compatible with, the plurality of worldviews to be expected in classrooms catering to a diverse range of learners (Lemke, 2001).

3.3 Developing an Inclusive Model of Science Education – A Humanistic Approach

A humanistic approach has long been advocated as a vehicle for improving the participation of diverse young people in science education. It presents itself as a student-orientated alternative to the pipeline-orientated approach that dominates traditional science classrooms (Aikenhead, 2006). This approach continues to evolve as it draws from the work of researchers with an orientation towards critically examining the nature and purpose of science education and schooling, including those in the fields of cultural, multi-cultural, urban and post-structuralist studies in science education. Aitkenhead (2006) draws from key studies in these fields to synthesise a conceptual framework for a humanistic approach that positions it as being fundamentally concerned with:

- *Challenging a traditional positivist and realist view of science*
  This includes recognition that science is neither objective nor value-free, and that the historical practices of science have acted to marginalise certain groups of people including females and Indigenous peoples;
- *Embedding transformative possibilities for personal and social action*
  This invokes valuing of the potential of participatory forms of science education to promote active citizenship, and to demonstrate practical utility in responding to the everyday realities and concerns of individuals and communities;
- *Combining traditional canonical science content with other sciences*
  The traditional science canon, while important, is recognised as reflecting only one way of knowing the world that often lacks representation of the scientific knowledge of minority cultural groups, including Indigenous and non-Western peoples;
- *Integrating the learning of science with other disciplines and school subjects*
  A unitary discipline interpretation of science education is rejected in favour of a view that supports the integration of science with other key learning areas, in order to reflect the multi-faceted nature of real-life scientific and technological concerns;
- *Acting as an agent of equity and social justice*
  There is acknowledgement that science education should serve a democratic purpose and contribute to the creation of a more equitable and socially just society.

Students – their needs, interests and dispositions – are at the centre of humanistic approaches to science education, and, as such, the primary concern of teaching and learning becomes one of meaningful engagement. The humanistic approach then is one that "animates students' self-identities, their future contributions to society as citizens, and their interest in making personal utilitarian meaning of scientific and technological knowledge" (Aitkenhead, 2006, p.2). Such approaches are often conceptualised as extraordinary in that "they intentionally go beyond the ordinary understandings and practices many children and youth experience as individuals in schools on a daily basis, to guide them toward the pursuit of social justice, agency as learners, and constructive action" (Faltis & Abedi, 2013, p.vii). Furthermore, learning experiences are intended to be grounded in the everyday lived realities of students and their communities, invoking a commitment to a sense of place (Calabrese Barton, 2002) within a humanistic approach. Lee & Buxton (2011, p.278) note that inclusive science learning opportunities for diverse learners can only occur when school science "values and respects the experiences that students bring from their home and community environments". How these ideological commitments translate into actual pedagogical practice is explored in the following section.

3.4 Pedagogical Practice to Support a Humanistic Approach to Science Education

As foreshadowed in the preceding section, pedagogical practice that aligns with the key principles of a humanistic approach to science education must be student-orientated with a commitment to responsiveness, equity and place. In reviewing the field, the pedagogical strategies that seemed most to embody the guiding tenets of the humanistic approach were that of culturally responsive, critical and place-based pedagogies. The following section briefly describes these pedagogies, and demonstrates how they are conceptualised in the field of engaging diverse youth in science education.

3.4.1 Culturally Responsive Pedagogy

Meeting the challenge of providing a more equitable science education experience for diverse learners has been realised theoretically through an affiliation by a number of authors in the field with the principles of culturally responsive pedagogy. Grounded in respect for students' lived experiences, Gay (2000, p.29) identifies culturally responsive teaching as having the following characteristics:

- It acknowledges the legitimacy of the cultural heritages of different ethnic groups, both as legacies that affect students' dispositions, attitudes, and approaches to learning and as worthy content to be taught in the formal curriculum.
- It builds bridges of meaningfulness between home and school experience as well as between academic abstractions and lived sociocultural realities.
- It uses a wide variety of instructional strategies that are connected to different learning styles.
- It teaches students to know and praise their own and each others' cultural heritages.
- It incorporates multicultural information, resources, and materials in all the subjects and skills routinely taught in schools.

The intention of culturally responsive pedagogy is to teach "to and through" the strengths of diverse students and be both "validating and affirming" (Gay, 2000, p.29). This aligns with the 'funds of knowledge' approach advocated by Gonzalez, Moll & Amanti (2005), that advocates the strategic drawing upon of the cultural resources of students, their families and communities to enhance academic learning. Such approaches move away from deficit framings of diverse youth and their families that essentialize difference and, through the use of metaphors such as 'gaps and mismatches', encourage a pedagogical focus on identifying what students lack, rather than what they know (Seiler, 2001).

Tobin's (2006) work in impoverished urban high school science classrooms in the United States has highlighted the need for teachers to be adaptive and respectful of the cultural resources and practices of diverse youth, rather than expecting students to 'leave themselves at the front door' and conform to the dominant conventions of teaching and learning science. Tobin (2006, p.220) notes that "if students are unable to enact culture from their lifeworlds as a foundation for learning science, they will inevitably feel alienated and disempowered". Bartolome (1994, p.191) further comments that "unless educational methods are situated in the students' cultural experiences, students will continue to show difficulty in mastering content area that is not only alien to their reality, but is often antagonistic toward their culture and lived experiences." This appreciation of the disparity between diverse students' lived experiences and the cultural practices of school science resonates with a critical pedagogy approach that further explores the potentially oppressive conditions of traditional science classrooms.

3.4.2 Critical Pedagogy

Critical pedagogy is predominantly concerned with identifying and challenging oppressive relationships of power in schooling (Hinchey, 2004). A critical pedagogy orientation towards science education necessitates exploration of the cultural practices of school science that can act to exclude and marginalise students from diverse backgrounds. The activities of traditional science classrooms have been shown to reproduce the socio-historical construction of science as "academic," "rigorous," and "elite" (Carlone, 2003, p.307). Teese (2000) draws attention to the traditional role of science education as 'gate-keeper' to tertiary education, and proposes that high-level science subjects perform a filtering role to ensure that only a small proportion of 'high-achieving' students gain access to elite professional pathways. Lemke (1992) discusses the notion of privileged cultural positioning, where certain groups in society are more likely to be positioned to experience success with the regular science curriculum, not necessarily as a result of higher intelligence but instead due to an easier fit between their cultural background and the practices of school science. This is supported by Roth & Calabrese Barton's assertion that "the poor, people of color, and women may fail in school science (or be failed by school science) exactly because of the nature of science practices and forms of knowing that are stressed in teaching" (2004, p.5). That science classroom practices continue to reinforce the status quo is reinforced by Seiler's observation that "there are degrees of uniformity and coherence across social contexts such as science classrooms, as certain essential features and meanings are reproduced, that is continued and produced again, often in limiting forms" (2013, p.111). Seiler (2013) draws on the work of Sewell (1995) to explain the stultified nature of science classroom practices as attributable to the institutional power of schools and a focus on homogenization that limits the production of new ways of knowing and doing science.

Recreating science classrooms as empowerment zones is often associated with changing the typical hierarchical nature of teacher-student relations in the science classroom through exploring avenues for greater student ownership of science learning. The standard science classroom provides limited space for students to generate, share and act upon their own genuine concerns and inquiries. Addressing the challenge of developing a meaningful sense of ownership in the science classroom has been taken up by Seiler (2001, 2011), who has centralized the role of student voice and choice in fostering the engagement of diverse students with science. Drawing on empirically identified best curriculum practices, Seiler's research demonstrates that it is possible to provide room for student voice and choice in the development of science

curricula, while simultaneously addressing mandated course content requirements and fostering the development of higher order thinking skills. The aim of Seiler's work in urban US schools has been to cultivate a dialogical educational space, where students explore and reflect upon their own experiences and curiosities to identify avenues of inquiry into the science in their lives. Drawing from the principles of inquiry learning, curriculum units are based upon driving questions that emerge from topics authentically grounded in student interests. Seiler notes that, "When science topics emerge from students (rather than from well-meaning teachers who attempt to impose connections to their lives), more promising patterns of student engagement emerge" (2011, p.368). The idea of an emergent curriculum is further developed within those pedagogies that emphasize a considered commitment to place.

3.4.3 Place-Based Pedagogy

According to Smith (2002), a place-based education approach is essentially concerned with grounding educational activities in local phenomena and students' lived experience. Place-based education positions the local community as a significant site for learning, and curriculum emerges from the particular characteristics of place (Lewthwaite, McMillan, Renaud, Hainnu & MacDonald, 2010). While the notion of 'place' can be problematic (van Eijck & Roth, 2010), and the theoretical articulation of 'place-based education' has been subject to extended discussion (Gruenewald, 2008), the unifying idea that underpins a commitment to place in engaging diverse learners with science is that of *connection.* A common critique of school science (and schooling more generally), is that learning is unnecessarily abstract and disconnected from the experiences of everyday life. As educational philosopher John Dewey has stated:

> *The great waste in schools, from a child's perspective, is his (sic) inability to use the experience he gets outside of the school in any complete or free way within the school itself, while on the other hand he is unable to apply what he is learning in daily life. That is the isolation of the school – its isolation from life. When the child gets into the schoolroom, he has to put outside of his mind a large part of the ideas, interests and activities that predominate in his home and neighbourhood (1907, p.47).*

Overcoming this disconnect requires the development of seamlessness between school and community life. Roth & Lee (2004) develop this idea of seamlessness in the context of science education through their conceptualisation of participation in science as an essentially social practice, that should be meaningfully embedded in the

collective concerns of a community. The authors demonstrated the usefulness of such an approach through their successful engagement of both students and community members in a citizen science project that saw students participate in a community effort to contribute to the environmental health of a local waterway. For these authors, science learning is not preparation for life after school, but rather is a way to open up participative spaces for diverse young people through enabling them to contribute to community life in the present. They note that:

> *Science educators have yet to critically examine the assumption that school learning actually relates to everyday out-of-school activity. The question is paramount if science education is to contribute at all to a more general project of lifelong learning in science, which appears to imply continuous forms of learning across the boundaries of schooling (Roth & Lee, 2004, p.275).*

Such a reconceptualization of the purpose of school science learning is compatible with the philosophical underpinnings of Indigenous pedagogical frameworks, as evidenced in Native American scholar Cajete's (1994) conceptualisation of education as being "an art of process, participation, and making connection" (p.24) as well as "learning about life through participation and relationship in community" (p.26). Drawing from the principles of place-based approaches to education has been central to the work of Lewthwaite et.al (2010), in aligning the practices of science education with the educational aspirations of Indigenous Inuit communities in Canada. In advocating for the possibilities of a place-based approach in relation to engaging Indigenous Australian learners, Fogarty & Schwab (2012, p.10) note that "Indigenous students learn best when learning has immediate or localised utility and is connected to the lived experience of the student". This aligns with the findings of Brayboy & Castagno, who draw upon a sizeable body of research to arrive at the conclusion that "community- and culture-based education best meets the needs of Indigenous children" (2009, p.32).

In spite of evidence that the teaching of science curricula through an emphasis on place and connection is effective in increasing both the engagement and academic performance of students from diverse backgrounds, there continues to be limited take-up of this approach due to a wide range of factors including its positioning on the margins of mainstream science education, a perceived lack of relevance to mandated curriculum requirements and teacher perceptions that it is both labour and resource intensive (Smith & Sobel, 2010). Fogarty & Schwab (2012, p.11) note that place-based approaches to learning "have difficulty penetrating, or finding room, in large scale

curriculum frameworks". As a result, such approaches continue to be an under-explored avenue for dismantling the boundaries between school science and everyday life.

3.5 Challenges to Realising a Humanistic Framework of Science Education

Realising the transformative potential of humanistic approaches to science education with an emphasis on responsiveness, equity and place, is hampered by a number of factors including the marginalisation of the field, the inflexibility of school science curricula and a lack of empirical evidence to qualify the impact of responsive teaching practices on the educational outcomes of diverse students (Sleeter, 2012). Much of the work in engaging diverse youth in science is occurring on the margins, as evidenced in Calabrese Barton (2003) and Rahm's (2010) work in developing after-school science programs to cater to the needs of diverse youth. While these programs are without question vitally important to diverse youth in reclaiming science education as relevant to their lives and communities, their positioning on the margins may work against their capacity to transform student learning into capital that might impact on their economic empowerment.

This is illustrated in a case study by Calabrese Barton that detailed the experiences of 'Kobe', a young African-American male student living in impoverished circumstances. Having being pushed out of school science (and school itself), Kobe was able to re-engage with science through participation in an after-school program grounded in an inclusive and connected approach to science. Such was his level of engagement with this program that Kobe chose to re-enrol in school and attempt to achieve accreditation in science subjects in order to be able to pursue a scientific career. However, he was to find that his "new strategies for engaging in science were not recognized in school" (Calabrese Barton, 2003, p.36). Kobe had changed, but, disappointingly the systemic processes of the school had not. In this sense, the agency developed by Kobe by participating in the after-school science program was not able to be transferred into a form of capital that could have significantly changed Kobe's life trajectory. This further reinforces the need to ensure that responsive approaches to science education do not remain limited to after-school settings.

For researchers and educators working in mainstream schooling settings, including the pioneering work of authors such as Seiler and Tobin in urban US high schools, there are continual tensions between the principles of socially just science education and the

realities of neoliberal educational reform. While social justice educators continue to advocate for a more expansive notion of science education that is responsive to the needs of diverse students, reform efforts that focus on standardisation and increased accountability continue to tighten the net around what counts as a 'good science education' (Carlone, 2003). Buxton conceptualises the current state of K-12 science curricula as being 'list science' where science curricula "is increasingly presented as a generic collection of facts, concepts, and inquiry processes, organized into lengthy strings of discrete benchmarks" (2010, p.122). This occurs in the context of an international trend towards the development of standardised national curriculum that promotes a 'one-size-fits-all' approach to science learning. This is in spite of the available evidence indicating that delivering more of the same, in relation to maintenance of traditional curricula and teaching practices, is likely to further marginalise and disadvantage youth from diverse backgrounds (Brayboy & Castagno, 2009). Alternative approaches to science education that have demonstrated significant potential for engaging diverse youth, such as place based education approaches, continue to lack representation in mainstream science curricula.

Sleeter (2012) suggests that the marginalisation of responsive approaches to engaging diverse youth is partially attributable to the existence of only a small pedagogical research base. While there exists a rather large theoretical body of work dedicated to articulating the principles of responsive teaching, exemplary examples of pedagogical practice that connect responsive pedagogy with student engagement, particularly in science education, remain thin on the ground. With teachers often attributing responsive teaching practices as most suited to 'soft' subjects, such as language arts and social studies, and of little relevance to 'hard' subjects such as the sciences (Boutte, Kelly-Jackson & Johnson, 2010), it is entirely probable that responsive pedagogical approaches will struggle to move in from the margins of science education.

If there is little evidence of exemplary pedagogical approaches to engaging diverse youth in mainstream settings, there is even less that explores the practices of engaging youth with science education in alternative settings. Such an omission would appear to indicate that traditional school science has not found a home in alternative education settings, which is perhaps revealing of a lack of fit between the relational pedagogical approach of alternative education and the traditional didactic nature of science education. While currently unexplored territory, alternative education sites, through their unique ability to trial flexible and innovative approaches to engaging diverse

youth, may be able to realize some of the transformative potential of humanistic approaches to science education, and potentially act as catalysts for change in the mainstream schooling process.

3.6 Chapter Conclusion

The intention of this chapter has been to collate the key themes across the literature that speak to the topic of engaging diverse young people in science, and which resonate with a progressive orientation towards socially just and democratic forms of schooling. A humanistic approach to science education, with an emphasis on responsiveness, equity and place, has been outlined as a vehicle for realizing the transformative possibilities of a reframed science education for diverse young people. While highlighting the potential of such an approach, it has been recognized that bringing such theory into practice is beset by a number of challenges, including the historically immutable nature of school science practices, and the positioning on the margins of the field of study dedicated to engaging diverse youth in science. Such marginalized positioning has resulted in a relatively thin body of literature, and a shortage of practical guidance for educators that might encourage the employment of pedagogies beyond the ordinary to engage a broader range of students in science education. The gaps within both curriculum policy and research literature in relation to considering the needs of diverse youth in science, form the basis for this study into how teachers in an Australian flexible learning setting work towards engaging diverse youth in science, and how this might be translated into a framework of practice. The study is exploratory in nature due to the absence of similar studies in the field, and is grounded in a participatory methodology that reflects the humanistic orientation of the thesis as a whole. The methodology of the project is outlined in the following chapter.

Chapter 4: Methodology

4.1 Introduction

As noted in the conclusion of the previous chapter, the intention of this research project was to explore how teachers in a Flexible Learning Centre setting work to engage diverse youth in science, and to translate these finding into a framework of practice that might be useful to the FLC network as a whole. In this chapter the methodology that informs the research process to achieve this objective is described. It begins by presenting the research questions and the reasoning for these questions. The methodological paradigm guiding the project is then detailed and linked to the case study research strategy which is seen to shape the form of data collection, methods used and the process of data analysis. The chapter concludes by discussing the ethical considerations of the project and by introducing chapters 5-9 which evidence the findings of the project.

4.2 The Research Questions

The research questions governing the project were designed to meet both theoretical and pragmatic goals. While the early chapters of the thesis explored the domains of alternative education and responsive science education from a theoretical perspective, it was necessary in the first phase of the research (Phase 1) to explore how this materializes in day to day practice and how the real life experience of alternative education settings creates both opportunities and challenges for the teaching and learning of science. In brief, understanding how contextual features influence science education was the first research imperative.
Thus, the first research question was:

How does the FLC context shape science education?

Moving beyond the contextual features and developing an understanding of science education pedagogical practice was identified as the next phase of the research process (Phase 2). As noted in Chapter 3, exploring the engagement of diverse young people in science is an emergent field of study, and there is very little research available in relation to the form of this pedagogical practice, particularly in the Australian context. The second research question was designed to facilitate the in-depth study of the enactment of science teaching practice as it occurs in the FLC context.

Thus, the second research question was:

How do teachers work to engage diverse young people in science education within the FLC context?

As noted in the introduction of the thesis, a driving force for the inception of this project was the perception that mainstream or school science was not serving the needs of disenfranchised youth. It was then evidently necessary to find a way of framing science so that it might be both responsive to diversity and in alignment with the holistic education goals of an alternative education setting. Based upon the findings of research question 1 and 2, it was envisaged that a pedagogical framework for science education delivery for disengaged youth would emerge in the final phase of the research (Phase 3).

Thus, the third and final research question was:

How can science education be better framed to meet the needs of disenfranchised young people?

In all, the research questions listed above reflect a generative and exploratory orientation towards understanding the processes in science education that best serve disengaged youth and, eventually, result in a specific outcome (that is, a pedagogical framework) in a particular context. The following section outlines the methodological orientation for the study.

4.3 Methodological Paradigm

The generative and exploratory nature of the research questions, coupled with a research focus on the meaning-making of participants within a particular setting (as explained in Chapter 1), locates the research within the qualitative, constructivist paradigm. Denzin & Lincoln (2008, p.31) highlight the fundamental assumptions of the constructivist paradigm as being concerned with:

- A relativist ontology (there are multiple realities)
- A subjectivist epistemology (knower and respondent co-create understandings), and;
- A naturalistic (in the natural world) set of methodological procedures.

Thus, researchers choosing to align with the constructivist paradigm direct their gaze towards “the socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry”

(Denzin & Lincoln, 2008, p.14). This attention to complexity, detail and context inherent to the constructivist paradigm was considered well-suited to the focus of inquiry of this project – exploring the practice of engaging diverse youth with science in a flexible learning setting. The high demand nature of the setting under study, the complex and dynamic conditions surrounding teaching practice in this space, and the need to respect the voice of participants operating within a schooling system on the margins, warranted the choice of a methodological paradigm that demonstrates a capacity for sensitivity to the social context in which data are produced (Mason, 2002).

While the constructivist paradigm is generally characterized as non-interventionist (Mason, 2002), with a primary focus on studying phenomena 'as they are', the practical nature of this project, as it was designed to address a number of concrete concerns identified by the FLC network (as detailed in Chapter 1), required incorporation of elements of the participatory paradigm in order to attend to an inherently pragmatic intent. Lincoln & Guba (2000) note a number of areas of convergence between the constructivist and participatory paradigms, with both sharing a similar axiomatic base. However, the participatory paradigm gives greater 'primacy to the practical' and places more emphasis on the active engagement of participants in the research process (Heron & Reason, 1994, as cited in Lincoln & Guba, 2000). This orientation towards affording the agency of participants was deemed of fundamental importance in addressing the overall aim of the study, which, as stated in Chapter 1, was to:

> *Work with* FLC staff to generate a framework to guide science education practice that would demonstrate responsiveness to the context.

The phrase 'work with' was deliberately accentuated within the research aim in order to highlight its significance in relation to the intended process of the study. The concept of 'working with' was emphasized in the earliest expressions of the research project, being recognized as a necessary component for sustainable and long term ownership of the project by FLC staff. In accordance with Heron & Reason's statement that good research is that which is "conducted *with* people rather than *on* people" (2001, p.179), the methodological design of the project was conceptualized within a collaborative frame with the intention of providing opportunities for active participation, mutual learning and growth, on the part of both researcher and participants.

4.4 Inquiry strategy – Case Study

As noted by Denzin & Lincoln (2008, p.34), "strategies of inquiry put paradigms of interpretation into motion". Within the qualitative tradition, Creswell (2013) identifies

five key forms of inquiry strategy – biography, ethnography, grounded theory, phenomenology and case study. The case study inquiry strategy was seen as particularly well suited to the research project due to its emphasis on the development of a "humanistic, holistic understanding of complex situations" (Brown, 2008, p.10). Factors unique to teachers engaging with highly vulnerable young people in the FLC context necessitated the use of a research strategy that did not isolate teaching actions from the contextual conditions underpinning such actions. Of the strategies available within the qualitative tradition, the case study was considered the most amenable to producing a credible account of the practices of teachers, with its emphasis upon the investigation of "a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2009, p.18).

4.4.1 Case Study Type

The case study as a research design element has been characterized through a variety of typologies that assist the researcher in determining what might be a 'best fit' approach to answering a particular research question (see, for example, Merriam, 1998; Stake, 1995; Yin, 1994). In designating a particular case study format, the first stage in the process is to determine the purpose of the case study. In relation to this project, the purpose of the case study was three-fold encompassing exploratory, explanatory and meta-explanatory elements (Yin, 1994) that were linked to the phases of the study (further detailed in 4.4.2). Phase 1 of the project, which addressed RQ1, was intended to be primarily exploratory in order to determine the contextual factors impinging on science teaching and learning within the FLC context. Phase 2 of the project, which addressed RQ2, was more explanatory, in that it was intended to capture the pedagogical practices employed by FLC staff that work to engage diverse young people in science education. Phase 3, which addressed RQ3, could be conceived as a meta-explanation, in the sense that it was intended to draw together the findings of the first two phases of the project in order to articulate an over-arching framework of practice. The case study design for this project was then typified as that of a nested study (Thomas, 2011), where the study of parts was integral to an understanding of the whole.

4.4.2 Research Design and Phases of the Study

Merriam (1998) notes the lack of set procedures or protocols to guide the process of a case study inquiry – from design, to data collection, to data analysis – requires of the researcher "an enormous tolerance for ambiguity" (p.37). Knowing a priori the best

way to proceed in a particular context is not always possible, requiring flexibility in approach and use of a research design that is "more emergent than preordinate" (Simons, 2009, p.31). Case study inquiry is then embodied through a form of evolving design that unfolds as appropriate in pursuit of developing an in-depth understanding of the phenomena of interest (Merriam, 1998). In the context of this study, pursuit of the phenomena of interest – exploring the practice of engaging diverse youth in science in a flexible learning setting – unfolded in the following three phases:

4.4.2.1 Phase 1: Developing an Understanding of the Context

The first phase of the project was designed to answer RQ1 and was thus dedicated to understanding the contextual conditions underpinning science teaching and learning practice within the Flexible Learning Centre context. Activities of Phase 1 of the project included a review of key EREA Youth+ organizational documents, participation in network planning days, visits to FLC sites across Queensland, and semi-structured interviews with teaching and leadership staff (N=10). These activities are described in more detail below.

4.4.2.1.1 Document Review

Program documents made available to the researcher included the EREA Charter (EREA, 2011), Youth+ Foundation Statement (EREA, 2010), Strategic Values Framework (EREAFLCN, 2011), FLC Occasional Papers (see, for example, EREAFLCN, 2008), curriculum documents (internal), and site-based annual reports. While all documents were considered of interest in terms of their potential to contribute to a 'reading' of the context (Mason, 2002), the Values Framework (EREAFLCN, 2011) was deemed of central interest due to its evolution through an extensive consultation process with FLC staff, young people and community members, from across the entire network. This negotiated document was then seen to be significant in terms of articulating the ideals of a wide range of stakeholders, in relation to the preferred values base and strategic direction of the network.

4.4.2.1.2 Participation in Network Planning Days

Early in the project, the researcher was made aware that Youth+ enabled ongoing staff professional development through the process of holding annual 2-day Planning Day events (involving all staff across the state). The focus of these events was to affirm the vision of the FLC network, encourage reflection on the philosophy and principles guiding the work of the Flexible Learning Centres, and to provide professional development opportunities to support and extend the practice of on-the-ground staff. With the researcher having no prior experience of alternative education settings,

attendance at these meetings early in the research process was critical in relation to developing a deep understanding of the philosophical base steering the FLC approach, and an empathetic understanding of the nature of the work undertaken at FLCs.

4.4.2.1.3 Early Site Visits

Preliminary visits to sites across the FLC network enabled the development of an understanding as to how the organizational philosophy translated into site practice, and how this was diversely represented across the network. While these visits were generally of a short, 1-day duration, they were vital in developing an overview of the variety of FLCs in terms of their geographical locations, physical structures and resources, student cohorts and local community conditions.

4.4.2.1.4 Interviews with Teaching Staff

While the document review, participation in network Planning Days and visits to sites assisted with the development of a broad picture of the FLCs, there was also a felt need to gain access to the particular "accounts and articulations" of teaching staff, in order to add depth and roundness to the findings of the first phase of the study (Mason, 2002, p.64). The teaching staff who chose to participate in the interview element of Phase 1 represented a range of experience levels and professional backgrounds, and were drawn from sites across the network. The interview questions asked at this time were 'grand tour' in nature (Lincoln & Guba, 1985) and invited teachers to recount their own professional histories, their philosophical orientation towards pedagogy and their experience of teaching within the network. In relation to the specific phenomena of the study, teachers were also asked to share their thoughts, perceptions and encounters with science and science education practice, both within and outside of the setting of the FLCs.

4.4.2.1.5 Interviews with Leadership and Mentoring Roles

Initial interviews conducted with Youth+ Leadership staff, including the then Network Principal and the Values Coordinator, were of a similar broad nature to those conducted with teaching staff, but were focused more on understanding the vision of leadership in terms of seeing possibilities for science education within the FLC context. In addition to the formal interviews engaged in with leadership at the commencement of the project, both the Network Principal and Values Coordinator acted in a mentoring role to the researcher, assisting with the process of induction into the FLC community, and providing constant feedback as to the validity of the early interpretive accounts that were produced during Phase 1. This process represented a form of "consensual validation" which Eisner (1991, p.112) describes as "an agreement among competent

others that the description, interpretation, evaluation, and the thematics of an educational situation are right."

Overall, Phase 1 established a picture of the philosophy and practice of the FLC network, and allowed for the identification of enablers and constraints in relation to the practice of teaching and learning science within a flexible learning setting. The data generated from Phase 1 informed the second phase of the project which involved working closely with one designated site in North Queensland and focused on answering RQ2.

4.4.2.2 Phase 2: Working with Teachers to Capture Individual Case Studies of Practice

Phase 2 of the project involved working intensively alongside three teachers at one FLC site in order to capture, through case study, their practice of teaching science to diverse young people. It was not expected that these individual case studies would reveal a universal truth to the experience of teaching in FLCs (in recognition of the unique teaching and learning milieu of each site), but rather that the case study findings would represent an operationalization of the philosophical practice of the FLC network, in the context of teaching and learning science. The following section provides a rationale for the selection of the site and key participants for Phase 2 of the study.

4.4.2.2.1 Selecting Cases and Sampling

Thomas (2011) highlights three potential routes for the selection of a case subject which he identifies as the seeking of the 'local knowledge' case, the 'key' case and the 'outlier' case. Briefly described, the local knowledge case emphasizes researcher familiarity with the case, the key case is that which is inherently interesting and the outlier case is that which "may illuminate the object by virtue of its difference, its outlier status" (Thomas, 2011, p.514). In relation to the selection of case study subjects for this project, all three routes identified by Brown were relevant. The main site selected for the project, the North Queensland Flexible Learning Centre[16], was familiar to the researcher, as were some of the FLC staff with whom a passing acquaintance had been developed over the years through joint employment-related participation in local youth networks and initiatives. This made entry into the field in some ways easier due to an already established sense of familiarity and a common understanding of the nature of the field of working with diverse youth. Additionally, as a long term resident of

[16] Pseudonym to maintain confidentiality (issues of confidentiality are further explored in section 4.5.4).

North Queensland, the researcher was familiar with the political, social and economic milieu of the local area that necessarily permeates school and classroom communities and informs the understanding of the contextual conditions of the case study.

In relation to 'key' cases, it was fortunate (and unusual) to have two teachers working at the North Queensland Flexible Learning Centre whom both had a background in secondary science, and an interest in developing science curriculum in the Flexible Learning Centre setting. The advantage of having two experienced science educators to act as key cases was that it allowed for observation of the deployment of considered practices of teaching and learning science, within a schooling system with an alternative educational philosophy, which in itself was considered of intrinsic interest. It quickly became apparent through the data collection process that the practices of these two teachers could be considered innovative, not only in the alternative education context, but also in mainstream settings. This was perhaps facilitated by the considerable teaching experience of the key participants, both in the mainstream and alternative setting, that had allowed for a forming of practice that drew from the best of both worlds, and continued to evolve though the process of engagement with this research project.

In relation to the 'outlier' case, it seemed important from the inception of the project to consider the needs of those teachers, constituting the majority of the network, who were in fact inexperienced in science and perhaps lacking confidence in science delivery. Unlike mainstream secondary settings, the FLC network as a whole does not specifically employ secondary teachers of science, generally preferring teachers with a generalist orientation which suits the holistic nature of the education program. This means that the majority of teachers within the network have minimal science education backgrounds, and are generally working 'out-of-field' when attempting to integrate science into the curriculum program. The first 'outlier' case selected was that of a novice teacher working at a new Outreach post of the North Queensland Flexible Learning Centre, in a remote region of West Queensland. While this novice teacher was enthusiastic in relation to participating in the research project, the tyranny of distance as well as the multitude of imposts related to establishing a new schooling service meant that it was difficult to maintain participation in the project over the long term. The resignation of this teacher after 12 months and an ongoing high rate of turnover of staff at this remote site led to the decision to not further pursue that site as a recruitment venue for additional project participants. However, the interest in engaging with a novice teacher remained and this opportunity arose slightly down the

track from the project inception with the employment of a new teacher at the North Queensland FLC who demonstrated enthusiasm for science, but limited experience with the actual teaching of science.

The inclusion of the outlier case had an unexpected additional benefit, in that the novice participant provided a pragmatic grounding that was perhaps in danger of being lost due to extended exposure to the more philosophical orientations of the experienced teacher participants. In this way, the outlier case acted in a sense as a bookmark, a reminder that there is value in the pragmatic as well as the philosophical, and that engagement is a construct enacted in a multitude of ways. Thus, while the notion of exploring the practices of experienced versus novice practitioners was perhaps initially motivated by a goal of cross-case comparison, it became apparent that the variety of approaches inherent in the FLC setting were better considered in a collective sense, with each different perspective enhancing understanding of the phenomena of engaging diverse students with science. Understanding the variety of perspectives inherent to the FLC setting was supported through the use of a participant observation research strategy, a technique that enables data collection through a process well-aligned with the epistemological assumptions of the qualitative case study.

4.4.2.2.2 Data Collection Methods - Fieldwork and Participant Observation

According to Creswell (2013, p.20), conducting a qualitative study means "that researchers try to get as close as possible to the participants being studied". This requires spending time in the 'field' where research participants live and work (Creswell, 2013). The richest portrait of fieldwork emerges from the sphere of ethnography, where the continuous presence of the researcher in the field is considered a necessary condition for best understanding the subjective experiences of people (Gobo, 2011). This extended fieldwork role is enacted through the research strategy of participant observation, which, according to Gobo (2011, p.7) encompasses the following characteristics:

1). The researcher establishes a direct relationship with the social actors;
2). Staying in their natural environment;
3). With the purpose of observing and describing their social actions;
4). By interacting with them and participating in their everyday ceremonials and rituals; and

5). Learning their code (or at least part of it) in order to understand the meaning of their actions (Gobo, 2011, p.7).

The goal of participant observation is then understood to be the development of an emic or 'insider' perspective, through extended engagement with participants in their natural environment. Participant observation as a research strategy has been critiqued as being overly subjective, with researchers considered to be at risk of 'going native' through the over-development of a sense of membership with participants, and through this process, losing their ability to 'step back' and observe the setting in order to describe it appropriately for outsiders. However, qualitative researchers generally accept the subjectivity of the researcher as "an inevitable part of the frame" (Simons, 2009, p.24), so the problem becomes not one of reducing subjectivity but rather ensuring that it is appropriately managed and disciplined. Membership, solidarity and 'good faith commitment' are considered critical to the development of an authentic and meaningful participant observation role (Adler & Adler, 1987), however, this does not necessitate a disengagement of the intellect. Researcher bias can only be acted against by becoming self-aware. Roberts & McGinty (1995) describe the use of a reflective log or journal by the researcher to enable regular engagement in reflexive research practice. The keeping of a journal may also assist the researcher to identify personal crossings from an etic to an emic perspective, and to ensure through reflection that this does not become unbalanced towards the latter as the project progresses.

In addition to keeping a reflexive journal, a decision was made to further enhance the credibility of the study through the development of an observation protocol that would provide a bounded focus for the observation process, through attention to Patton's (1980) key areas of observational interest, namely; the physical setting, the social climate, program activities and participant behaviours, informal interactions and unplanned activities, language, non-verbal communication and program documents. These categories informed the development of a template (see Appendix B) that guided the collection of field notes during the process of classroom observation, and allowed for both descriptive renderings and the inclusion of interpretive comments reflecting the evolving understanding of the researcher. It is important to note that use of an observation protocol does not make the process objective, as, duly noted by Simons (2009, p.56) "what we place in the foreground is what is of significance to us at any one moment, and this may change many times in the course of the study" (Simons, 2009, p.56).

The validity of the participation observation process is considerably enhanced by the length of time spent in the field, with studies of a more longitudinal nature providing greater opportunity for exploration of understandings and misunderstandings that occur within the complex process of observing research participants in the field. It was for this reason that the researcher made a commitment to working intensively with teacher participants over an extended period of time. Classroom visits were made on a weekly basis over a period of eighteen months, with the average visit being of 2 hours duration. Observation records were of 2000-3000 words in general length and were supplemented by semi-structured interviews with teacher participants, reflective conversations post-observation and regular email/phone correspondence. As a participant, the researcher worked alongside teachers in the planning and delivery of science orientated units of work, with the level of researcher participation tailored to the needs of the individual participants. Additionally the researcher attended local planning days, site celebrations and contributed to activities in the best interest of the site including a successful application for funding of the building of a dedicated science laboratory.

The researcher role transitioned as the project progressed over time, with a significant movement from what might be considered an initial 'detached observer' role (Gold, 1958) to that of 'passionate participant' (Lincoln & Guba, 2000). As the project progressed, peripheral researcher membership translated into complete membership (Adler & Adler, 1987), through prolonged engagement with participants in the everyday teaching and learning experiences of the field. This sense of affiliation reinforced the sustainability goal of the project, in terms of ensuring that outcomes were of enduring value to both local participants and the wider FLC Network. Collaborative enterprises that would give teacher participants greater voice and ownership of the project were actively sought and realised through engaging participants in processes of co-authoring refereed journal articles and co-presenting at academic conferences. According to Lassiter (2005, p.13) "such practice transforms the role of the so-called informant: instead of collaborators appearing to only inform the production of knowledge, they take on the role of 'consultant', of 'co-intellectual'". These co-authoring processes acted as a vehicle for a dual/researcher participant framing of practice, which also contributed significantly to the data analysis component of the project.

4.4.2.2.3 Data Analysis

The use of participation observation and fieldwork within the case study research strategy generates a considerably large amount of data to be managed. In the case of this project, conducting fieldwork over the course of 18 months resulted in an extensive amount of observational data, as well as interview transcripts, email records, curriculum exemplars, student artefacts and planning documents for review. In relation to data management, the qualitative software program NVivo was utilized to enable efficient storing, sorting and retrieval of project data. While cross-sectional data organization is common in qualitative studies, exemplified in categorical coding processes, Mason (2002, p.166) indicates that non-cross-sectional data organization can be more appropriate for case studies where:

> *there is a need to understand complex practices;*
> *which may be particular, specific or idiosyncratic;*
> *and where context is of central emphasis.*

Non-cross-sectional data organization then is "a practice guided by a search both for the particular in context rather than the common or consistent, and the holistic rather than the cross-sectional" (Mason, 2002, p.165).

While non-cross-sectional data organization promotes maintenance of the case as a holistic unit, it is still necessary to make considered choices as to which 'slices' of data will be selected from the wealth of material available and be represented in the final case studies. Within this project, the intention was to create 'snapshots' of teacher practice that would illuminate the innovative elements of individual teachers' practice that work consistently to engage diverse young people in science education. Green (2002, p.vii) captures well the relationship between 'slices' and 'snapshots' in the following excerpt:

> *The term 'slice' emphasizes that, while the depictions…are only partial, they are not random or lacking coherence. Further, what any slice looks like is affected not only by who is doing the looking but also by how it is cut and who does the cutting. So the depictions reflect not only the perspectives of the subjects of the research but also the perspectives of the researchers and their particular interpretations of the research paradigm or methodology being used. What is presented can also be seen as snapshots, that is, pictures of research outcomes at a given time and place as selected by the viewer.*

Leaving the role of selecting which slices of data represent significant elements of teachers' practice solely in the hands of the researcher raises ethical questions around power and the politics of representation. Lassiter (2005, p.4) raises a significant question in asking "who has the right to represent whom and for what purposes?" In the context of an overall methodological orientation towards 'working with' research participants, it would seem necessary to include participants in every stage of the research process, including their own representation in case study texts. Hinson (1999, as cited in Lassiter, 2005, p.12) conceptualises truly collaborative projects as those that redress power imbalances in the research setting through "a sharing of authority and sharing of visions", realised through "inviting consultants to shape form, text, and intended audience". While the process of co-producing texts which research participants is complex, Lassiter notes that "the texts that we produce with our consultants do matter. They matter intellectually, politically, and ethically in a variety of contexts – in the academy, in the communities in which we study, in our practice, in our moral commitments" (2005, p.14).

In the case of this project, the journal articles co-produced with the teacher participants proved significant in relation to framing FLC teaching as intellectual work to the wider community, in giving voice to a school community working on the margins of mainstream education, and in assisting teachers to clearly articulate their own pedagogical practice and promulgate 'what works well' in this particular setting. The process of co-producing texts also enhanced the credibility of the final case studies, as working with participants provided a pragmatic grounding in relation to "what is 'real', what is useful, and what has meaning" (Lincoln & Guba, 2000, p.167). Co-writing with participants required open and honest conversations about the highs and lows of projects, considered discussions about what should and should not be included, negotiations about correct terminology and phrasing, and continual revisiting of the goals of the project in terms of both the researcher and participants' perspectives. It was, without doubt, a long and involved process, yet teachers set aside a considerable amount of their own time to participate in the process, and demonstrated a high level of engagement with their role as co-intellectual.

4.4.2.3 Phase 3: Articulating a Framework of Practice

Phase 3, as the culminating phase of the project, required a synthesis of Phases 1 and 2 of the study in order to articulate a framework to guide future science teaching practice across the FLC network and respond to RQ3. Development of the practice

framework occurred in consultation with the teacher participants involved in Phase 2 of the project and involved a cyclic process of development, feedback and refinement. Initial versions of the framework were presented in the form of concept maps that served the function of identifying and clarifying key areas of significance in terms of the practice of engaging FLC young people in science. Such a process required the employment of abductive reasoning, where the researcher moves "back and forth between data, experience and wider concepts" (Mason, 2002, p.181).

Early feedback from staff initially resulted in continuing expansion of the concept maps, in an attempt to include every potential element of interest, however, the framework itself became unworkable in the sense of lacking clear direction and intent. It then became necessary to refine the multiple conceptual categories of the initial draft into a smaller number of over-arching key elements. This process was guided by a search for the recurrent, in terms of identifying the key areas of emphasis that persistently arose in conversations, observations, and the literature field considered synergistic to the educational goals of the FLC network. This winnowing of the data, based upon "an integrated knowing stemming from deep immersion in the data" (Simons, 2009, p.126), resulted in the emergence of five key dimensions that formed the foundation of the framework (and are explicated in more detail in findings Chapter 9). These five key dimensions were then further supported by a short set of sub-questions that synthesized the outlying ideas of the original concept maps. Fine-tuning of the framework with the key teacher participants ensued until a draft version was arrived at that was seen to be "grounded in professional agreement as to the usefulness or significance of particular insights" (Simons, Kushner, Jones & James, 2003, p.359).

This draft version of the framework was then presented to staff across the network at a planning day event, in order to gain feedback from staff outside of the main study site and validate the wider usefulness of the framework. The framework was positively received, with some minor changes suggested to enhance clarity (e.g. adding descriptors for each of the key dimensions) and to remove redundancies (e.g. some of the sub-questions were seen to be duplications). A final revised version of the framework was then formally presented to Youth+ leadership staff who suggested no further changes, and moved to position the framework as a supporting document for the network's Learning Choices curriculum program.

4.5 Ethical considerations

The project received ethics approval (approval number H3025) from the Human Research Ethics Committee (HREC) at James Cook University (JCU). As the project involved working with schools operating under the umbrella of the Edmund Rice Education Australia (EREA) Catholic Independent school system, it was also necessary to obtain EREA ethics approval and adhere to the associated Research Guidelines. The main ethical considerations in the project were related to informed consent, ensuring the welfare of participants (including those who identify as Aboriginal and Torres Strait Islander Peoples) and confidentiality and anonymity.

4.5.1. FLC Network Staff Participants

Staff recruited to the research project were made aware from the earliest point of negotiation that participation was entirely voluntary, and that they were able to withdraw at any time. In order to avoid harm to professional reputation, the information statements provided to staff as part of the informed consent process made clear that it was not the intention of the project to negatively critique teacher activities, but rather to seek innovative instances of pedagogical practice to inform the development of a network-wide framework for guiding the teaching and learning of science. Having teacher participants co-construct the case study outputs of the thesis ensured that they were able to have a voice in the representation of their practice to the wider community.

4.5.2 FLC Network Student Participants

While the project focused on teacher practices, students were necessarily included in the study as classroom members. As the students attending the Flexible Learning Centres were under the age of 18, it was necessary to gain both their own and parental/carer consent for their participation in the project. This was considered a challenging aspect as many young people attending the centres were living away from the family home, and often did not have regular contact with their parents or legal guardians. Divulging information related to students' home situations to outside parties also raised ethical concerns so it was decided that Flexible Learning Centre staff would manage the completion of informed consent forms for both students and their families. Staff endeavoured to carefully read and explain the information pages to students and families and it is hoped that this process ensured participants were well aware of the nature of the research project.

To protect the privacy of the students, the information sheet clearly stated that the data collected would only look at students' participation in education activities, and would

not include any individual information about their personal life, family background or schooling history. This seemed the best way to protect the young people's confidentiality in the early stages of the research project, but presented challenges when it came to presenting the findings of the research, as the dynamic of the schooling context is very much influenced by the background experiences of the young people who attend. In such, it has been necessary to generalise as to the complexity of the young people's lives, and focus greater attention on teaching and pedagogy, in order to reduce the odds of inadvertently identifying young people through description. Where references to young people occur in project publications, pseudonyms have been used to protect students' privacy.

4.5.3 Conducting Research with Aboriginal and/or Torres Strait Islander Peoples

As a large proportion of the students and staff project participants identified as Aboriginal and/or Torres Strait Islander peoples, it was considered of critical importance to ensure a culturally aware approach to the research ethics of the project. To ensure preparedness for ethical research conduct, the researcher attended both the 'Research Conduct and Ethics Workshop' and the 'Research Protocols Workshop for People Conducting Research With or for Aboriginal and/or Torres Strait Islander Peoples' offered by JCU at the commencement of the doctoral study.

Additionally, the research was conducted under the supervision of Australian Aboriginal and Torres Strait Islander Studies at JCU (formerly known as the School of Indigenous Australian Studies), which enabled input and advice in relation to how to conduct research sensitively and how to best reflect the perspectives of Aboriginal and/or Torres Strait Islander teaching staff and student participants in the research product. Under the guidance of the centre, the project adhered to the Guidelines for Ethical Conduct in Aboriginal and Torres Strait Islander Research as prescribed by the NHMRC (2003).

4.5.4 Confidentiality

Maintaining confidentiality within the project was complex due to the unique nature of the EREA Youth+ FLC network. In particular, preserving the anonymity of the main study site was hampered by its exclusive positioning in the educational landscape of North Queensland. There are no other similar types of operations in the northern region, and only a limited number of like schools in the state of Queensland as a whole. Reference to the school site then has been as made as generic as possible in order to

provide some level of confidentiality in relation to likely recognition by national and international audiences.

In terms of maintaining the confidentiality of FLC staff, this was negotiated to suit the preferences of staff and the desired outputs of the different phases of the project. The general staff interview data generated in Phase 1 of the study was presented via pseudonyms, except in the case of leadership staff occupying singular roles, for which permission was granted to use real names. In relation to Phase 2 of the study, the co-authoring of case studies made inevitable the rendering of the key participants' full names and contact details. This requirement was discussed with participants prior to embarking upon the process of co-writing and was considered acceptable by those involved. In the case of overall raw data collection materials collected through-out the study, all staff and students names have been de-identified.

All of the confidentiality issues reported above were discussed with network and site-based leadership in order to ensure that the decisions made were deemed satisfactory in relation to the requirements of the Youth+ organisation to protect the welfare of staff and students.

4.6 Chapter Conclusion

This chapter has outlined the case study research method used for the project, and has detailed the significance of an extended fieldwork strategy in contributing to the development of authentic educational research. Together, chapters 1 to 4 provide a theoretical and methodological foundation from which the results of the study can be understood and discussed. The chapters that follow, 5 to 9, evidence the findings of the project and chronologically represent the phases of the study as summarised in Table 2 below:

Table 2: Links between the Finding Chapters, Research Phases and Research Questions

Findings Chapter/s	Phase	Research Question
5	Phase 1 – Developing an understanding of the context	*How does the FLC context shape science education?*
6, 7, 8	Phase 2 – Working with teachers to capture individual case studies of practice	*How do teachers work to engage diverse young people in science education within the FLC context?*
9	Phase 3 – Articulating a Framework of Practice	*How can science education be better framed to meet the needs of disenfranchised young people?*

Chapter 5 explores the broad context of the EREA Youth+ FLC network in order to ground the North Queensland case studies presented in chapters 6-8. The case studies take the form of publications co-authored with teacher participants (as previously described in this chapter), and are an exploration of possibilities for science education within the FLC network. Chapter 9 is a culminating point of the thesis, in that it presents the practice framework that is a product of the theoretical and empirical findings of the research project. Together, the chapters demonstrate the progressive stages in the analysis and interpretation of the research findings and highlight the contextual, pragmatic and philosophical considerations of developing a framework of science education for the FLC context.

Chapter Five: Understanding the Context

5.1 Introduction

This intention of this chapter is to lay the groundwork for the case study chapters that follow. As noted in Chapter 4, this project employs a case study research strategy that signifies research on a system "bounded in space and time and embedded in a particular physical and socio-cultural context" (Gobo, 2011, p.16). This chapter then explores the broad context of the FLC network in which the research participants practised, and identifies key factors in play that framed both the constraints and action possibilities that existed at the commencement of the research project. It draws from data collected during Phase 1 of the project and speaks to Research Question 1:

> How does the FLC context shape science education?

The chapter commences by exploring the radical education standpoint of the FLCs and juxtaposing this against the prohibitive conditions of school science. It then makes note of the pervasive influence of school science in its manifestation in the teaching and learning practices of the FLC network. This then requires an examination of what should count as science within the network, according to the stated values and priorities of the system. The chapter finishes with a pragmatic exploration of possibilities for making science happen in a manner that is authentic to the educational philosophy of the network, with possible avenues of enactment detailed in the chapters that follow.

5.2 A Radical Standpoint Juxtaposed with School Science

Chapter 2 introduced the EREA Youth+ FLC network as a provider of alternative or flexible learning educational options in Australia. As a schooling system designed to meet the needs of some of the most disenfranchised youth in Australia, it is unapologetic in taking a political stance that promotes a radical viewpoint of education, as indicated in the quote that dominates the front page of the organisation's foundation statement:

> *Our schools exist to challenge popular beliefs and dominant cultural values, to ask the difficult questions, to look at life from the standpoint of the minority, the victim, the outcast and the stranger (Philip Pinto, 2002, Youth+ Foundation Statement, EREA, 2010).*

This radical standpoint, embedded in a vision of education that is democratic, socially just and transformative, forms the paradigm or lens for viewing the activities of the schools within the network. This is reflected in the following description of the teaching and learning practice of Flexible Learning Centres:

> *Flexible Learning Centres strive for authenticity in their teaching, learning, and assessment practice. Flexible pedagogy is characterised by approaches which reflect individual young person needs, approaches that give emphasis to a learning community, learning which is critically reflective in confronting cultural and social barriers. Learning which can be used to promote a culture of success and build a vision for a better world (Youth+ Foundation Statement, EREA, 2010, p.6).*

The intention of FLCs then, is to provide a radicalised educational experience that is 'not like school', in recognition of the fact that young people who seek out an alternative education pathway have made a conscious choice to engage with a different form of educational framework. As explained by the FLC Network Principal[17], this requires an element of 'de-schooling', where both staff and young people find new ways of participating in a learning environment. How this comes about in practice is reflected in te Riele's identification of the three common curriculum aspects of flexible learning programs of this type – the inclusion of practical and applied learning strategies; the use of individual learning plans; and curriculum delivery through integrated or project-based approaches (2012, p.34). This practice orientation works particularly well within the established curriculum streams of flexible learning programs, that te Riele (2012) has further categorised as *enabling* (including credentialed learning, remediation in literacy and numeracy, mentoring and pastoral care), *co-curricula* (of additional value to credentialed learning and including such activities as dance, art and outdoor adventure camps) and *connected with community* (activities explicitly connected to the community including service learning and sports).

In the context of this project however, the notion of 'de-schooling' science in order to meld it with the personalised, connected and experiential approach of the FLC network was considered to be no easy task. As noted by Tytler (2007), the form of school science has remained relatively unchanged over the last half century and has created

[17] The person occupying the Network Principal role in the early days of the project is now the Director of Youth+.

an educational blueprint that is remarkably resistant to change. This creates a set of tensions between the ways of working that characterise Flexible Learning Centres, and the tightly framed nature of science as it is most generally represented. That the influence of school science is pervasive was made clear in the fact that it was able to exert influence even in the alternative education setting of the FLCs, as will be explored in the following section.

5.3 The Influence of School Science in the FLC Setting

Seiler & Gonsalves (2010) observe that the resilience of school science in its traditional form has created powerful ideas around what constitutes 'real' science for both teachers and students, and wider society. Associated with this notion of 'real science' is a set of beliefs around what 'real' teachers and 'real' students do within the practice of teaching and learning science (Seiler & Gonsalves, 2010). These taken-for-granted assumptions were seen to act as a constraining factor in the FLC context, where teachers and young people sometimes struggled to step outside of their preconceived notions of what real school science must be. The following section explores how the pervasive influence of school science impacted on the positioning of science within the FLC network and shaped the forms of participation enacted by staff and young people.

5.3.1 Positioning of Science and the Constraint of Possibilities

At the beginning of the project, science was, in most FLC places, allocated a 40 minute session during the week. While the Network Principal was quite clearly opposed to the idea of the "40 minute science dump", the reality was that where science had gained any traction in an FLC timetable, it was positioned in a very similar form to that of mainstream settings:

> *Yeah one lesson a week yeah so it's probably about 40 minutes one lesson a week but they don't all do it every week. So they do it every second week kind of thing (Jess, Teacher).*

This replication of science as a compartmentalised subject area resulted in a number of unintended consequences. Its isolation as a subject untenured to the rest of the FLC timetable and unrelated to the curriculum of import meant that it often lost out to other activities considered more essential, as reflected in the following teacher quote:

> *At this school, they don't see science in the same way that they see literacy or*

numeracy. They see it as a bit of a timeout activity, a bit of a fun sort of activity (Jess, Teacher).

Its manifestation in 40 minute 'blocks' also necessitate the 'owning' of science by one designated teacher. With the majority of teachers across the network operating 'out of field' (Hobbs, 2012), this created its own set of tensions in that a number of teachers felt unqualified to implement 'proper' science education. Non-science background teachers were quick to highlight their own perceived deficiencies and make the point that they were 'not real science teachers':

Yes well I'm not trained to be a science teacher I'm trained as a PE teacher and health teacher…I think the biggest challenge would be I don't necessarily feel qualified or prepared to do it (Jess, Teacher).

Interestingly, a number of the teachers who declared that they were not real science teachers had professional backgrounds involving qualifications and work experience that were clearly science-related:

I did a Bachelor of Education in Physical Education Secondary. So my background's mainly - I majored in physiology, majored in biomechanics, they were my two. Did a bit in exercise physiology. I had to do a fair bit of research when I ran a company called Allergy Education Australia, for three years, so I had to learn a lot of anaphylaxis and allergies and that sort of thing. I did a lot of science through first aid and learning about first aid, and learning the best ways to treat life threatening situations. I did also run a swimming pool for a few years. Which doesn't sound very scientific based, but I had to learn pretty quickly about water and the components of water and how to run a plant and chemicals and safety and that sort of stuff. So I've had a fairly - not maybe such educational, although I did do a fair bit of that in uni, but just life experience more than anything (Aaron, Teacher).

This conceptualisation of not being equipped to teach proper science also engendered in teachers a sense of inadequacy in relation to the resources and facilities available within FLCs to support teaching and learning activities. In discussing what was needed to better support science education, the teacher from the above quote noted:

It would be nice to have a science area. It doesn't have to be a full blown lab,

but some storage area, some resources to run - a big science cupboard where I could just go and buy the 100 straws I need, and just have it all. So I can run it. It's at my fingertips. A science teacher that knows a little bit more about what they're doing than me (Aaron, Teacher).

Other teachers made similar comments in relation to the lack of available resources:

Yeah so just sorts of things like that and just to have - even if I come up with an idea that I think that would be good, like getting, I was thinking about getting like the petri dish - what are they called petri - with the jelly and stuff in it that you can look at moulds and things grow in it. But I don't know where you get them from, we don't have the money to buy it anyway (Jess, Teacher).

There was also evident concern in knowing how to use science equipment and materials:

Because I'm not a science teacher I actually don't know which ones are safe and which ones are not - so I stay away from all of it (Rosalie, Teacher).

Teachers then struggled to live up to their ideal of what real school science should be. That they should be delivering a form of real science was reinforced by the static positioning of science within the FLC timetable and their positioning as having sole responsibility for the science program. In order to live up to this ideal of 'right' science, the science activities that were on offer at the FLCs during the early stage of the research project often reflected what teachers appeared to remember most clearly from their own experiences of school science:

I just remembered things we did at school, like we made lava lamps. Even simple things like egg drop (Aaron, Teacher).

The need to deliver 'real science' was reinforced by the perception that young people themselves gained value from participating in regular science classroom activities:

The very fact that we're doing science in what is perceived to be a dumb school, and they can see and feel and smell that it is real science that we're doing – they feel better about themselves, because they think they can do this. (Rosalie, Teacher).

Yet, at the same time, teachers recognised that presenting science in a traditional form could act as a barrier to participation for FLC young people:

> *A lot of kids come in that already have that preconceived "I hate Science" and "I'm not going to walk into the Science classroom" thing (Claire, Teacher).*

In sum, it was made apparent that even within an alternative education setting, the concept of what constitutes 'real science' had a significant shaping influence on the expectations of both teachers and students. As suggested by the Network Principal, there was a need to help both staff and young people 'see' science differently:

> *So to broaden that vision of science for me, to find the science in what's being done and to maybe develop that is important to me…to have a different vision of it that's suitable for Flexis (Dale, Network Principal).*

5.4 What Should Count as Science Education in this Setting?

With the Network Principal calling for a broader vision of science education for FLCs, deciphering what *should* count as science education in the FLC setting was fundamental to the interests of the research project. As noted by Roberts (1988, p.29), what normatively counts as science education in a particular setting is an expression of "the value positions people honour and believe in". School, community and teacher values then play a significant role in the shaping of the answer to what counts. In the case of the FLC network, school system priorities were informed by a Strategic Values Framework that reflected the radical education viewpoint discussed earlier in the chapter. The Strategic Values Framework contained six key dimensions – Relationship, Community, Safety, Learning, Transformation and Eco-Justice (EREAFLCN, 2011). How these might inform science education is explained in the following quote from the Values Coordinator of the FLC Network:

> *This notion of relationship, community, transformation, safety, eco-justice, I think, fits really well with that particular paradigm and world view - that we are part of an interconnected whole and of a life system that is emergent. So it's about how do we cope as part of that interconnected web of life in a way that's safe for other species, that's safe for the long term survival of us as human beings but also sustainable. I think in that sense, that notion of safety and*

sustainability - not just from a human perspective but from a biological ecosystem perspective, it's a huge one (Ann, Values Coordinator).

The values framework of the FLC Network then reflects an eco-justice sensibility, as reinforced by a similar quote from the Network Principal:

We are part of the system, we don't dominate a system, we're part of it. It's about the paradigm that you come to, I think, and the lens you look at this stuff through. The relationship between social justice and science is extremely important because what we need to be able to do to be just to our environment and to others is to take a scientific view on ecology and that needs to happen. I would strongly argue that our schools could be lighthouses for that (Dale, Network Principal).

This commitment to eco-justice is complemented by a belief that what science education might have to offer young people in the FLC context is a greater sense of connection to the world around them:

It is important that young people get to understand the physical environment in a way that is meaningful to them and realise that science is one aspect of relating to the world and the environment in a way that can provide people with a deeper understanding of their place (Dale, Network Principal).

This understanding of place is interpreted through a plurality of worldviews that reflects the commitment to diversity that underpins the FLC approach.

…it might be embedded in Indigenous cultures, it might be embedded in counter-culture…I mean there is a whole range of knowledges that we can expose young people to and give them an opportunity to reflect on the diversity of what's out there (Dale, Network Principal).

This in turn leads to a vision of a different form of science education where science is seen:

…not as a body of knowledge but a way of thinking and a way of critical thinking, exploring and enquiry. To me that's the heart of really good science. To me, that approach to science education which is about critical inquiry, asking

questions, collaborating, researching, I think that has a lot to offer in terms of a way of thinking because that way of thinking can then be transferred to general life issues (Ann, Values Coordinator).

The idea of transference, as taken up by the Values Coordinator in the preceding quote, was one that featured strongly in the pragmatic considerations of what should count as science education by the teachers within the FLC network. Teachers noted that a science education that mattered would enable FLC young people to develop transferable thinking skills that would empower them to experience more agency in their everyday lives:

If they don't have that relatively measured – if they don't have the habit of measured thinking, if everything is reactive, spontaneous, just responsive to what happens to them, they will never be able to cope with the rest of the world because the rest of the world, the official world with which they need to deal with, actually works in that way, so they won't be able to cope. It will be like they don't have the language or it will be like some game that somebody never told them the rules to and they will be victims of it. They will be absolutely helpless in that world. They are helpless in that world at the moment. So to give them an opportunity to develop a measured response to things so that they can be proactive and purposeful and intentional about their own lives rather than just simply responding to something that has happened to them is probably what I see. Once again I'm talking about the thinking skills and the process and way of thinking about something (Vivienne, Teacher).

In explaining the thinking skills referenced above, the teacher further explained this in the context of science education as:

That process of deduction, that process of stringing one thought to another thought to draw a conclusion. Now whether this has to do with some physical phenomena in the world or chemical reaction or making a prediction or just coming to a conclusion about anything, the same skills apply. So it's those thinking skills that I think science has to offer our young people. That logic of things (Vivienne, Teacher).

A science education that counts in the FLC setting was thus conceptualised by participants as needing to reflect both the strategic values of the network, and a holistic

orientation to the education of disenfranchised youth. However, there was also recognition that the nature of the FLC context provided both challenges and 'spaces of possibility' (Carlone, 2002) in relation to enacting a more expansive model of science education.

5.5 Making Science Happen

In the FLC context, the first and most fundamental measure of success is participation by young people (Murray, 2011). A core aim of the centres then is to overcome the sense of weariness with schooling that many disenfranchised young people experience, and which manifests in an apathetic response towards learning. Many teachers spoke of a general sense of lassitude towards education exhibited by FLC young people, as indicated in the following quote:

> *They think if they sit in the classroom every day, they will get an education and I keep saying, it's not like sitting in the sun you know and getting a sun tan, you've got to engage with it, but they see themselves, I don't know, I think sometimes it's that flotsam and jetsam thing, like the world will do with me what it's going to do (Vivienne, Teacher).*

It was also made clear that the ordinary participation strategies of mainstream settings based on extrinsic motivators have little impact in the FLC setting:

> *They don't see the purpose in knowing anything for the sake of knowing it. Where kids in mainstream want to know the knowledge because it's going to be on the test, these kids don't care. They don't see the purpose because even if it was going to be on the test, they don't see the purpose of the test (Claire, Teacher).*

An expanded view of science education for the FLCs would then need to work towards assisting young people to overcome this sense of lethargy towards learning. Staff spoke of the possibilities of science as a vehicle to develop in young people a sense of awe and wonder about the universe, as exemplified in the following quote:

> *It's bringing them to that sense of wonder and awe about what an amazing planet we live in and the workings. I'm not a scientist but how the world works at the sub-atomic level, it's quite amazing. The more we can bring young people into connection with that, and the intricacies of it, and the wonder of it –*

along with the critical thinking around it and why things are, what they could be (Ann, Values Coordinator).

The 'how' of making science happen for FLC young people focused on providing opportunities to re-ignite young people's interest in learning through building on the strengths of the key pedagogical strategies already in place across the network. The term 'hands-on' was used repeatedly in discussing how to better engage young people in science, and this was often linked to the outdoor education curriculum, which formed an important component of the learning choices on offer across the FLC network:

I think there's a really interesting exploration of the outdoor education stuff we do, both in terms of environmental science and environmental understanding and responsibility for the environment that is growing with us. Again, very practical, hands-on, going into the bush and doing camps and paddling down creeks (Dale, Network Principal).

ICT and technology were also considered avenues of possibility for fostering young people's interest in learning science:

What are the other ways that you can bring those experiences to people in a way that doesn't turn them off and is challenging? I actually think the potential of technology is really, really powerful here. It's very visual as well so I think there's a lot in that. I mean things like iPads and other things like that. It seems to be that young people have a natural aptitude for it (Dale, Network Principal).

Teachers also spoke of the plain need to engage with students' interests and make science learning fun for young people. A sense of fun was considered essential to engendering meaningful participation in science:

I spoke to them about what they would want to do for science and they said, something interesting, something fun (Jess, Teacher).

I want it to engage kids in their passions and I want it to educate our young people in a way that they'll enjoy and embrace in some form (Aaron, Teacher).

The idea of engaging young people in their passions was also related to encouraging young people to have a voice in issues or matters that might be of personal and/or community concern:

> *It seems to me if I was a young person…becoming more politically aware…one of the things I would want to know more about would be…what's happening with the environment, what's happening with climate change, what's that responsibility about as a young person (Dale, Network Principal).*

> *The other area I think is the advocacy potential and I think for our young people, recognising that they actually have a voice and giving them opportunities be advocates for – whether they are social justice causes or environmental causes, it is really important (Ann, Values Coordinator).*

Making science happen then was considered a process of building on young people's interests and passions to ignite a sense of curiosity and wonder about the world around them. In turn, it was hoped that this affective engagement would lead to an abiding concern that might translate into future advocacy in relation to matters of local and personal significance. The process of engaging young people in a more expansive view of science education was centred upon developing the strengths of the pedagogical approach already in place at the FLCs, including use of outdoor education, ICT and hands-on engagement strategies.

5.6 Conclusion

The purpose of this chapter has been to provide a broad overview of the factors that shape the act of science education in the FLC context. It recognises that "participants produce the meanings of science in local settings within and against larger, more powerful and pervasive (i.e. prototypical) meanings of science and science education" (Carlone, 2002, p.309). That the dominant conceptualisation of 'real science' still permeates the actions of participants in the FLC context is made evident by the tensions around science delivery that are of real concern to teaching staff. Developing a more expanded view of science education in order to respond to the needs of the context has required an exploration of what form of science might count for the FLC network, and how this might be made to come about in a way that is respectful of the educational philosophy underpinning the FLC approach. The following chapters consist of case study publications that capture how this expanded view of science education might be enacted in practice.

Introduction to Case Study Chapters 6-8: An Exploration of the Possible

Chapter 5 identified some of the pitfalls and possibilities around science education delivery in the FLC context. As explained in previous chapters, the lack of available research or practical examples of how to engage diverse youth in science in the context of an alternative or flexible learning setting required an exploratory orientation towards discovering what might authentically work in this context. This is reflected in Research Question 2, which is the focus for Chapters 6-8:

> How do teachers work to engage diverse young people in science education within the FLC context?

Exploring what might be possible, in relation to science education for the FLC context, required working intensively with teachers based at the North Queensland Flexible Learning Centre who had an interest in developing science curriculum and practice, as described in Chapter 4. This process involved working alongside teachers to support their own professional practice, to keep true to the educational philosophy of the FLCs and to provide support and encouragement for including the principles of humanistic science education, as outlined in Chapter 3.

The case studies presented in Chapters 6-8 take the form of publications co-authored with three key teacher participants from the North Queensland Flexible Learning Centre. The act of creating these particular products facilitated a form of reification, as described by Wenger (1998, p.58), where form is given to experience through the production of objects that solidify experience into 'thingness'. Wenger further explains reification as a "not a mere articulation of something that already exists but creating the conditions for new meanings" (Wenger, 1998, p.68). The focused attention required to develop these case study products promoted the pedagogic intentionality of the teacher participants, as explained in Chapter 4, and opened up dialogic spaces to explore and negotiate what works to engage FLC young people in an expanded view of science education, as necessitated by the findings of Chapter 5.

In using the phrase 'what works', it is important to signify that the case studies presented are not intended to provide 'the answer' or 'the way' to do science in Flexible Learning Centres, or any other setting catering to the needs of disenfranchised youth.

Instead they are intended to represent the considered practices of a small group of teacher participants whom were endeavouring to catalyze momentum for science education in the FLC context. They are reflective constructions of 'what mattered', fixed in particular times and geographies. This boundedness though does not limit the findings of the case studies from being received as indicative of a particular way of working that characterizes the FLC network, and which might map a path forward for the development of shared understandings as to what counts as science education for diverse and disenfranchised youth.

Chapter 6: Case Study 1 - Science education in a 'classroom without walls': Connecting young people via place

6.1 Introduction

This chapter consists of the article "Science education in a 'classroom without walls': Connecting young people via place" which was published in the journal of Teaching Science[18] and was awarded the Most Valuable Paper Award in its year of publication. Permission to reproduce the approved author version of the article is included in Appendix C. The article was written in conjunction with Kellie Stemp who was, at the time, Head Teacher of the Outreach Service connected to the North Queensland Flexible Learning Centre. The nature of the Outreach Service (as will be described in the paper) allowed a unique opportunity to implement a unit of work with both a hands-on and outdoor education focus. The unit of work described within the article was formed in response to Kellie's enthusiasm to trial a place-based approach which resonated with her own professional interest in exploring how curriculum might be better connected to self and community. The key findings of the paper demonstrated that, while there were challenges in implementing a place-based approach, there was significant potential in utilizing such an approach to engage young people in science education to achieve outcomes that were considered meaningful in the FLC context.

[18] Full reference: Wilson, K., & Stemp, K. (2010). Science education in a 'classroom without walls': Connecting young people via place. *Teaching Science, 56*(1), 6-10.

6.2 Article Abstract

Edmund Rice Education Australia Flexible Learning Centres (EREAFLCs) operate within a social inclusion framework to 'walk with' young people who have disengaged from the traditional schooling system. Students attending the centres face multiple stressors in their everyday life as well as significant barriers to achieving success in the classroom environment. Addressing the immediate literacy and numeracy concerns of students as they present at the centres has left little time to formalise strategies for engaging students with traditionally 'difficult' subjects such as science. In addition, there is very little research material available to assist teachers in the development of teaching and learning strategies for science education that deal with the unique situation of the flexible learning context. The aim of this research project has been to work with Flexible Learning Centre staff to identify and trial a range of science teaching strategies to enable the conceptualisation of a general framework to guide future science curriculum development. This article details one unit of work undertaken with an Outreach annexe of the Flexible Learning Centre Network located in a regional area of North Queensland. The trial involved implementing an environmental regeneration unit based on the philosophical principles of a Place-Based Education Approach in order to ascertain the potential of such an approach to engage disadvantaged young people.

6.3 EREAFLC Network and Outreach Services

The EREAFLC Network aims to provide a flexible, relevant and supportive educational experience that will enable young people to find their own pathway in life. Teaching and learning is characterized by “small class sizes, a flexible curriculum that draws on individual interests and needs and a democratic pedagogical approach that encourages learner empowerment and autonomy” (EREAFLCN, 2008, p.2). Educational outreach services are an integral component to the Flexible Learning Centre approach as they ensure equity of access irrespective of geographical location. There are currently seven Outreach services operating across the state of Queensland.

6.3.1 It’sUp2U Outreach North Queensland

The ‘It’sUp2U’ Outreach program commenced in 2006 with an initial cohort of ten young people, a youth worker and a teacher. Since then the program has expanded to a group size of fifteen young people, with continuity of staffing over the three years of operation. The program itself is mobile and is best defined as a ‘classroom without walls’, as learning activities take place at a range of venues such as libraries, parks,

the local PCYC and other community facilities. Young people attending the Outreach service are generally aged between 13 and 17 years and are predominantly male students. A significant number of students who attend the Outreach services in North Queensland identify as being Aboriginal and/or Torres Strait Islander Peoples.

Whilst there is more diversity than commonality amongst young people's backgrounds, students attending the Outreach service have typically experienced one or more significant and complex educational, social, developmental, psychological, health, legal or familial situations which demand unique responses. As a result of life circumstances, students have often experienced major disruptions to their schooling experiences such as extended periods of absence that have impacted on the development of their basic academic skills. Available data from the EREAFLC Network indicates that approximately 70% of the student population experience literacy and numeracy difficulties with 30% identified as having a suspected disability impacting on learning and 5% presenting with a diagnosed disability (EREAFLCN, 2008).

While there is criticism of literature that overly focuses on the challenges and limitations experienced by disengaged youth (te Riele, 2008), it is important to recognize that these issues present strongly in the Outreach context and must inform teaching and learning practice. Burck (2008, p.1) provides an interesting analogy that perhaps encompasses both the strengths and challenges characteristic of disengaged young people:

> *Kaleidoscopes and young people have a great deal in common. The beauty of a kaleidoscope is how it transforms simple fragments of coloured glass into wonderful complex designs. It is not one isolated fragment that brings the kaleidoscope to life, but how all the fragments come together...Ultimately the challenge is how to work with these different factors in a manner that gives the young person a chance to succeed and grow.*

6.4 Curriculum Philosophy of the Outreach Program

The curriculum philosophy of the Outreach program has been developed with a primary focus of enhancing the relationship of young people with the wider community and vice versa. While family and cultural bonds might be strong for young people, it is often the case that relationships outside their inner circle have been characterized by marginalization, discrimination, rejection and failure. As a result, there is little sense of reciprocal responsibility or obligation to the wider community either for or from these

young people. Teaching staff believe that if students can contribute positively to their own family and cultural communities, as well as wider society, they may be seen - and in turn see themselves - as agentic individuals capable of effecting change at both an individual and community level. In order to best facilitate this contribution, the integrated curriculum philosophy of the Outreach Program is based on a combination of two inter-related ideas, that of Place–Based Education and Social Capital Theory.

6.5 Place-Based Education

According to Smith (2002), a Place-Based Education Approach is essentially concerned with grounding educational activities in local phenomena and students' lived experience. Woodhouse & Knapp (2000) note the importance of delineating between the evolving concept of Place-Based Education as compared to the related approaches of Outdoor Education and Environmental Education. While a Place-Based Approach encompasses the experiential and ecological sensitivity concerns of both outdoor and environmental education approaches, it is most specifically concerned with the dynamics of a particular place. To use a *Place* emphasis within a study module means to look at all aspects of the specific geographical location: its history, geography, ecology and anthropomorphic purpose. As such, it is a multi-disciplinary approach (Woodhouse & Knapp, 2000).

A Place-Based Approach connects place with self and community with a focus on sustaining cultural and ecological integrity (Woodhouse & Knapp, 2000). In relation to the cultural backgrounds of the young people attending the Outreach, Aikenhead (2006) has emphasized the context-bound nature of Indigenous learning as learning that occurs about a particular place. Ardoin (2006) discusses the notion of 'place identity' that develops through relationships with places and can be an important factor in developing self-concept. The Wetlands project detailed in the following case study provides a *Place* perspective through its location within the local area, incorporation of Indigenous perspectives as well as the connection between the wetlands area under rehabilitation and larger systems such as the ocean and Great Barrier Reef.

6.6 Social Capital

Social capital is commonly defined as a network of relationships together with shared norms, values and understandings that act to encourage cooperation within or amongst groups (Australian Bureau of Statistics (ABS), 2004). Stevens (2005) puts forth that the key element of social capital is not the networks themselves but rather the act of cooperation in pursuit of the common good. Bassani (2007) further refines the concept

by asserting that social capital is the trust, loyalty, security and self-confidence that stems from such relationships. Balatti (2008) indicates that social capital and learning are intrinsically related and that pedagogical choices affect the social capital outcomes that students' experience. She notes that social capital can be both 'good' and 'bad', an idea of particular importance in the Outreach setting where social capital may play a critical role in affecting learning outcomes for students from diverse backgrounds. For the teaching staff of the Outreach Program, this expanded definition takes into account their observation that young people often form relationships that include activities which do not support their physical, mental or emotional well-being. Focusing on social capital in this context involves creating opportunities for young people to form relationships based on social rather than anti-social activities. It also involves creating an extended web of relationships to enable young people a wider array of choices in relation to realizing their full potential. Science education as a tool for enabling the building of social capital is perhaps not a common conceptualization and there are limited tools available for assessing a causal relationship between the two. However, an additional research project connected with the EREAFLC Network is investigating in more depth potential avenues for assessing and formalizing the contribution of social capital to students' learning outcomes.

6.7 Engagement with Science

Of key interest to both teaching and research staff involved in the Wetlands Project was the ability of the Place-Based Education approach to engage young people in science education activities. Informal discussions with young people early in the project related to their general experiences with science indicated a history of either failure or lack of exposure to the subject, with a resulting common attitude that 'science is yuk'. This sentiment from the young people was in fact so strong at the commencement of the project that the word 'science' was omitted from any discussion of the project activities in order to prevent further disengagement.

Aikenhead (1997, p.219) has previously conceptualised Western science as a 'sub-culture' in that it is characterized by a "well-defined system of norms, beliefs, expectations and conventional actions". He has elaborated on perceived attributes of this sub-culture in describing it as "mechanistic, materialistic, reductionist, empirical, rational, decontextualized, mathematically idealized, communal, ideological, masculine, elitist, competitive, exploitive, impersonal and violent" (Aikenhead, 1997, p.220). In comparison, science education frameworks that have been developed to embed an Indigenous worldview focus strongly on elements of connection, belonging, identity and

place (see for example, Lewthwaite & McMillan, 2008). Negative prior experiences of science might feasibly be attributed to a 'lack of fit' between the Outreach students' cultural backgrounds and the dominant culture of Western science as it plays out in both educational settings and wider society. Of interest to this research project was the potential for a Place-Based Education approach to bridge this disconnect between young people and science as it is might be traditionally perceived.

6.8 The Wetlands Project

6.8.1 Inception of the Wetlands Project

The momentum for the Wetlands Project originated with interest from the teaching staff in completing a unit of work with a practical environmental regeneration focus. Such a unit would conceivably fit well within a place-based education approach as it would enable young people to become actively involved in a restoration project connected to their own place. Intended as a predominantly outdoors-based unit of work, it would build on students' preference to be involved in hands-on, experiential activities. This focus would also allow students to demonstrate different strengths than those commonly recognized in a traditional classroom setting which might contribute positively to student self-esteem and sense of agency.

6.8.2 Conservation Volunteers Australia

As discussed above, the building of social capital is an important focus for teaching staff at the Outreach. For this reason, staff sought to form a partnership with an outside organization, even though the teacher in charge possessed a background in biological sciences and was well equipped to facilitate the unit. Conservation Volunteers Australia (CVA) was approached as a possible candidate as it is an organization with a strong local presence in the regional community of the Outreach. As well as involvement in a number of environmental projects, the organization acts as a service provider for the Green Corps Australia program which provides training and employment pathways for youth in the area of natural resource management (DEEWR, 2009). In the local area, CVA employs a Coastal Education Officer, Scott Fry, who, upon approach, immediately indicated his willingness to collaborate with teaching staff to develop an environmental regeneration project for the Outreach young people.

6.8.3 Development of the Wetlands Project

It was decided to focus the project on a local wetlands area that was a current CVA regeneration site in order to enable sharing of resources and manpower if required. As well, the Outreach young people would be able to broaden their understanding of local

conservation and land management through witnessing the current work of both volunteers and Green Corps employees. A unit of work was developed by Scott that accounted for the needs of the Outreach young people by emphasizing a practical approach while encompassing authentic scientific and numeracy activities that would arise naturally within the context.

6.8.4 The Wetlands Site Activities

The practical element of the project commenced with the young people being allocated a 10x10m plot at the wetlands site. The site was originally consumed by 2m high guinea grass, a local weed originally introduced as cattle feed. Over a series of 8 weeks, the young people were involved in fairly labour-intensive activities including weeding, digging, mulching and the planting of 100 native plants. Working alongside, Scott shared with the young people his expertise in relation to species identification as well as interdependence and ecosystem relationships. Towards the end of the project, a macro-invertebrate mapping and water quality testing exercise was conducted.

6.8.5 Embedding Indigenous Perspectives

An over-arching tenet of the Outreach philosophy is to respectfully consider multiple perspectives, particularly Indigenous ways of knowing. Hence, initially grounding the Wetlands Project from an Indigenous perspective was considered of key importance. It was decided that the project would commence with a tour by a local Aboriginal guide who would share with the young people traditional ecological knowledge related to native plants and animals, as well as traditional and modern Aboriginal philosophy related to land management and sustainability. In addition, CVA provided a number of locally published resources to support the ongoing incorporation of Indigenous perspectives.

6.8.6 Integration of Multiple Key Learning Areas (KLAs)

The Wetlands Project integrated the KLAs of Science, English, Mathematics and SOSE – both during field-based activities as well as those activities more familiar to a regular classroom setting. Literacy activities were specifically focused on developing relevant vocabulary associated with the wetlands unit of work. Mathematical activities related to the measurement and spatial dimensions of the project. A SOSE focus included discussions around the significance of the wider picture of human activity, ecological sustainability and climate change. It is important to note that the discussion of separate KLAs here is not representative of how the activities were presented to students. A deliberate effort was made to ensure that classroom and practical activities

were seamlessly interwoven and were always relevant and connected to the progress of the wetlands unit. For some young people, completing any type of classroom activity can be a very real challenge, so relevance and purpose as drivers of motivation became a critical factor in engagement.

6.8.7 Assessment

Performative assessment was decided upon as an authentic and inclusive evaluation method for the Wetlands Project. Digital photographs were taken at each stage of the project by both students and staff. A limited access web page was developed on the Ning social networking site to allow young people to upload and share the images with students at other Outreach locations across the state (this was particularly appreciated by students who attend an Outreach located in a remote, desert area of Queensland and have had little exposure to wetland environments). Students were required to rationalize which images were selected as well as provide a short caption providing information about the image. A future intended project is to have the young people develop an instructional booklet to act as a resource for other Outreach groups who might like to complete a similar project.

6.9 Findings

6.9.1 Engagement

A strong indicator of student engagement for the Outreach is simply whether the students turn up for school each day. For the term of the Wetlands unit, the average unexplained absence was 10%, the lowest level of absence since the inception of the program in 2007. It is well worth noting that during the same term teaching staff observed an unprecedented level of family crisis for the young people, lending even greater significance to this data. Student absence has a negative impact on overall learning outcomes for young people attending the Outreach and so investigating factors which might improve attendance is of high importance in this context.

At the commencement of the Wetlands Project, there was some initial discouragement due to the perceived enormity and physical demands of the fieldwork. As well, the physical conditions were difficult in that the project took place in the early part of the year, an extremely hot and humid time in the tropics of North Queensland. Initially, teaching and volunteer staff played a large role in motivating students to engage in the field work, primarily in leading by example and encouraging students. It was often the case that teaching and volunteer staff would initiate involvement, the young people would watch this activity for some time and then, one by one, they would join in.

Whether the students were motivated by guilt or inspiration, the lag time between watching and participating grew shorter at each subsequent field trip and eventually occurred in reverse – towards the end of the project, the young people were encouraging the staff when staff became increasingly deflated by the heat.

An important element related to this change in student engagement that progressed over time might be the horizontal group cohesion that this project enabled. In describing an experience with a Place-Based Education Approach, Smith (2002, p.586) highlighted the fact that teachers acted "more like partners than supervisors". The willingness of teaching staff to actively involve themselves in the laborious activities appeared to motivate the young people and contributed to a sense of group obligation and responsibility.

Teaching staff also perceived that an important factor in engaging students was the immediate evidence of success at the completion of an activity. This occurred from the very first field trip experience. The difference in the wetlands site after the initial weeding was completed was visually startling, particularly as it seemed to take so little time. The transformation of the site from being overgrown with guinea grass to one where just a small number of native plants were visible had a profound effect on both staff and young people. Lewthwaite & McMillan (2010), in their work with Indigenous students in Canada, note the motivating importance of allowing students to 'work to an end' or experience successful completion of a task.

As the unit progressed, students required less and less encouragement or prodding to become involved in either the field work or classroom activities. Instead of standing back as was first the case, students began to ask relevant and pertinent questions both during the fieldwork sessions and as part of discussions immediately following. Students began to actively seek knowledge around the work that they were doing. An excerpt from observation notes below illustrates both the knowledge the students sought and the relationship formed with Scott over the term.

> Student: "Is it true that trees help us breathe?"
>
> Scott responded by explaining that trees convert carbon dioxide into oxygen and this is good for people and for the world. He also talked about trees providing shade and asked the young people to imagine what the world would be like without trees.

Student: “So are you saving us? (*in relation to the work of CVA)*

Scott: “Well, you are saving yourselves with the work you have been doing out at the wetlands”.

For some young people, the act of asking a question indicates a significant step forward in re-engaging with the educational process. As a teacher at another FLC site commented in an interview:

> *Even for these guys to ask the questions and be interested enough to say, why? A lot of the Flexi kids have gotten to the point where they don't ask 'why' anymore, they're not interested in anything that's going on around them. So to get them to ask the question 'why', I think is very important.*

6.9.2 Change in Attitude

The change in general attitude of students over the course of the ten week program was considered quite significant by the teaching staff. Students were initially resistant to the program, particularly in relation to the physical labour involved. However, a change was immediately evident as soon as the students put on their 'work gear' complete with fluorescent shirts and steel capped safety boots. With the physical component of the work supported by more traditional curriculum activities, students came to an understanding and appreciation of the wider environmental significance of their work. To illustrate such a change in attitude, an initial comment was 'You guys are going to waste us (*overwork us*)!' In comparison, towards the conclusion of the project another student exclaimed, 'Hey, we're doing a really good thing for the environment here, aren't we?' They were able to recognize that they were contributing positively to their community.

6.9.3 Pathways to Employment

One of the senior students, a young Torres Strait Islander man who had started to think about transitioning to employment, gained a place in further training with CVA as a result of this unit of work. It is unlikely that he would have done so without having engaged in the Wetlands unit. Previously, the young person hadn't pictured himself as capable of physically laborious work. His success in completing the wetland activities transformed this self-image. As well, entry into the CVA training program required an interview with a panel. It is unlikely the student would have in the past attended or

spoken up in such an interview due to limited experience with non-Indigenous people in such a formal setting. With Scott being part of the interview panel, the student felt comfortable to attend and engage in discussion during the interview. Feedback from the panel indicated that this student was considered one of the best candidates that they had interviewed. Follow-up with this student since he has transitioned from the Outreach Program and commenced training indicate that he has made changes in his lifestyle that support his commitment to the CVA Green Corps, and also increase his overall health and well-being. In this case, a partnership with CVA truly resulted in an increase in social capital.

6.10 Conclusion

The intention of the design of the Wetlands Project was to find an approach that would enable young people who have had limited success with their educational experiences so far, to experience success in a subject that might previously have seemed disconnected from the realities of their lives. In describing education generally, Cope and Kalantzis and the Learning by Design Project Group (2005, p.14) state that:

> *If the distance between the life-world and the learning is too great, the educational effort will be misdirected, compromised or ineffectual. And if there is no distance between the life-world and what is to be learnt, learning will be diminished or illusionary. The distance between the life-world and what is to be learnt must be productive.*

A Place-Based Education Approach was considered the most amenable to bridging this disconnect due to its similarity in philosophy to those approaches that have been seen to work best with young people from diverse backgrounds. The PBE approach also presented possibilities for the development of positive social capital which is considered of high importance by Outreach teaching staff in expanding the pathways available to students.

The student outcomes that have been defined as important, in particular those of student engagement and social capital, may seem to be only of particular significance in this context, however, Brown (2007, p.452) notes that “excluded students hold valuable insights that researchers and practitioners can draw on to improve the schooling experiences of those most vulnerable to academic failure and to social marginalization within and beyond our nation's public school systems”. Overcoming the sense of disconnect that the general population of young people experience in

relation to science education is a challenge that impelled Tytler, in 2007, to call for a ‘Re-imagining of Science Education’. Perhaps further exploration into the merits of a Place-Based Approach can be part of this re-imagining.

6.11 Article Summary

The article within this chapter described the implementation of a wetlands environmental regeneration unit of work with an emphasis on connecting curriculum to self and community. This orientation towards connectedness was developed through a theoretical lens with an emphasis on place-based education and social capital. The groundedness of a place-based approach was realised through the development of a partnership with a local community organisation, Conservation Volunteers Australia (CVA). Key elements of the unit of work included a hands-on and outdoor emphasis, integration of key learning areas, inclusion of traditional ecological knowledge and performative assessment. The findings of the article demonstrated that implementation of the wetlands unit resulted in increased student engagement, as judged by a sharp reduction in daily absenteeism and by young people's increasing willingness to engage in project activities over the course of the unit. The CVA partnership provided further positive outcomes in relation to providing a bridge to increased social capital for FLC young people, and through introducing opportunities for employment. The article conclusion asserted that a place-based approach appeared amenable to the ways of working of Flexible Learning Centres, and opened up possibilities for bridging the perceived disconnect between science education and the needs of disenfranchised youth.

Chapter 7: Case Study 2 - Expecting the unexpected: Engaging diverse young people in conversations around science

7.1 Introduction

This chapter consists of the article "Expecting the unexpected: Engaging diverse young people in conversations around science" which was published in the Australian Educational Researcher journal[19]. Permission to reproduce the approved author version of the article is included in Appendix D. The article was written in conjunction with Todd Alloway, who took responsibility for the teaching of science at the North Queensland Flexible Learning Centre shortly after the commencement of the research project. The unit of work described came about at a time when a new Australian National Curriculum was in the process of being rolled out with an emphasis on including Indigenous Perspective across all mandated key learning areas. This prompted Todd to consider how he might be able to include a greater focus on embedding Indigenous perspectives within the teaching and learning of science. The key findings of the paper indicated that using a dialogic approach to stimulate conversations around culture provided new pathways for engaging young people in science, and created an authentic space for the inclusion of diverse cultural perspectives.

[19] Full reference: Wilson, K., & Alloway, T. (2013). Expecting the unexpected: Engaging diverse young people in conversations around science. *Australian Educational Researcher*. 40(2), 195-206.

7.2 Article Abstract

The issue of limited engagement with science for Indigenous young people in Australia appears to have been sidelined from the mainstream debate around falling rates of engagement with science at the secondary schooling level. The 'closing the gap' mantra of education policy in Australia has seen an extraordinary focus on improving literacy and numeracy outcomes for Indigenous students, which, while valuable, has subsumed the importance of other key learning areas including science. Teachers are soon to be expected to incorporate Indigenous Perspectives within the science subjects of the new Australian National Curriculum yet appear to be under-resourced to meet this challenge to traditional approaches to science teaching. The purpose of this paper is to explore the pedagogy of a teacher working at an alternative secondary schooling site in North Queensland Australia, who volunteered to modify his teaching of science to explicitly incorporate Indigenous Perspectives. The qualitative data collected, through a series of classroom observations and teacher interviews, demonstrates the complex and multi-faceted nature of the science education experience when traditional pedagogical boundaries are dismantled to allow for a drawing upon of the lived experiences of diverse young people. The teacher's ability to embrace this broader vision of science is linked to the inclusive culture of the alternative school environment that is brought into being through a 'common ground' philosophy of mutual respect and democratic relations.

7.3 Introduction – The Missing 'Crisis' in Science Education

The draft national K-10 Australian Curriculum for Science (Australian Curriculum, Assessment and Reporting Authority, 2010, p.1) states that "an issue for science education in Australia is not so much the performance of our students on international tests, but rather student engagement and interest in science". This statement implicitly references the well-documented 'crisis' in science education that has charted the steadily declining interest and engagement of mainstream secondary students in the study of science (Fensham, 2004; Schreiner & Sjoberg, 2004; Tytler, 2007). This emphasis on engagement of the majority of the student population has overshadowed the fact that a significant percentage of the Australian population of secondary students are neither engaged in science, nor are they meeting basic proficiency levels in international tests. Data from the OECD Program of International Student Assessment (PISA) demonstrates that nearly one quarter of students from low SES backgrounds and almost half of Australian Indigenous students are not meeting a very basic level of

scientific literacy (Thomson & De Bertoli, 2008). While "Australia remains committed to the principle of equity and social justice education" (Thomson, De Bortoli, Nicholas, Hillman & Buckley, 2010, p.21) it is evident that there is room to improve the science education outcomes for young people from low SES and Indigenous backgrounds in Australia.

7.4 Catering to the Needs of Diverse Young People

While there is a move towards greater integration of diverse curriculum content through the incorporation of Indigenous Perspectives as a cross-curricula priority in the new Australian National Curriculum for Science, there is minimal recognition of diverse ways of knowing, nor advice to teachers in relation to what might constitute 'culturally affirming pedagogies' (Chigeza, 2011). This is hardly surprising in that there is little empirical evidence available that explores what types of pedagogical practices work to effectively teach secondary science to Indigenous and other groups of marginalised young people in Australia. There is in fact only a small body of local work to draw upon to conceptualise a pedagogical approach suitable for the under-served population of Australian students who might be considered 'non-mainstream' (Lee & Buxton, 2011) in that their particular needs are evidently not being met by traditional approaches to science education.

Chigeza (2011) has suggested that Australian educators might usefully adopt a Freirian derived 'capacity building perspective' in order to better engage non-mainstream students in science. He argues that "a capacity building perspective can empower minority and marginalised students by affirming their lived languages, experiences and knowledge in their learning" (Chigeza, 2011, p.406). This approach aligns with the work of international scholars in the field of engaging diverse young people in science who call for a reflexive approach to science education (Calabrese Barton, 1998) that focuses on both the intellectual resources of the learner, and their cultural funds of knowledge (Gonzalez & Moll, 2002). Central to this approach is placing emphasis on what students know and can do, rather than on what they do not know and cannot do (Seiler, 2001). According to Tobin (2006, p.220), in the context of working with African American students from low income homes, "it is possible that teachers perceive urban youth as lacking the culture they need to support the learning of science and do not recognize the potential of what they can do as a foundation for learning science." It is not too much of a stretch to imagine that educators in the Australian context may have the same limited perceptions of the capacities of non-mainstream students in relation to learning science. Tobin's (2006) empirical work has attempted to capture the ways in

which successful teachers in diverse settings have been able to structure the participation of students, by recognising and engaging with the cultural capital that young people bring from their life-worlds into the classroom. This adaptive approach calls for a new way of educating which emphasizes respect for young people's cultural and linguistic backgrounds, and acknowledges the central role of relationships in engaging diverse young people in science teaching and learning.

In the tradition of Tobin's work, the purpose of the study reported in this paper has been to explore the pedagogical structures of a teacher working to engage diverse young people, in this instance at an alternative or 'flexible learning' secondary schooling site in North Queensland, Australia. The place of science education in flexible or alternative settings is at best tenuous in that it is perceived as a difficult subject for students already struggling with the 'basics'. While studies demonstrate that students attending alternative settings undoubtedly experience greater barriers to academic success than the mainstream population (see, for example, Foley & Pang, 2006), the argument of this paper is that science education may play an important role in more fully realising the intellectual potential of non-mainstream young people.

7.5 The Work of the Flexible Learning Centres

The Edmund Rice Education Australia Flexible Learning Centre schooling model was instigated in south-east Queensland, Australia, twenty-five years ago with the aim of providing an alternative learning pathway for young people who had, for a variety of reasons, found themselves completely disengaged from the mainstream secondary schooling system. As a result of high need and corresponding invitation from communities, the operation expanded from a single site in Brisbane to a network of 11 sites across urban, regional and remote areas of Queensland. In 2012, the Edmund Rice Education Australia Flexible Learning Centre Network (EREAFLCN) continues its expansion nationally to cater for young people in disadvantaged areas of Western Australia, Victoria, New South Wales, South Australia and the Northern Territory.

Young people attending these centres have often experienced complex life circumstances including homelessness, contact with juvenile justice and child safety systems, young parenting and disability (EREA, 2010). They have also generally experienced large gaps in their schooling (due to school absence, suspension and/or expulsion) which has had a negative impact on the development of their basic academic skills, particularly in relation to literacy and numeracy. Young people across the network come from diverse cultural backgrounds and those who identify as

Indigenous Australians comprise a large percentage of the student cohort in regional and remote locations.

7.5.1 Values

Key to the EREAFLCN approach is recognition of the strengths that students bring to the educational setting, and an organisational philosophy that encourages teachers to be innovative in finding ways to foster these unique abilities. The key values that guide teaching and curriculum development are that of *Relationship, Community, Safety, Learning, Transformation and Eco-justice*. These are in turn connected to an internally developed four pathways enlightenment model – *widen your options for wonder, be courageous, dare to dream and make a difference* (Morgan, 2009). Underpinning both of these models, and in alignment with the recently developed Australian National Curriculum, is a commitment to including Indigenous Australian Perspectives and Sustainability Education.

7.5.2 Respectful Relationships

'Respect' is the first of four guiding principles (*Respect, Safety, Participation & Honesty*) that frame the common ground philosophy of the Flexible Learning Centres. The concept of 'common ground' emphasizes the democratic and relational (EREA, 2004), and applies to both adult staff members and young people who choose to participate in the Flexible Learning Centre program. Respectful relationships are the core business of the Flexible Learning Centre and this is reflected through curriculum documents published on behalf of the EREAFLC Network:

> *Relationships within the program are based on a respect for personal dignity and recognition of difference (EREAFLCN, 2008, p.5).*

Exploring the multi-dimensional nature of 'relationship' in the Flexible Learning Centre context is key to developing an understanding of the pedagogical practice that enables previously marginalised young people to find pathways of re-engagement within a program of science education.

7.6 Project Methodology

The project described here forms part of a larger study exploring the role of science education in re-engaging disadvantaged youth. This four year project has involved working in partnership with teaching staff at a Flexible Learning Centre site in North Queensland, to trial and self-evaluate units of work embedded within a socio-cultural perspective of science teaching and learning. Data sources have included classroom

observation notes acquired through extended time in the field, semi-structured interviews with teaching and support staff and a review of key organisational, policy and curriculum planning documents. Qualitative analysis of this data through a process of coding and progressive focusing (Simons, 2009) has been directed towards producing case studies which illuminate the range of pedagogies employed by Flexible Learning Centre staff in order to engage diverse young people in science.

7.7 The North Queensland Flexible Learning Centre

The North Queensland Flexible Learning Centre is situated in a regional town of the tropics with a population of close to 200 000 people. The centre is registered as a secondary special assistance school and enrols up to 110 young people (attendance and enrolments fluctuate). There is a slightly higher ratio of male to female students, and approximately 47% of the young people attending the North Queensland centre identify as Indigenous. The centre aims to provide:

> *…holistic learning experiences that address the social needs of young people, and promotes their emotional, cognitive, spiritual and academic development. The purpose of the learning experiences is to empower young people to take personal responsibility for their actions and learning, achieve greater autonomy and self-reliance and to engage in the transition to further education and/or employment (EREAFLCN, 2010, p.2).*

7.7.1 School Description

The school is comprised of a series of brown brick buildings that form an L shape around a central courtyard. This courtyard acts as the heart of the school and is the place for whole school meetings and community celebrations. The walls surrounding the courtyard are brightly decorated with student paintings of totem animals that have personal and community significance. The school principles of Respect, Participation, Safety and Honesty are prominently displayed on a sign at the corner of the courtyard and close to an outdoor manual workshop area. Adjoining the courtyard is a large kitchen and eating area that acts as a communal space for preparing and sharing food. It is here that young people are often greeted for the day as they receive breakfast from teaching staff and from their peers working in the kitchen. The sliding glass doors of the kitchen are lined with curtains handmade by students and the walls inside the eatery are decorated with photographs of young people engaging in Flexible Learning Centre activities.

7.7.2 Teaching and Learning at the Flexible Learning Centre

The key to effective teaching at the Flexible Learning Centre is creating the optimum conditions to enable young people to participate in learning activities. This is in itself a challenging task as young people's attitudes towards learning are often apathetic - coloured by prior negative schooling experiences that might include significant academic failure, social isolation and school exclusion. Reconnecting young people with education involves firstly identifying where each young person is at – both academically and socially - and then ascertaining what they need to build for themselves a 'good life', on their own and their community's terms. Teaching staff balance necessary remedial work in literacy and numeracy skill development with opportunities for young people to demonstrate their talents in thinking creatively and in completing performance based tasks. Curriculum content is chosen on the basis of relevance to young people's interests, connection to community and place, and scope for incorporation of experiential learning activities.

7.7.3 Teacher Co-Participant

The teacher co-participant in this study, Todd[20], of white middle-class background, had recently commenced work at the Flexible Learning Centre after having spent six years teaching Physical Education, Science, Mathematics and IT at a secondary boys' college. Holding a Bachelor Degree in Exercise Science with requisite course content including the subjects of Physiology, Biology, Physics and Chemistry, Todd was confident in his own ability to teach science content and concepts. His teaching philosophy centred upon helping students to understand the conceptual underpinnings of science, a philosophy many times reiterated in conversations and interviews and exemplified in the statement - "if they know the concept, they can figure things out from there". In the Flexible Learning Centre context, Todd was dedicated to re-igniting a sense of curiosity in young people, explaining:

> *A lot of the Flexi kids have gotten to the point where they don't ask 'why' anymore, they're not interested in anything that is going on around them. So to get them to ask the question 'why', I think is very important.*

As an experienced teacher, Todd had a well-developed suite of pedagogical tools to engage young people in the teaching and learning of science. However, his prior teaching experience and training had not provided a great deal of scope for the

[20] The teacher participant, Todd, as co-author of this paper, has chosen to be identified.

integration of the social and cultural aspects of science related topics. Todd was keen to trial the integration of Indigenous perspectives in science and hoped to broaden his own traditional delivery repertoire to better reflect the historical, cultural and social elements of science as a field of human inquiry (Lemke, 2001).

7.8 The Solar Oven/Alternative Energy Unit

The unit of work from which the following lesson micro-analysis derives was intended as an exploration of the science concept of energy. The key concept was contextualised through an alternative energy focus, with the primary practical activity being the construction of a functioning solar oven. The topic was selected on the basis of pragmatics, in that the teacher had taught a similar unit of work in his previous school and so was familiar with the necessary content, as well as for the affordance of the topic to breadth of inquiry and the potential integration of both Indigenous and Sustainability perspectives. Physical resources to support the inclusion of diverse perspectives were provided by the research team, including hard copy materials detailing traditional Indigenous stories of sun and fire, and digital resources to enable exploration of alternative energy and related sustainability topics. While Todd made use of, and appreciated, the provision of educational resources to support the topic, the actual integration of diverse perspectives that occurred throughout this unit of work ended up being more of a result of Todd's ability to engage his students in conversations around culture and their own lived experiences, rather than through the addition of culturally appropriate content to the curriculum. It appeared that once Todd had set his mind to grounding the unit from a social/cultural/historical perspective, he was then able to move back and forth between exploring these elements and making explicit connections with science to enhance student learning and engagement. The following description of the very first lesson of the unit of alternative energy work demonstrates how opening a dialogic space in the science classroom both engages young people, and simultaneously allows for a more natural and authentic inclusion of diverse cultural perspectives.

7.8.1 Lesson Vignette

The lesson described here was in the fact the very first 'formal' science lesson for junior students that had taken place in the Flexible Learning Centre within a timetabled slot dedicated especially to science. Todd's original intention for this introductory lesson was to assess students' background knowledge of the unit topic, connect to their real world experiences and foreground a sense of purpose for the unit. However, his opportunity to cover these aspects in depth was somewhat constrained by the

truncation of his science lesson due to a whole school morning meeting running considerably over time. With young people at the centre prone to noting the exact minute when morning tea and lunch were due, extending the lesson into break time was not a viable option, and so Todd was forced to compress his 40 minute teaching sequence into a 15 minute timeframe.

The lesson took place in a computer room due to a lack of a designated science or open learning space in the school at that time. The setting was not ideal as students were distracted by the presence of the computers, which they intermittently played with or, in one instance, accidentally toppled onto the floor. The room itself was narrow and seemed overcrowded with computers, desks, chairs and fourteen restless students. Todd compensated for the shortcomings of the setting by forming a circle of chairs in the centre of the room creating a sense of connection through proximity. He maintained a continuous dialogue with the young people throughout the lesson and did not move from the circle to write on the available white board - a move which may have resulted in a breaking of the flow of conversation. The student group itself comprised of three female students and eleven male students. Although outnumbered, the girls in the group appeared more confident than the boys in contributing to the class talk and did in fact dominate much of the discussion. Through the course of the lesson, it was made evident that the students had limited previous experiences with school science with only two students out of fourteen recalling any science experiences whatsoever – one having obtained a 'bunsen burner licence' and another having completed a unit on meteorology.

Todd introduced the unit to students by posing the open-ended question – What is science? While student responses ranged from 'experiments and stuff' to some of the boys yelling out 'I don't know', one young Indigenous girl, Kira[21], offered that 'science is literacy' and 'science is history'. Building on Kira's response, Todd advised the class that the unit of work for the term would include looking at history and culture in relation to science. His reference to culture prompted Kira to then ask 'Do white people have culture?' In a typical classroom, this type of question might be shut-down by the teacher in that it would seem outside the boundaries of a science discussion. However, Todd saw the potential of this student question in relation to creating an entry point to interest the class in exploring the connections between culture and science. He proceeded to engage in a discussion about culture with students, explaining that

[21] All student names are pseudonyms.

everyone has culture and that culture is not static – a concept then further explained by referencing the traditional and the here-and-now. Having captured the students' attention, he then broadened the discussion to include reference to the divergence in Indigenous culture related to place and geography, and the development of different ways of being for different groups of peoples. This provided an opportunity for a hitherto uninvolved male student to participate in the discussion in the form of advising that 'at one stage there were 140 different groups of Aboriginal peoples.'

In the meantime, Kira continued to persist with her original line of inquiry in relation to whether there is such a thing as white culture. She regained Todd's attention and demanded to know exactly what constituted white culture. This sparked an animated class discussion highlighted in the excerpt from the lesson observation notes below:

> *Kira asks Todd directly what his culture is. He states that he is Australian. Kira argues that his family hasn't been here very long whereas her family has been here 'generation after generation after generation' (indicated also with cyclic hand movement). Todd discusses that people can be included in many cultures so that Kira is part of Aboriginal Australian culture as well as wider Australian culture that he (Todd) is also part of. Kira still wants to know where White people's culture comes from. Other students try to help out. They talk about people all over the world coming from one place originally. Geraldine mentions that the world was 'all together' and then it split up. One boy asks if everyone spoke the same language then? (when the world was all one place). Another boy asks 'why people got black?'*

Todd attempts to answer the last question posed in this quickly flowing conversation by providing a brief overview of the theory of human evolution and environmental adaptation, but, compressed for time, is forced to move the conversation onto introducing the unit topic of solar ovens. He proceeds to ask the group how they think solar ovens might work. Kira and Geraldine explain the solar oven process in terms of making electricity and taking energy from the sun. Todd builds on this discussion of energy and begins using the term more frequently in the following discussion. He inquires of the group as to whether they have had any previous experiences with solar ovens and Geraldine offers 'that's how they might cook the snake in the desert'. Jerry joins in to the discussion for the first time by explaining how kangaroos are cooked, contributing a fairly graphic description of taking the legs off a kangaroo and putting it

on a spit. This provides a lead in for Todd to discuss traditional cooking methods in different cultures and to add a sustainability slant to the conversation.

In relation to environmental sustainability and cooking, Todd begins a discussion about totems and skin groups. He explores the idea of cultural restrictions on hunting totem animals that, as well as a spiritual purpose, serves an environmental purpose of protecting different species from over-hunting. Kira offers that her totem animal is the dugong. Davey, a non-Indigenous student, asks Todd if he has a totem animal. Todd explains that the use of different totems and even the concept of totems is specific to particular peoples and their places in that, some groups of Indigenous peoples may not have 'totems', they may have different spiritual beliefs. As the lesson comes to a close, Todd states that, for homework, students need to have a chat with people at home about cooking and what family members might know about traditional cooking methods.

7.9 Analysis - The Nature of Student/Teacher Interactions in the Classroom

In Jay Lemke's exploration of language and communication in the classroom (1990), he describes the typical course of dialogue in the science classroom as following a triadic dialogue pattern: Teacher Question – Student Answer – Teacher Evaluation (or Question-Answer-Evaluation). The purpose of such dialogue is to establish student mastery of the science content delivered and to check for student understanding. This form of dialogue pattern is also understood as a form of closed questioning in that the teacher is aware of the answer before the question is proposed. In the FLC case study, the teacher naturally asks questions of students but these are more open-ended and rarely have prescribed responses. Whereas the first science lesson of the year in a typical secondary classroom might commence with an introduction to the basics of school science, Todd began his unit by asking a contestable question in the form of 'What is science?' He immediately created a space for different interpretations of science, and opened the door to an unexpected line of inquiry that serendipitously followed his intended path of exploring culture in the context of science. The question of 'what is science?' evidently piqued the ongoing interest of some students who, throughout the course of the unit, continued to pursue connections to the nature of science, often asking the teacher 'so, this is science too?'

Further exploration of the role of questioning in this particular classroom reveals that teachers and students appeared to have equal status in relation to posing questions.

The teacher would put forward questions to stimulate discussion but would also 'take questions from the field', so to speak, and would adjust his own course of action for the lesson to incorporate the needs and interests of students. This is exemplified in the case of the student asking the teacher 'Do white people have culture?' Rather than redirecting the student to the topic at hand, ostensibly discussion of the nature of science, the teacher instead allowed space for a new line of inquiry. The class group as a whole then became highly engaged in this peer initiated discussion, and the ensuing dialogue provided useful teacher information in relation to topics of interest for future science inquiries. In relation to Todd's own teaching aim of overcoming student apathy towards learning in the FLC context, students' willingness to participate and contribute towards this discussion evidenced the value of broadening the boundaries of dialogue in the science classroom.

An additional important element of the nature of teaching interactions in this study is that student questions are treated as legitimate inquiries and are responded to comprehensively and in depth, as exemplified in Todd's response to the young person who posed the question 'Why people got black?'. The content of the teacher response is not in any way dumbed-down and students are positioned as capable learners (Seiler, 2001) who are capable of grappling with complex concepts. Todd confirmed in a post-unit interview that he engages in dialogue with students at the Flexible Learning Centre in the same manner as he would in any other educational setting, and that the concessions he makes for learning to meet the needs of FLC students relate to literacy rather than intellectual demands. Overall, while this short lesson excerpt cannot capture the breadth of the teaching and learning activities that occurred over the course of the entire alternative energy unit, it does reflect the key elements of Todd's pedagogical practice that allowed him to go on to develop further successful science-related interactions with the diverse young people in his classroom.

7.10 Transferability to Other Contexts

Seiler (2011, p.1) poses a pertinent question in asking:

> *How can teachers enact a curriculum that is responsive to students and emergent from them when teachers are under enormous constraints to cover specific course content and to prepare students for standardized tests?*

It is the case that teachers and young people at Flexible Learning Centres are not constrained by the demands of standardized testing due to their classification as a

Special Assistance School. However, teaching staff in this context face multiple other stressors including limited resources, extremely negative student attitudes towards schooling, aggressive behaviours, high rates of absenteeism and the presence of learning disorders and disabilities. Enacting a quality curriculum is a daily challenge in this particular milieu, yet teachers strive to be responsive to young people's complex needs and to provide a sufficiently broad curriculum to allow for the diverse career pathways that students may choose to follow.

The intention of this article has been to demonstrate that it is indeed possible to engage non-mainstream young people in science, but it requires a different way of educating and the opening up of participative spaces for diverse voices and experiences. It provides a brief snapshot of a different classroom dynamic where:

> *Through dialogue, the teacher-of-the students and the students-of-the teacher cease to exist and a new term emerges: teacher-student with student-teachers. The teacher is no longer merely the one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach. They become jointly responsible for a process in which they all grow (Freire, 1993, p.265).*

As the brief lesson analysed within the paper indicates, such dialogue does not necessarily take up a great deal of time, but instead requires consideration of how teachers and students are positioned in the classroom, and whose voice is privileged the most. Aligning with a socio-cultural approach to science education, such pedagogical practice requires reflexive consideration of the "kinds of personal identity and cultural values our science teaching accepts, respects or is compatible with" (Lemke, 2001, p.300).

7.11 Conclusion

It is not acceptable to have a large proportion of the Australian student population leaving school with rudimentary science knowledge and a potential life-long apathy to science learning. As educators, we need to continue to explore ways and means of bringing marginalised young people back into the centre of science learning. This paper is a short exploration into the practices on one teacher who has demonstrated a willingness to expand his practice repertoire to make room for student voice and dialogue. It is intended to act as encouragement to other teachers who hope to continually reinvent their pedagogy to better meet the needs of all of their students.

7.12 Article Summary

The article within this chapter described the implementation of an alternative energy/solar oven unit of work, with an emphasis on embedding Indigenous Australian perspectives. The inclusion of diverse cultural perspectives was theorised through a Freirian capacity building perspective that was found to align with the principles of culturally responsive science education pedagogy. The enactment of a culturally responsive approach was explored within the article in the context of an introductory lesson that provided a serendipitous opportunity to work with students to connect the study of science with culture. By posing open-ended questions and following students' lines of inquiry based on their own interests and curiosities, the teacher was able to engage the class in an animated and lively conversation. Through the use of dialogue, issues of culture and cultural practices were explored in a way that was personally relevant to students' own experiences and everyday realities. Diverse perspectives were then embedded through drawing upon the cultural capital of students, rather than looking to outside sources of cultural content. The article conclusion asserted that privileging the voices of students opens up new possibilities for engaging diverse young people in science.

Chapter 8: Case Study 3 - Exploring ICT integration as a tool to engage young people at a Flexible Learning Centre

8.1 Introduction

This chapter consists of the article "Exploring ICT integration as a tool to engage young people at a Flexible Learning Centre" which was published in the Journal of Science Education and Technology[22]. Permission to reproduce the approved author version of the article is included in Appendix E. The article was written with Suzi Boldeman who was, at the time of the writing of the article, a newly appointed teacher at the North Queensland Flexible Learning Centre. Suzi indicated an early interest in participating in the project and was keen to explore strategies for using ICT to engage FLC young people in science. The unit of work described within the article was formed to capitalise on Suzi's keen interest in working with web-based technologies and reflected her personal belief that ICT acts as an 'equalizer' in the FLC context – allowing young people who might not experience success in traditional school-based subjects to take on the role of 'expert' when working within the sphere of ICT. The key findings of the paper demonstrated that the use of ICT was a potent means of engaging young people in the FLC context, and could additionally serve as a bridge to connect science education and the modern realities of young people's everyday lives.

[22] Full reference: Wilson, K., & Boldeman, S. (2011). Exploring ICT Integration as a Tool to Engage Young People at a Flexible Learning Centre. *Journal of Science Education and Technology, 21*(6), 661-668.

8.2 Article Abstract

The Edmund Rice Education Australia (EREA) Flexible Learning Centres aim to provide a supportive learning environment for young people who find themselves outside of the mainstream secondary schooling system. Drawing on 21st Century learning principles, the Centres aim to deliver a personalised learning experience with an emphasis on flexibility and individual choice. Provision of a comprehensive curriculum enables young people to make positive future life choices and successfully transition into employment and further training. The aim of this research project has been to work with teaching staff at a Flexible Learning Centre in North Queensland, Australia, to explore the value of integrating ICT in the form of Web 2.0 technologies to enhance young people's engagement with the subject of science. The findings of this case study suggest that ICT integration is effective in revitalising science education interest for disengaged young people. This may have wider implications in relation to general concerns of declining student interest and participation in science in the secondary years of schooling.

8.3 Introduction

Education commentaries refer to the need for students to develop a repertoire of 21st century skills and competencies in order to successfully transition from school to further education and work. Competencies considered vital for success in the 21st century workplace include the ability to problem-solve, think creatively, collaborate and innovate (Cisco, 2007). Development of these 21st century competencies is aligned to a pedagogical approach that emphasizes personalised learning, reinvigorated educational spaces and innovative curriculum delivery (Leadbeater, 2008). Pivotal to this type of learning is the application of innovative information and communication (ICT) technologies that best allow educators to facilitate contemporary forms of teaching and learning (MCEETYA, 2005).

However, meeting the challenge of ICT currency is no easy task for schools in that "digital technologies morph and change quickly at a rate that generally outpaces curriculum development" (Johnson, Smith, Willis, Levine, & Haywood, 2011, p.4). Schools are often left 'behind the times' with outdated forms of hardware and software, as well as organisational restrictions in relation to how they engage with more modern ICT tools such as Web 2.0 technologies. Compounding challenges include a lack of teacher training and ongoing professional development in the best use of newer technologies, as well as a shortage of practical examples in relation to how these might

be employed to increase both the engagement and future success of diverse student cohorts (Walsh, Lemon, Black, Mangan & Collin, 2011).

This paper hopes to contribute to an identified gap in the research field by providing a practical example of engaging diverse young people through the incorporation of newer technologies. This study forms part of a larger Australian Research Council project titled 'Re-Engaging Disadvantaged Youth Through Science', which explored the potential of engaging marginalised young people through the medium of science and technology education. The aim of the case study reported within this paper has been to investigate how ICT (specifically a selection of Web 2.0 tools) might be integrated into a unit of science education work, to cater specifically to the engagement needs of students who have found themselves positioned outside of the mainstream schooling system and instead attend a Flexible Learning Centre.

8.4 The Flexible Learning Centre Context

The Edmund Rice Education Australia Flexible Learning Centre Network (EREAFLCN) commenced operation in Queensland, Australia, twenty-five years ago with the aim of providing an alternative learning pathway for young people who had found themselves completely disengaged from the mainstream secondary schooling system. Young people attending these centres come from diverse cultural backgrounds and have often experienced complex life circumstances including homelessness, contact with juvenile justice and child safety systems, young parenting and disability (EREA, 2010). They have also generally experienced large gaps in their schooling due to school absence, suspension and/or expulsion which has had a negative impact on the development of their basic academic skills.

While the personal challenges young people face can at times seem insurmountable, they bring many unique talents that have often remained unrecognised in the mainstream schooling setting. Being tracked into lower ability classes with an emphasis on remedial literacy and numeracy work has in many cases denied young people an opportunity to demonstrate their often considerable talents for creativity, design and problem-solving. Key to the EREAFLCN approach is recognition of the strengths that students bring to the educational setting and an organisational philosophy that encourages teachers to be innovative in finding ways to foster these unique capabilities (EREA, 2010).

Drawing on 21st Century learning principles (Leadbeater, 2008), the Centres aim to deliver a personalised learning experience with an emphasis on flexibility and individual choice. Anticipated educational, economic and social outcomes for young people attending these centres include completion of secondary certificates of education, attainment of introductory and advanced level vocational qualifications, successful transitions into traineeships and apprenticeships, securing of safe housing and the development of positive relationships with individuals and the wider community.

Engaging young people in a full suite of educational activities, encompassing all key learning areas as prescribed by both state and national curriculum documents, is vital in ensuring that post-school options for students are broad rather than limited in scope. Provision of a comprehensive curriculum enables young people to make positive future life choices and successfully transition into employment and further training. Equity and necessity demand the inclusion of science within the education program, however, young people often resist engaging in the subject due to preconceptions that science is both 'hard' and 'boring'.

8.5 Student Engagement with Science

The issue of student engagement with the subject of science remains a key concern for educators both internationally and nationally. Fensham notes mounting international concern about the "failure of recent school science curricula to foster interest in science as a career or as a lifelong interest" (2004, p.1). He highlights disengagement in science as the greatest contemporary problem facing science educators (Fensham 2004). In the Australian context, Tytler (2007) calls for a 're-imagining' of science education in order to combat the evidence of a continuing decrease in student enthusiasm for science subjects and related career pathways. The draft national K-10 Australian Curriculum for Science (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2010, p.1) states that "an issue for science education in Australia is not so much the performance of our students on international tests, but rather student engagement and interest in science".

The Relevance of Science Education Project (ROSE) identified key affective dimensions related to student engagement and interest in studies of science and technology. Primary elements included students' attitude to, and appreciation of, science and technology as human constructs or achievements. The ROSE study highlighted the importance of affective outcomes in relation to students' personal and potentially life-long orientations towards science as a field of interest (Schreiner &

Sjoberg, 2004). While a considerable body of research has been dedicated to exploring the affective dimensions of engagement and their impact on student learning in the mainstream schooling context, there is little data available in relation to how disengaged young people might be encouraged to develop a positive orientation towards science and technology.

8.6 The Role of ICT in Enhancing Engagement for Disadvantaged Young People

According to a recent report by Walsh et al. (2011) that provides a comprehensive overview of the role of technology in engaging disenfranchised youth, the continued emergence of new information and communication technologies (ICT) represents a valuable opportunity for finding novel and innovative ways to reconnect disengaged young people with an educational or training program. Within the report, ICT is understood as a broad term encompassing applications of technology including the Internet, mobile phones and devices, gaming, assistive technologies, digital photography, music and media production. The authors note the prevalence of personal ICT use by young people, further supported by data from the Australian Bureau of Statistics (ABS) that indicates 96% of 12-14 year olds in Australia access the Internet and 76% of the same age group own a mobile phone. Young people "use ICT frequently and in a variety of ways; as a source of information, entertainment and social communication" (ABS, 2011, p.1). While there is some disparity in relation to access across socio-economic groups, those young people who cannot access online activities at home often make use of school facilities, resulting in an across the board high level of overall access for young people living in Australia. According to Walsh et.al (2011, p.2):

> *…even those young people who are typically most at risk of disengagement from learning expect ICT to play an integral role within their daily lives. They also expect it to play an integral role in their learning. Young learners want and expect flexible and engaging learning environments that effectively use ICT.*

8.7 Flexible and Engaging 21st Century Learning Environments

Common characteristics referred to in descriptions of an ideal 21st century learning environment include an emphasis on personalised learning, provision of dynamic learning spaces and integration of new and emerging technologies (see, for example, Keamy, Nicholas, Mahar & Herrick, 2007; Leadbeater, 2008; Walsh et al., 2011). According to the MCEETYA *Learning in an Online World* series of publications,

"pedagogies that integrate information and communication technologies can engage students in ways not previously possible, enhance achievement, create new learning possibilities and extend interactions with local and global communities" (2005, p.2). Teachers are encouraged to integrate ICT into their pedagogies in order to motivate and engage their students; personalise learning; engage with diversity to support inclusiveness; develop ICT literacies; establish communities of learning; and assess progress and evaluate teaching (MCEETYA, 2005). However, despite these calls for a more personalised and integrated pedagogy to suit the 21st century learner, Walsh et.al note that "there is still a marked lack of reliable and original research and evaluation in relation to the use of social or interactive technologies in pedagogy" (2011, p.3).

8.7.1 21st Century Learners and Web 2.0 Technologies

21st century learners are commonly described as 'digital natives' and their approach to learning is influenced by "their expectations of 24 hour a day, seven days a week, three hundred and sixty five days a year multiple media communications" (MCEETYA, 2005, p.4). Young people today are generally accustomed to the more recent Web 2.0 technologies including blogs, wikis, multi-media sharing sites, podcasting and social networking. This latest platform of technologies is underpinned by a changing communication interface with an over-arching orientation towards collaboration, contribution and community (Anderson, 2007). Such a shift in the way people communicate, create and share information requires young people of today to develop a different skill set than that of the previous generation (McLoughlin & Lee, 2008). However, according to Cisco (2007, p.6) "there are limited opportunities to leverage the creative and collaborative capabilities of Web 2.0 technologies in the classroom".

8.7.2 Mobile Devices and Applications

According to the 2011 Horizon Report, mobile devices (including phones, iPads and similar 'always connected' devices) are near term adoption technologies set to change the educational interface over the next twelve months. As access to affordable and reliable networks continues to grow, mobile devices are becoming increasingly popular across the world as a primary means of accessing the Internet (Johnson et al., 2011). In terms of equity, mobile devices allow a larger proportion of the population to access online resources and Walsh et.al (2011) note that mobile phone ownership is rapidly becoming ubiquitous, even in highly disadvantaged contexts. The Horizon Report highlights the need to find ways to take advantage of a technology that nearly all staff and students carry in an educational setting, and that provides instant access to information, social networks and tools for learning and productivity (Johnson et al.

2011). As innovation in mobile device development continues at an unprecedented pace, they become increasingly useful in education settings as a means of integrating ICT with minimal financial outlay and a reduced need for IT or support staff. Mobiles provide a range of educational opportunities which may take the form of electronic book readers, applications for creation and composition, digital capture and editing, self-study, reference and drill and practice applications (Johnson et al., 2011). MCEETYA consider mobile devices as vital components of an ICT rich learning space (2008), yet despite this, only a very small number of practitioners report using mobile devices or applications in their classrooms (Walsh et al., 2011).

8.8 Project Methodology

The project described here forms part of a larger study exploring the role of science education in re-engaging disadvantaged youth. This four year longitudinal project has involved working in partnership with teaching staff at a Flexible Learning Centre site in North Queensland to trial and self-evaluate units of work with a science education emphasis. Data sources have included classroom observation notes acquired through extended time in the field, semi-structured interviews with teaching and support staff and a review of key organisational, policy and curriculum planning documents. Qualitative analysis of this data, through a process of coding and progressive focusing (Simons, 2009), has been directed towards producing case studies which illuminate the range of pedagogies employed by Flexible Learning Centre staff in order to engage diverse young people in science. It is a study of the particular in depth and as such, employs non-cross-sectional data organization to enable examination of discrete parts of the overall data set (Mason, 2002). This allows an analytical understanding of the distinctiveness of elements of the data set, which, for this particular case, is centred upon determining the relationship between ICT integration and student engagement with science, in the context of a North Queensland Flexible Learning Centre.

8.9 The North Queensland Flexible Learning Centre (FLC)

The North Queensland Flexible Learning Centre is situated in a regional town of the tropics with a population of close to 200 000 people. The centre is registered as a secondary special assistance school and currently enrols approximately 85 young people (attendance and enrolments fluctuate). There is a slightly higher ratio of male to female students and approximately 40% of the young people attending the North Queensland centre identify as Indigenous. Through the recent provision of government funding, the school is gradually transforming from a fairly basic facility of a series of small classrooms to a more dynamic learning space incorporating new hospitality,

music and outdoor facilities, as well as a proposed science laboratory and manual arts working area. However, until the new science laboratory is built, there exists no dedicated science space or area to store related work items which requires teaching staff to be inventive with everyday items and the facilities at hand. While comparatively under-resourced in the science department, the centre is well-resourced in terms of ICT. The centre has two computer labs available with good quality hardware and software, Internet access, digital cameras and recording devices and a recent acquisition of a set of iPads. Teaching staff at the centre readily integrate the use of ICT in their classroom activities due to its widespread appeal across the student cohort. However, the integration of ICT with science has yet to be fully explored due to the sometimes tenuous position of science education within the FLC curriculum. With few facilities and resources available to support a science program, it requires a motivated teacher to take on a subject that the majority of young people resist engaging with.

8.9.1 Potential of ICT in Engaging Young People in Science in the FLC Context

Young people attending the Flexible Learning Centres are prolific users of technology, with the majority owning at least one form of mobile device with online capabilities. In a context where it can be challenging to engage young people with learning, it can be ironically difficult to disengage them from their mobile devices. While it is not supposed that the nature of these activities are necessarily educational (and authors such as Kimber & Wyatt-Smith (2010) indicate that much youth online activity is in fact banal and superficial), it would be remiss to ignore the opportunity to build on the ways young people are constantly engaging with this technology for their own purposes.

It is through this medium that young people appear to indulge their natural curiosity in science related topics. While their own investigations appear to be somewhat indiscriminate, they often report information that they have discovered via media-sharing sites such as YouTube, and even social networking sites such as Facebook, that would indicate an orientation towards science learning. However, when science is introduced as a topic in the school setting, the student response is often demonstrably negative. The intention of the ‘rocket science’ project has been to create a learning environment evidencing greater seamlessness between ICT and science, in order to enhance young people’s overall engagement with science and technology.

8.10 The Junior Rocket Science Project

8.10.1 Teacher background

The teacher and co-author of this report is an early career professional in her mid-20s. Her teaching experience has incorporated both primary and secondary settings, with her current role at the Flexible Learning Centre requiring her to broadly teach across the junior secondary curriculum. As a relatively young person, the teacher is at home with Web 2.0 technologies including the latest generation of mobile devices, and is a frequent user of media sharing platforms such as YouTube. While her own experiences of school science were characterised by minimal engagement, she was able to pursue a personal interest in science activities outside of school hours, a contributing factor to her belief in the need for science to be hands-on, practical, fun, creative and contemporary. Her vision of science education for young people at the Flexible Learning Centre focuses on the establishment of a supportive atmosphere that encourages students to try new things, learn from failure and support each other in collaborative endeavours.

8.10.2 Student Participants

Students at the Flexible Learning Centre are streamed into Junior and Secondary Classes but remain with the same teacher for the majority of schooling time, primarily in recognition of the importance of consistent teacher-student relationships in improving outcomes for disengaged young people. While requiring a broader range of subject mastery on the teacher's behalf, this beneficially enables easier subject integration, as the same group of students remain with the same teacher for most learning experiences. The group of all male students who participated in this study comprise half of the junior cohort of the Flexible Learning Centre with a median age of 14. Young people in this class are still in the early stages of re-engaging with the learning process and often struggle to participate. Significant literacy challenges contribute to a disinclination to participate in written activities, which often manifests in shut-down behaviours. Additionally, some students in this class have a recognised learning disability that negatively impacts on academic progress as it is traditionally recognised.

8.10.3 Project Impetus

The impetus for this project arose through informal conversations between the researcher and teacher as to how science might be incorporated into the following term's learning activities. Drawing on her remembered positive experiences with science, the teacher had brought in backyard experiment books from her childhood, and had asked for assistance in building on these simple activities to create a unit of work. She was aware that she would have a challenge on her hands in engaging

students as most students reported prior negative experiences with school science. However, through a process of student consultation, she was encouraged to note some enthusiasm towards science as it exists outside of the school domain. Realising that students primarily accessed science content of their own interest through the conduit of television and the Internet, she intended for the unit of work to make best use of visual information sources. She hoped that such use would engage students in the topic of study and also assist those who struggle with literacy to process necessary content, thereby enabling full participation in class activities.

8.10.4 Coke and Mentos Activity

The first activity trialled with students to attempt to engender some initial interest was the Coke and Mentos 'geyser' experiment, made familiar by the TV program Mythbusters. The teacher and students used their classroom set of iPads to research associated YouTube clips, and then replicated the activity outside at school. Students performed the experiment in a variety of ways, intuitively testing different variables to measure the associated effect on the height of the Coke/Mentos reaction. After completing the practical activity, students then watched the related Mythbusters episode via YouTube, in order to understand in more depth the science behind the experiment. That they were absorbing rather than just viewing the video is evident in students' write-up of the activity, where explicit reference was made to the scientific content explained in Mythbusters. The fact that students were even willing to try writing up a report on the activity was considered a good sign in relation to engagement, and reinforced the teacher's perception that the combination of YouTube, practical activities and later reinforcement of scientific content was instrumental to encouraging young people's participation in science.

8.10.5 The Water Bottle Rocket Unit

Capitalising on students' evident interest in YouTube, the teacher modified her original unit of work (which had a greater emphasis on chemical reactions) into one with a focus on water bottle rockets, which was well-supported by video material within the YouTube platform. Coincidentally, there was a state-wide competition for school students to compete in a water rocket bottle challenge which provided additional momentum for the unit of work. Overall, the Water Rocket Bottle topic was considered conducive to seamless integration of ICT, and an experiential orientation towards science learning.

The core activity of the unit was the development of a water bottle rocket through a cyclic prototyping process of design, testing, evaluation and modification. A water rocket is a chamber (usually a plastic soft drink bottle) partially filled with water. Air is forced inside using a pump (or air compressor). When the rocket is released, the pressurized air forces water out of the nozzle (bottle spout) and the bottle launches itself in the opposite direction. Testing the effectiveness of modification of different rocket design elements allows students to conduct 'fair tests' and gain experience in controlling and manipulating variables.

The water bottle rocket activity is particularly effective in demonstrating Newton's third law, that for every action there is an equal and opposite reaction. In the case of real-life rockets, the action is the force produced by the expulsion of gas, smoke and flames from the rocket engine and the reaction force propels the rocket in the opposite direction (Shearer & Vogt, 2011). With the water bottle rockets, the air pumped into the rockets builds up a significant amount of pressure, which, when the bottle is released, forces the water out of the opening and propels the bottle skyward.

8.10.6 Practical Implementation of the Unit

As with the Coke and Mentos activity, students firstly viewed YouTube clips to develop an overall sense of the purpose and nature of the activity. They then made a rough mock-up of a water bottle rocket in order to immediately engage with the hands-on process of launching and testing. Subsequent practical activities saw students modifying and re-testing their rockets, drawing on knowledge developed through reinforcing classroom-based activities. Modifying and testing activities took place outside to allow launching to an appropriate height, and due to the messy nature of the activities that generally resulted in a large amount of water being dispersed. Classroom-based activities were still practical in nature, with sample activities including students constructing paper gliders and attaching paper clips to test the potential effect of weight on the rocket nose cone, and balloon/straw experiments to explore propulsion effects.

8.10.7 Recording Activities

Students were provided with a workbook which allowed them to keep a weekly record of their rocket design and modifications, by means of drawings and explanatory prose. For those students who particularly struggle with writing tasks, the teaching staff transcribed while the students narrated a recount of their problem solving activities. Additionally, photographs and video were taken of the practical activities and some

student recounts were also video-taped. The photographs were intended to complement students' workbook activities as a visual record, and the video provided a source of material for students to create their own instructional video to be uploaded to the school website.

8.10.8 Use of iPads

Access to a classroom set of iPads allowed the teacher to integrate ICT in both classroom and outdoor practical activities. Mobile device applications related to the topic of study were first tested for usefulness, and then pre-loaded by the teacher onto the iPads. A favourite application of students that also played a useful education role was the 'Wind Tunnel' App, which allowed students to draw shapes onto the iPad screen and then see the resulting graphic display of wind flow affects around their shape. This app also allowed students to visualise pressure effects and points of weakness in their rocket design elements. Students accessed YouTube clips via the iPad and also conducted website research and online activities through this medium. The online interactive activities provided by NASA relating to Newton's Laws of Motions proved engaging for young people through this format, something attributed to the video nature of the activity and the fact that students were able to replay videos and answer questions at their own pace. Evidence that use of the online medium was able to engage students with more complex scientific concepts was encouraging to see.

While there were insufficient iPads to provide one per student, the teacher considered this beneficial as students worked together in groups of their own accord and through this group interaction, provided peer mentoring when others experienced difficulties without the need for teacher intervention. The collaborative learning aspect of the use of iPads was an unintentional but welcome outcome. The teacher noted that young people were often reluctant to ask for assistance for fear of appearing foolish in class, but were more willing to accept assistance from their peers, particularly when working with technology. ICT was considered as a great 'leveller' in the Flexible Learning Centre setting, in that it provided a place where all young people could meet despite disparities in their academic abilities in other subject areas.

8.10.9 YouTube

YouTube was critically important in engaging young people's interest in the water rocket bottle unit. While students had not previously demonstrated a particular interest in rockets or space science, they were highly engaged with the YouTube clips demonstrating the potential capabilities of water bottle rockets. The YouTube clips

motivated young people by presenting the possible outcomes of water bottle rocket design and provided tangible evidence that this activity worked, and was of interest, to the real world. The teacher noted that watching the YouTube clips was what really drew the young people into the unit, and she doubted that there would have been anywhere near the same level of interest without this incorporation of social media. As well, YouTube provided invaluable in assisting with teaching instruction as young people appeared to quickly grasp hold of ideas that they had watched via video. An example of this occurred when the teacher provided text-based instructions for the paper glider classroom activity, and students subsequently struggled to understand the dotted lines and folding instructions. When the teacher then changed tack and allowed students to access YouTube clips on their iPads, showing people actually constructing paper gliders, the young people quickly understood what was required and successfully completed the activity. In this sense, YouTube videos provided an engaging avenue for modelling the activities of instruction.

8.10.10 Student Participation

During the course of the water bottle rocket unit, the majority of students attended and participated in every lesson. Some students reported back to the teacher that they were in fact taking their work home and modifying their rockets in their own time, with the help of siblings and other local young people. At a school where homework is not set, due to a range of reasons including the sometimes difficult home circumstances of young people, this enthusiasm to continue with work outside of school time is a very positive outcome. The fact that they were also sharing these activities with others shows that it would seem to hold value for young people outside of the school setting. With the primary intention of this unit being to find a pathway to encourage and develop young people's interest in science, this translation from the classroom to the neighbourhood provides important evidence of a prolonged interest that extends beyond teacher and classroom expectations.

An advantage of the outdoor nature of the activities associated with the water rocket bottle unit was that it created a contagious energy which even attracted students outside of the instructional class. The dynamic nature of students being outdoors, constructing rocket bottles, and the resulting dramatic lift-offs and waterfalls, caused a number of older students to try to join with the junior class. One senior student asked at a morning assembly "why can't we do any science like the junior students" which is a fairly unusual aside in this context. Having young people actively photographing and videotaping activities, as well as visibly modifying their rocket designs with the help of

the Wind Tunnel app, gave the work a sense of modernity that is so often missing in science classrooms. This also helped to attract those young people who might be less interested in science, but more interested in ICT.

8.11 Conclusion

ICT integration plays an important role in capturing students' interest in a topic and creating dynamic links to real world situations and scenarios. Mobile devices are advantageous to learners with literacy challenges, in that they provide avenues to alternative modes of learning such as video modelling and auditory information delivery. Additionally, ICT demonstrates the potential to assist young people in overcoming their fear of academic failure, in that they may feel more competent and capable in the ICT domain than they do in the science education domain. They are able to act as leaders in assisting other young people and teaching staff in the use of ICT, whereas their previous positioning in mainstream secondary science education settings may not have been as positive. ICT integration would seem to play an important role in overcoming students' negative prior experiences with school science, and in developing a more positive general orientation towards science. The argument of this paper is that starting 'where young people are at' in their highly connected, technology rich life worlds might be a critical point of engagement. Schreiner & Sjoberg (2004, p.21) state that "only by meeting the learners at *their* premises can science teaching contribute in developing young people into concerned, empowered and autonomous individuals".

8.12 Article Summary

The article within this chapter described the implementation of a rocket bottle unit of work with an emphasis on integrating ICT through the use of web 2.0 technologies. The value of integrating ICT was supported through an account of the principles of 21st century learning that call for an emphasis on personalised learning, and the creation of dynamic learning spaces. With young people attending FLCs being prolific users of technology, the rocket bottle project aimed to capitalise on young people's interest in modern technologies in order to enhance engagement in science learning. This was realised through the use of iPads, mobile device applications and YouTube videos, to engage young people with understanding science concepts related to physics. The findings of the article indicated that along with increased engagement, there were a number of additional benefits to integrating ICT which included overcoming literacy barriers to learning, facilitating peer mentoring and providing avenues for catering to the diverse learning styles of FLC young people. The article conclusion asserted that ICT may be a critical point for engaging diverse young people in science, and in assisting them to develop a more positive orientation towards science learning.

Summary of Chapters 6-8

Chapters 6-8 presented a snapshot, in the form of individual case study publications, of the efforts of three teacher participants from the North Queensland Flexible Learning Centre to engage diverse young people in science. The article summaries provided for Chapters 6-8 highlighted the key practical learnings of each case study, which are briefly recapped below:

Case Study 1:

Case Study 1 highlighted the central themes of connection, belonging, identity and place, as understood within a place-based educational approach (Smith 2002; Lewthwaite & McMillan, 2008). The idea of connecting curriculum to self and community was prominent within this case study, and was realised through practical implementation of a unit of work based upon regenerating a local wetlands area. Respectfully considering multiple perspectives, particularly Indigenous ways of knowing, was an additional area of focus within the unit. The willingness of teaching staff to participate alongside young people in the physical tasks of the unit contributed to a sense of shared purpose and group solidarity.

Case Study 2:

Case Study 2 was grounded in a Freirian capacity building perspective (Freire 1968; Chigeza, 2011), and emphasized the significance of recognizing the cultural capital that young people bring to the learning environment. Engagement in science was seen to occur through connecting learning to students' life-worlds, and their cultural communities. Teacher-student relations were characterized by mutual respect, and student interests and concerns were treated as genuine and worthwhile avenues of inquiry. The democratic relations of the classroom captured within the case study were supported by a dialogic and responsive form of pedagogical practice.

Case Study 3:

Case Study 3 was situated within a 21st century learning model (Leadbeater, 2008), and paid explicit attention to the integration of Information and Communication Technologies as a means to foster the engagement of disenfranchised youth with science. ICTs were seen to play a potentially significant role in assisting young people to develop a more positive orientation towards science, and provided additional benefits in terms of reducing barriers to engagement with more critical and creative forms of thinking. Young people's sense of familiarity with ICT, particularly mobile

devices and their applications, enhanced their sense of self-efficacy in terms of being capable learners, and facilitated the natural inclusion of peer mentoring.

Case Study Connections

As well as being of intrinsic interest in and of themselves, the practical learnings of each case study were considered as potential meeting points between the theory of humanistic science education (as outlined in Chapter 3) and the educational approach of the FLC Network (as detailed in Chapters 2 and 5, and further explored within the case studies themselves). The following table (Table 3) articulates these meeting points through explicating the links between the enacted practice of the case studies, the core values of the FLC network, and the pedagogical approach of a humanistic science education.

Table 3: Case Study Connections

Case Study	Practical Learnings	FLC Values Framework (Relationship, Community, Safety. Learning, Transformation and Eco-Justice)	Humanistic Science Education Pedagogies (Responsive, Critical and Place-Based Pedagogies)
Case Study 1	• Connecting curriculum to self and community • Responding to locally embedded concerns • Respectfully considering multiple perspectives, particularly Indigenous ways of knowing • Emphasis on practical, outdoor activities	*Relationship* – Teacher as partner in working towards shared group goals *Community* – Embedding learning in place and establishing community partnerships *Learning* – Connecting learning to personal and community concerns *Transformation* – Supporting young people to form new identities as capable and contributing community members *Eco-justice* – Environmental responsibility linked to action	*Place-Based Pedagogy:* grounding educational activities in local phenomena (Smith, 2002); facilitating a sense of connection, belonging and identity through an emphasis on place (Lewthwaite & McMillan, 2008) *Responsive Pedagogy:* building bridges of meaningfulness; incorporating multicultural information, resources and materials (Gay, 2000)
Case Study 2	• Recognizing the cultural capital young people bring to the learning community • Making learning relevant to the life-worlds of young people • Broadening the boundaries of dialogue in science education	*Relationship* - Democratic teaching and learning relationships *Community* - Including community cultural practices as a resource for learning *Safety* – Honouring young people's questions as legitimate inquiries *Learning* – Positioning young people as capable learners who can grapple with complex concepts *Eco-justice* –Connecting learning to environmental sustainability themes	*Critical Pedagogy:* Changing the typical hierarchical nature of teacher-student relations in the classroom and creating space for students to share their own concerns and inquiries (Seiler, 2011) *Responsive Pedagogy:* Drawing upon the cultural resources of students, their families and communities to enhance academic learning (Gonzalez, Moll & Amanti, 2005)
Case Study 3	• Use of ICT to engage young people and enhance a positive affect towards science learning • Encouraging problem-solving, creativity and persistence through integration of design and technology elements • Catering to diverse learning styles through ICT mediation	*Relationship* – Encouraging positive peer relations through peer mentoring *Community* – Taking learning from the classroom to the neighbourhood *Safety* – Creating a safe and supportive atmosphere for new learning *Learning* – Adjusting activities to meet the learning needs of young people while maintaining intellectual challenge	*Responsive Pedagogy:* Teaching 'to and through' the strengths of young people (Gay, 2000) Using a wide variety of instructional strategies that are connected to different learning styles (Gay, 2000)

Common Aspects of Practice

While each of the case studies were seen as individual representations of practice, and in such, brought to life different elements of the FLC Values Framework and pedagogical principles of humanistic science education (as indicated in the table above), there were seen to be common aspects of practice that manifested across each of the three case studies. These were seen to be integral components in engaging FLC young people in a science education of consequence, and included attention to:

- Making learning **relevant** by connecting curriculum activities to the local community, to personal interests, to other subject areas, and to the going-ons of the real world;
- Encouraging a **learning by doing** approach through providing scope for the incorporation of hands-on and experiential learning activities;
- Retaining the **intellectual challenge** of activities while making accommodations for learning difficulties that young people might experience, such as difficulties with literacy and writing tasks;
- Positioning young people as **capable and agentic learners**, through providing opportunities for success, respecting the opinions and questions offered by young people, and encouraging young people to participate and have a go;
- Encouraging a sense of **belonging and connection**, through supporting young people to develop positive relations with peers (through group and mentoring work), reducing the formality of the teacher-student relationship, and blurring the lines between school and community.

Cumulatively, the case studies provided a grounded platform for developing a framework to guide science education practice across the FLC network, which was the main intended output of the research project (as described in Chapter 1). The case studies signposted areas of significance which, when supplemented with the additional data collected through the project, contributed to the development of a broader picture of how science education might be envisioned within the FLC setting. The following chapter (Chapter 9) will further synthesize the case study findings through articulation of a practice framework that integrates the contextual, practical and theoretical findings of the project.

Chapter 9: The 'Thinking about Science' Framework

9.1 Introduction

This chapter describes the culminating phase of the research project that was designed to answer Research Question 3:

> How can science education be better framed to meet the needs of diverse young people?

As indicated in earlier chapters, the pragmatic outcome of answering Research Question 3 was intended to be the development of a framework to guide science education practice that would demonstrate responsiveness to the needs of the FLC context. The intention of this chapter then is to draw together the diverse threads of the thesis in order to present a framework that meets this imperative. The chapter begins by introducing the framework as a product of an evolving process, informed by both the empirical and theoretical findings of the study. The intent and structure of the framework is then explained, along with a description of the key dimensions that form its foundation. The framework itself is then presented, accompanied by a discussion of the utility of the framework, in terms of aligning with the other fundamentals of educational practice within the FLC network. The chapter concludes with a discussion of the limitations of the framework, which leads into the recommendations and conclusions of Chapter 10.

9.2 Framework Introduction

The purpose of the framework, as presented within this chapter, was to articulate a form of shared understanding as to how science education might be better framed to meet the needs of diverse young people in the FLC context. Facilitation of this shared understanding occurred through engaging in a collaborative development process with FLC staff (as described in Chapter 4), the results of which informed the pragmatic intent, structure, and iterative shaping of the framework. The literal content of the framework was developed through a reflexive consideration of the findings of Phases 1 and 2 of the study, and integration of the theoretical perspective developed in Chapters 2 and 3 of the thesis. The following section briefly recaps the key points of Chapters 2 and 3, and links these to the evolution of the framework.

9.2.1 Theoretical Forming of the Framework

The theoretical orientation of the thesis, in relation to articulating a meeting point between the alternative education philosophy and practice of the FLC network, and the

science education literature that demonstrates synergies with such an approach, was influential in the forming of the framework. As described in Chapter 2, alternative or flexible learning settings prioritize pedagogy that is flexible and responsive to the needs and aspirations of young people, respectful of cultural diversity, dedicated to care of the whole person and delivered in a learning environment that is not like school. In order to develop the framework, this orientation was melded with the key tenets of a humanistic approach to science education (as detailed in Chapter 3) that include challenging a traditional positivist view of science, representing diverse worldviews, integrating science with other disciplines and embedding transformative possibilities for personal and social action (Aikenhead, 2006). Underpinning both of the educational viewpoints above is a commitment to holistic pedagogical practices that demonstrate concern for both the cognitive and affective needs of young people. This created a challenge in developing a framework that could represent concerns of affect, within the science education domain that is typically dominated by concerns of cognition. In order to address this challenge, the framework went through several re-orientations in order to include both an affective and cognitive balance, with attention to the broad social, emotional and academic outcomes for young people that FLCs hope to achieve.

With the literature in the field of humanistic science education tending towards the theoretical rather than the practical, and with the work of the FLCs being more 'understood' than documented, there were very little examples to guide this process. As indicated in Chapter 3, the international works of educators such as Calabrese Barton (1998, 2002, 2003), Seiler (2001, 2011, 2013), and Tobin et al. (2005) provided insights into the possibilities of science education when reframed to meet the needs of diverse youth experiencing complex life circumstances. However, their findings have been necessarily framed within the particular challenges of the social, geographical and political contexts of their North American studies, which, while demonstrating some broad similarities to the education concerns of FLCs at a meta-level, cannot represent the local conditions of this project. This framework then has attempted to take some of these learnings from the international literature and combine them with the local examples of practice evidenced in the case study chapters, to allow the emergence of a framework that is responsive to the unique needs and conditions of the FLC context.

9.3 Pragmatic Intent of the Framework

In addition to addressing the theoretical concerns of the project, there existed a parallel imperative to create a tool of pragmatic usefulness for teaching staff in relation to facilitating the teaching of science within FLC settings. Conversations with leadership

and teaching staff across the course of the project made clear that a prescriptive form of practice framework was neither required nor desired. Rather, there was a need for a type of teacher reflection tool to encourage ongoing dialogue around science curriculum across the FLC network, and to act as a platform for staff professional development. This was further reinforced by a teacher's poignant request at a staff network meeting to 'teach us how to *think* about science' – seemingly an invite to a meta-cognitive rather than technicist approach to facilitating science teaching practice. This comment was timely in making clear the needs of FLC teaching staff, and ultimately led to the naming of the framework as the 'Thinking About Science' Framework.

9.4 Structure of the Framework

In order to remain true to the intent of the framework, it was necessary to conceptualize an appropriate framework structure that would evidence a tilt towards reflection, rather than prescription. The Productive Pedagogies Framework (QSRLS, Lingard et al, 2001), as a well-established tool of pedagogical reflection for Queensland schools, influenced the choice of 'key dimensions' as a method of framing the areas of significance within the framework. While the Productive Pedagogies tool evidences a much wider scope than the framework of this project (with concern to incorporating all areas of teaching and learning), the orientation of the tool towards encouraging meta-thinking about teaching practice (Mills, Goos, Keddie, Honan, Pendergast, Gilbert, Nichols, Renshaw & Wright, 2009) reinforced the appropriateness of key dimensions as an organizing structure for a framework with a reflective intent.

An additional structural consideration was the need to keep the framework brief, in light of the understanding that the generation of long lists detailing specific elements of teaching and learning has not been seen to be effective in supporting pedagogical practice (NSW Department of Education and Training, 2003). The focused design of the framework then resulted in five key dimensions, each with an accompanying descriptor and short series of sub-questions to facilitate further thinking within that domain. The following section of the chapter (9.5) explicates in further detail the nature of the key dimensions, before presentation of the 'Thinking About Science' framework in section 9.6.

9.5 Key Dimensions

The key dimensions that form the framework were informed by both the theoretical underpinnings of the project and the empirical data collected through the case study

research design. As noted in Chapter 4, the key dimensions were recognized as areas of emphasis that recurred in conversations, observations and the literature field considered synergistic to the educational goals of the FLC network. The key dimensions in their final form evolved to be:

- Relevance
- Place and Community
- Experience
- Creativity and Problem-Solving, and,
- Transfer and Action.

These areas were considered synergistic with the pedagogical approach of a humanistic science education (Chapter 3), the values and goals of the FLC network (Chapter 5), and the enacted practice of the case studies (Chapters 6-8). The following section provides a description of these five key dimensions and their significance in reframing science education to meet the needs of FLC young people.

9.5.1 Relevance

As detailed in Chapter 3, ensuring that science education is relevant and connected to everyday life is a key element of engaging diverse young people in science (Aikenhead, 2006; Calabrese Barton, 2003; Roth & Calabrese Barton, 2004, Roth & Lee, 2004; Seiler, 2011; Tobin, 2006). Much traditional science content seems far removed from the realities of young people's everyday lives and of little use in addressing the challenges young people face when experiencing complex life circumstances. The alternative is relevant science learning that starts where students are at, in terms of their everyday experiences and lifeworlds, and then draws their knowledge outwards to allow them to develop a better understanding of issues that have personal and social significance. This resonates with the concerns of the project's teacher participants, who emphasized the need to connect science learning to young people's needs, strengths and interests, as well as to the broader concerns of their local community. Relevance was a prominent consideration within the case study units (Chapters 6-8), where it was represented via concerns to connect curriculum to community, relate topics to young people's everyday lives, and build on the perceived interests and motivations of FLC young people. In this way, a focus on relevance was seen as a tool for bringing science closer to the lived realities of young people in order that it might act as "a formative tool for generating personal and community change" (Calabrese Barton, 2003, p.18).

9.5.2 Place and Community

Inter-related with the topic of relevance, a place- and community-based approach to science learning focuses on strengthening young people's connection to others and the regions in which they live (Smith, 2002). As noted in Chapter 3, a place based approach to science education has been found to be particularly effective in engaging Indigenous learners (Brayboy & Castagno, 2009; Lewthwaite et.al 2010; Fogarty & Schwab, 2012;), and is compatible with the principles of Indigenous epistemologies of science (Aikenhead & Ogawa, 2007). This aligns with the pluralistic worldview and commitment to place and community evident within the educational philosophy of the FLCs (as described in Chapter 5). The case studies previously reported demonstrated how science learning might be interpreted through a place and community lens. It was made evident that the key to the inclusion of a place and community emphasis was a blurring of the boundaries between school and community, and the positioning of community as a local resource for learning. An enhanced connection with place and community was seen to provide benefits for FLC young people in enabling them to develop attachment to local places, build stronger social capital networks, engage with diverse worldviews and develop a vision of themselves as capable contributors to community life. As noted by Ardoin (2006, p.120), and of particular significance in meeting the needs of young people attending FLCs; "reconnecting people with places may enhance psychological, social and spiritual well-being".

9.5.3 Experience

According to Fogarty & Schwab (2012), the goals of place and community-based education (as referred to in the previous section) are generally realised through a 'learning by doing' or experiential pedagogical approach. As stated by Knapp (2010), experiential learning is a dynamic process that encompasses learner's direct involvement in authentic tasks that encourage skill development, experimenting and constructing meaning from experience. In practice, Ayers (2010) notes the importance of providing opportunities for students to actively engage with direct sources and hands-on materials, rather than being fed a diet of 'pre-digested materials', as is often the case in traditional science classrooms. In the circumstance of the FLC network, the need to ensure that science learning was delivered with a hands-on emphasis was made clear from the earliest interviews, as indicated in Chapter 5. The effectiveness of hands-on learning in engaging FLC young people in science was evident across the three case studies, where young people were seen to overcome their initial reluctance to engage in science through participation in activities of a practical nature that drew upon resources with which young people had some familiarity. Along with increased

participation in science, an emphasis on experience is further intended to embed meaningful opportunities for young people to develop scientific process skills such as inferring, hypothesizing, observing, measuring, comparing and communicating that, according to Horton & Hutchinson, form "the most powerful tools we have for producing and arranging information about the world" (1997, p.13).

9.5.4 Creativity and Problem Solving

Inherent to the experiential learning process described in the preceding section is a focus on creativity and problem solving. Fensham (2004) notes that students might be better engaged in science education if it was understood less as simply 'knowledge learning' and more as an opportunity for creative problem-solving. According to Razzouk & Shute (2012), coupling science with design and technology opens up creative avenues for play, tinkering, problem-solving, and the generation of novel and innovative ideas and processes. The non-linear characteristics of creative design thinking and problem solving can be attractive to FLC young people who often demonstrate a natural inclination to 'think outside the box', a disposition which may not have been recognized or supported in mainstream school settings. When mediated through technology (as described in Case Study 3), further opportunities are provided for young people to practice higher order thinking skills, without being unduly limited by literacy barriers that might normally preclude involvement in more complex science activities. In addition, engaging young people in a process of solving the problem of a meaningful task allows for the inclusion of key science concepts at points where it seems natural and sensible to gain such knowledge to progress the task at hand. The essential nature of fostering young people's capacity to think creatively within the study of science is reinforced by Owen's (2006, p.17) statement that "in a world with growing problems that desperately need understanding and insight, there is also a great need for ideas that can blend that understanding and insight in creative new solutions".

9.5.5 Transfer and Action

Integral to the humanistic approach to science education outlined in Chapter 3 is an orientation towards viewing the teaching and learning of science as an opportunity to increase diverse young people's sense of agency and self-efficacy (Calabrese Barton, 2003; Seiler 2011; Tobin, 2007). As noted in the earlier chapters of the thesis, young people attending FLCs often experience significant life and academic challenges that impact on their self-esteem and the picture they build of themselves as learners. In the case of science, many FLC young people have histories of failure with science education that bring them to the conclusion that science is not for them, and is of little

use to their practical realities. As indicated in Chapter 5, overcoming this disenchantment was considered a process of building young people's positive affect towards science, and then capitalizing this into a sense of being able to meaningfully act upon issues of personal and social significance. This was realized in the case study chapters where a positive affective towards science resulted in improvements in young people's sense of agency, and an increasing ability to see connections between science learning and real life. As indicated in Chapter 5, teaching staff were hopeful that this form of learning might in turn lend itself to personal transformation, whereby young people are enabled to translate the ways of thinking and doing science into real life in the form of building "capital stock for intelligently dealing with further experiences" (Dewey, 1938, p.87). While difficult to measure, this factor remains an important consideration in meeting the holistic educational purpose of the FLC network to provide an education that has meaning beyond school. As noted by Stuckey, Hofstein, Mamlok-Naaman & Eilks (2013, p.19), "science learning becomes relevant education whenever learning will have positive consequences for the student's life".

9.5.6 Key Dimensions Summary

The description of the key dimensions above makes a case for why these areas of significance matter, in terms of framing science education to better meet the needs of diverse youth. The key dimensions have been conceptualized as non-hierarchical, in that one dimension is not considered to be more or less important than another, with all contributing to a more engaged and connected form of science education pedagogy for FLC young people. While it is not expected that all dimensions would be incorporated within any one particular unit or topic of study, consideration of these dimensions at a meta-level may contribute to a broadening and deepening of pedagogical practice. The intertwined nature of the key dimensions further facilitates an integrated approach to planning, in order to support the broad range of social and academic outcomes deemed important within the FLC setting.

Overall, the key dimensions, while grounded in the theoretical and practical findings of the study, were considered forward-looking in the sense of acting as a vehicle for FLC teaching staff to further develop and extend their science teaching practice. Section 9.6 presents the key dimensions and their associated explanatory elements, within a framework format deemed suitable to their intended role as a means of reflection and professional development.

9.6 Presentation of the Framework

In choosing an appropriate form of presentation for the key dimensions, a first preference was for a cyclical layout, in order to represent the inter-twined nature of the dimensions, and additionally reflect the non-linear style of pedagogical practice characteristic of FLCs. However, attempting to include the accompanying descriptors and question sub-sets for each key dimension within a circular format resulted in a cluttering that detracted from the intent of the framework to be easily accessible and comprehensible. In the end, a simple column design was decided upon as the most pragmatic route to presenting the framework in a balanced and visually clear form. Figure 1 following presents the Thinking about Science Framework in its entirety.

Figure 1: The Thinking about Science Framework

Focus Area	Descriptor	Reflective Questions
Relevance	Curriculum is connected to the life-world of the learner and to issues of personal and social significance.	• How does this topic connect to young people's needs, strengths and interests? • How is this topic relevant to young people's everyday lives? • Does exploration of this topic serve an authentic purpose?
Place and Community	Place based education enhances social and ecological connections and positions the community as a significant site for learning.	• Can this topic strengthen a local connection to place and community? • How can diverse world-views be acknowledged and valued? • Does this topic position young people as contributors to their school, family and cultural communities?
Experience	Engagement occurs through an emphasis on practical activities and hands-on experiences.	• Are there opportunities for students to develop their understanding through practical experience? • How can familiar and accessible resources be employed to support practical learning? • How can scientific process skills be meaningfully integrated?
Creativity and Problem Solving	Creative capacities are recognised through opportunities for tinkering, creating, testing ideas and problem solving.	• Are there varied pathways for young people to develop their capacity to problem-solve and think creatively? • Can technology assist with enhancing the creative elements of this topic? • How can key science concepts be made available to enable young people to organise and expand their thinking?
Transfer and Action	Authentic, action orientated activities are easily translatable to real-life situations and experiences.	• How might young people be encouraged to connect the ways of thinking and doing science to their real life experiences? • What real-world issues and applications are associated with this topic? • Is science learning connected to personal or social action?

9.7 Positioning of the Framework

As noted earlier in the chapter, the framework developed serves the primary purpose of acting as a teacher reflection tool to encourage deep consideration of which teaching and learning practices within science education might best serve the needs of FLC young people. As such, it is intended to work in with the core elements that form the work of all educational settings, namely the three message systems of curriculum, pedagogy and assessment (Bernstein, 1971). The following section briefly describes how the framework is positioned in alignment with these three systems including consideration of the external assessment accountabilities that form an outside influence on the educational practices of the FLC network.

9.7.1 Curriculum

The curricula mode of the FLC context demonstrates alignment with Weinstein & Fantini's (1970) conceptualization of a three-tiered model of a 'curriculum of affect' that comprises of:

Tier 1 – building blocks and basic skill development

Tier 2 – personal discovery and exploration of creative talents

Tier 3 – group inquiry curriculum

This three-tiered model evidences a match with the curriculum streams of flexible learning programs that were categorized within Chapter 5 as enabling, co-curricula and connected with community (te Riele, 2012). The intention of the "Thinking about Science" framework is to predominantly align with the third tier, dedicated to group inquiry and enacted through attention to concerns of the individual and the community (Weinstein & Fantini, 1970). In this way, it complements the other necessary parts of the FLC curriculum while promoting greater concern with more intellectually challenging learning, a key impetus of the research project as described in Chapter 1.

In relation to decisions about the curricula content that might form the basis of science teaching and learning activities, it is recognized that available curriculum documents at the national and state level can provide broad direction as to the important areas of interest in the study of science. However, as noted in Chapter 1, the tightly scripted form of current science curricula does not lend itself well to direct translation into the FLC context, particularly in relation to its correlation of particular content with prescribed age and grade levels. In FLC settings, it is not possible to presume that young people have had any form of prior experience in science, or that young people of a certain age will have similar shared conceptual and skill development in science education. As such, science content in this setting is generally treated as 'new'

learning, and decisions about what content is suitable is based on the interests and needs of young people, rather than what might be considered appropriate at a particular age or grade level. The abiding concern of this project then has been not one of directing teachers towards particular science content, but rather ensuring that science learning is included in some form.

9.7.2 Pedagogy

While the forms of pedagogy across the FLC network were seen to be as diverse as any other educational system of a moderate size, over the course of the research project there was evidence of a growing move towards project-based learning as an over-arching framework to scaffold teaching and learning experiences within the FLCs. While project work has always formed part of the curriculum of FLCs, there were, and continues to be, efforts to expand this element to encompass more of the regular curriculum and so provide a richer, more integrated form of learning experience. Professional development activities have been offered across the network to support teaching staff in employing a project-based approach, and in moving away from traditional conceptualizations of knowledge and learning as occurring within discrete disciplinary or subject boundaries. While uptake of a project-based approach has been variable, it has firm roots in the setting of the North Queensland Flexible Learning Centre where the case studies of Chapters 6-8 were derived, and so heavily influenced the orientation of the framework towards this form of practice.

9.7.3 Assessment

Determining the most appropriate form of assessment for young people attending FLCs was an issue of ongoing concern for the network during the time of the research, and, in itself, was the topic of an additional ARC Linkage Project, dedicated to finding novel ways of capturing “students’ capitals, skills and resources developed through their flexible learning experiences” (Brader, Luke, Klenowski, Connolly & Behzadpour, 2013, p.699-670). This focus on orientating assessment towards identifying student capitals, rather than highlighting academic deficits, was reflected in the observed daily assessment practices of teaching staff which were geared towards authentic and performative forms of assessment, as indicated within the case study chapters. While the “Thinking about Science” framework does not make any reference to the forms of assessment that might accompany its use, it is intended to lend itself to the current ways of doing assessment that take place in the FLC context.

9.7.3.1 External Assessment Accountabilities

In relation to external frameworks guiding assessment across the FLC network, there was a significant change mid-way through the project from the predominant use of state-based frameworks to guide assessment to reliance on the Australian Core Skills Framework (ACSF) – a tool developed to support adult learning in English language, literacy and numeracy (DEEWR, 2008). While the ACSF now dominates the assessment regime of the FLCs, there remains an external requirement to show engagement with mainstream curricula in order to maintain the network's registration as an accredited non-state school. The current form of this engagement has been to incorporate consideration of the Australian National Curriculum general capabilities and cross-curricula priorities within planning and assessment documents. The key dimensions of the "Thinking About Science" framework support the integration of these capabilities and cross-curricula priorities, particularly in relation to those that encourage critical and creative thinking, personal and social capability, intercultural and ethical understanding, use of information and communication technologies, and the integration of sustainability and Indigenous perspectives (ACARA, 2014).

9.8 Framework Limitations

As noted in the previous section, the framework has been designed to align with the fundamentals of educational practice within the FLC network, however, due to its contingent and exploratory nature, it has attendant limitations that require further consideration, as indicated below.

9.8.1 Teacher agency to teach science

The framework, in itself, presumes agency on behalf of the teacher to engage with the teaching and learning of science. This is a result of the framework being mostly informed by the more experienced science teachers across the network, and through the predominance of literature based on the work of effective, rather than novice, teachers. In this way, it cannot address the concerns of FLC teachers who feel ill-prepared and ill-equipped to teach science (an issue raised in Chapter 5). What the framework does attempt to do is create a more broad vision of science that might enable teachers from non-science backgrounds to see possibilities for incorporating science learning in the regular curriculum of the FLCs. The overall intent of the framework was to make clear that science teaching and learning activities can resemble the other curriculum activities of the FLCs, and do not necessarily require dedicated laboratory spaces, specialized equipment or expensive materials and resources. The case studies in Chapters 6-8 met all of the above conditions and so

provide an exemplar of how this might look in practice. Further potential opportunities for enhancing teacher agency within the FLC context will be taken up in the following chapter (Chapter 10).

9.8.2 Valuing of Science

Another inherent assumption of the framework is that staff across the FLC network will conceptualize science education as valuable to young people attending, and so will prioritize its inclusion within the FLC curriculum. That this has not widely been the case was made evident within Chapter 1 of the thesis, where it was noted that science education was at best ad hoc across the network. The lack of prioritization of science has previously been attributed to the lack of fit between traditional science practices and the educational philosophy of alternative settings, a problem that this thesis has attempted to move towards resolving. However, the problems with the valuing of science can be seen to still remain, in that the translation of the framework presented within this chapter into practice by the FLC network resulted in the removal of any references to science from the framework. The rationale for such a move was stated as a desire to be able to use the framework for curriculum work more generally and was considered, by those involved, as a positive reflection of the framework's overall utility. This forms something of a conundrum in that the purpose of the thesis was to present a more generalist, integrated and inclusive vision of science education to align with the holistic approach of alternative educational settings, however, it was not intended for this to negate the value of science learning in its own right. The challenge of ensuring that science teaching and learning is valued and takes place within FLC settings is an ongoing one that will be revisited in Chapter 10.

9.8.3 Young People's Voice

A limitation of the framework linked to the scope of the project is that it represents teachers' perceptions of FLC young people's needs more strongly than it does their voices. As a pedagogical tool for reflection, it was necessary to centralize the professional opinion of teaching staff, however, understanding young people's needs and interests in their own words could have provided a fuller picture of appropriate and responsive science education practice. As noted in Chapter 4, there were considerable limitations to involving FLC young people more fully in the research process, including concerns about maintaining their privacy and confidentiality. The outsider position of the researcher at the commencement of the project also created an uncertain situation as to whether young people would willingly engage in meaningful conversations about science education with a stranger to the setting. As relationships between researcher

and researched have developed over time, better opportunities have been made available to initiate open and authentic conversations with young people around science education. This provides an avenue for further research that might allow for more rounded data collection to strengthen the tentative form of this framework, the opportunities for which are explored in more depth in Chapter 10.

9.9 Conclusion

This chapter presented a framework of practice for the FLC network designed to respond to the question "How can science education be better framed to meet the needs of disenfranchised young people?" The framework was conceptualized as a pedagogical reflection tool and drew from the empirical findings of the study as well as the related literature to centralize five key dimensions – Relevance, Place and Community, Experience, Creativity and Problem-Solving, Transfer and Action. The inter-relationship of the framework with the other core elements of educational practice within the FLC context was further described, leading to a consideration of some of the limitations of the framework in terms of the realization of its purpose and intent. As the output of an exploratory process, the framework has been positioned as a stepping stone in reframing science education to meet the needs of alternative education settings such as the EREA Youth+ FLC network, while recognizing that there are further challenges to be met. Chapter 10 will provide recommendations to support the ongoing work of enhancing the teaching and learning of science within the FLC network, and will connect these with the wider concerns of providing an equitable science education for all Australian young people, as introduced in Chapter 1.

Chapter 10: Conclusions and Implications

10.1 Introduction

The purpose of this final chapter is to summarize and synthesize the findings of the thesis. The chapter begins by revisiting the original concern of the project, the dilemma of engaging diverse youth in science. The methodology of the project is then recapped and positioned as a generative response to meeting the unique needs of the research context. This is followed by a re-examination of the findings of the project, as they relate to the three research questions and the practice of engaging diverse youth in science. The future of science for the EREA Youth+ FLC network is then discussed, with acknowledgement of the challenges and possibilities for promoting science education in this particular context. Implications for educators more generally are then suggested and linked to the framework output of the project. The chapter concludes with the critical reflections of the researcher and suggestions for areas of further research inquiry.

10.2 Engaging Diverse Youth in Science – An Ongoing Concern

Chapter 1 highlighted the disparity in equitable science education outcomes for diverse groups of young people in Australia. Reference was made to international testing results that indicate Australian students who fall into certain 'domains of disadvantage' (such as being from low SES backgrounds, remote locations and/or identifying as Indigenous Australians) have outcomes in science education that are significantly below their mainstream peers (Thomas & De Bertoli, 2008). This inequitable situation has remained unchanged over a considerable period of time, and little progress appears to have been made in relation to addressing this national concern. With low performance continuing to be attributed to structural factors (such as socio-economic disadvantage), and personal factors (such as students' attitudes, engagement, motivation and beliefs – see, for example, De Bertoli & Thomson, 2010), minimal attention has been directed towards exploring the processes of schooling that act to exclude diverse young people, particularly in the Australian context. The intention of this thesis has been to draw attention to the needs of diverse young people, as a distinct group under-served by the mainstream practices of school science.

In terms of equity and the specific context of this project, a driving concern was that young people attending alternative or flexible learning educational settings might be missing out on accessing a quality science education. This was attributed to the nature of curriculum offerings in these settings, a shortage of contextually appropriate

curriculum materials, as well as a perception of a 'lack of fit' between alternative education philosophy and the prevalent culture of school science (Chapter 1). With evidence showing that flexible learning settings have expanded exponentially over the last decade (Chapter 2), the size of this problem in terms of the numbers of Australian young people potentially lacking access to a source of secondary science education is significant. As noted within the PISA5 report, "students can't win if they aren't allowed to play" (OECD, 2011, p.4), and the omission of science from alternative curricula further disadvantages those students who might already have experienced a reduced form of science education through significant gaps in schooling (as mentioned within Chapters 6-8). Flexible learning settings then face an ongoing imperative to ensure that disenfranchised youth are provided with opportunities to develop their scientific proficiency, so that they might access an education with equivalent breadth and opportunity potential as that of their mainstream peers.

The *form* that this science education should take has been a central query of this thesis project. As has been previously mentioned, determining what might constitute a quality science education for disenfranchised young people is an exploratory field, and there was little local material available to guide the process of framing an approach suitable for flexible learning settings. That school science was problematic for disenfranchised youth was made clear through the concerns initially raised by the project partner, the EREA Youth+ FLC network (as described in Chapter 1), as well as through a review of the international science education literature that dedicates itself to addressing the needs of diverse and under-represented youth. The findings of this review suggested that a humanistic approach (Aikenhead, 2006) might act as a vehicle for engaging diverse young people in a science education that would evidence quality - both in terms of developing scientific proficiency, as well as in addressing the whole-person educational philosophy of flexible learning settings. Bringing such a theory into practice within an exploratory terrain was guided by the following research questions that were developed to focus the design of the study:

RQ1: How does the FLC context shape science education?
RQ2: How do teachers work to engage diverse young people in science education within the FLC context?
RQ3: How can science education be better framed to meet the needs of diverse young people?

10.3 A 'Working With' Methodology

As indicated in the early chapters of the thesis, the unique nature of the EREA Youth+ FLC network, as a relatively new form of educational approach in the Australian schooling landscape, necessitated an exploration of how things might be done differently in a non-mainstream, high demand setting. Chapter 5 detailed the radical educational standpoint embraced by the Youth+ organisation in order to cater to some of the most disenfranchised young people in the Australian community. The 'de-schooling' philosophy applied was seen as a response to a perception that young people seek out FLCs as a deliberate move against the mainstream schooling practices that have not demonstrated responsiveness to their needs. As a result, it was made clear during the early stages of the project that it was neither practical nor desirable to attempt to translate mainstream curriculum and ways of doing science across to the setting of the FLCs. Instead, it was necessary to develop a deep understanding of the philosophy and practice of the FLCs, in order to conceptualize how science might best be framed in these settings.

The choice of pathway to achieve this goal was to engage in an extended period of fieldwork and participant observation (as described in Chapter 4), in order to come to know the setting and the nuances of the educational work that occurs in these places. Regular engagement with the setting over a period of three years (including involvement with classroom activities, planning events, celebrations and professional development activities) allowed for increasing insight and comprehension into what matters in these places, both in relation to science education and to education more broadly. The complexity of the practice, as it unveiled during the early stages of the project, made clear that developing a holistic understanding of the work of teachers in engaging FLC young people in science education would be best captured through use of a case study research strategy. The decision to co-author the case studies with the key research participants was one that was intended to show respect for the professional expertise of teaching staff, and to assist them to formally articulate the ways of working in these settings. This was considered beneficial in enabling the sharing of science education practice strategies, both within the FLC network and outside, in the mainstream domain. Having the case studies published in widely read educational journals, such as The Australian Educational Researcher (Chapter 7), was seen as significant in bringing the work of FLCs in from the margins of mainstream educational dialogue.

The intent of the methodology overall was to *work with* participants to negotiate how to best represent their experiences in such a way that would recognize both the challenges and opportunities of flexible learning settings. In order to achieve this goal it was necessary to understand the culture of the FLCs, the needs and interests of staff and young people, and the values and principles that frame the everyday activities and modes of interaction of the setting. Engaging in a process of co-authoring and co-publishing with key participants was, in some ways, a unique way of coming to know both the setting and the mindset of teaching staff, via the extended conversations and negotiations required to develop a publication. This process involved a form of member-checking that was more than a review of texts pre-formed by the researcher (Lassiter, 2005), and was rather a collaborative process of co-constructing meaning. In this way, teachers were valued as "creators of educational knowledge" (Groundwater-Smith & Dadds, 2004, p.242). The merit of this approach in flexible learning settings may extend itself to other high demand contexts where teachers are often researched upon, but may have minimal voice in representing their own practice.

10.4 Returning to the Research Questions

Returning to the research questions that underpinned this project, it can be seen that they have been designed to reflect a generative and exploratory orientation towards understanding the processes that might constrain and enable the participation of diverse youth in science in the context of a flexible learning setting. The following section briefly recaps the findings of the project, in terms of answering the three research questions.

Research Question 1: How does the FLC context shape science education?

The findings relating to this research question were primarily reported upon in Chapter 5, and indicated that the pervasive nature of school science played a key determining role in the positioning and valuing of science within the FLC network. In spite of the radical educational standpoint espoused by the network, staff and young people's actions were observed in many cases to be bound by the powerful ideas that surround the concepts of 'real' science, 'real' teachers and 'real' students (Seiler & Gonsalves, 2010). The resilience of school science as a construct was seen to be enacted through teacher's attempts to implement a form of science education that was, at times, fundamentally at odds with the holistic educational philosophy of the FLCs. This was particularly the case for teacher's operating 'out of field' in attempting to teach science, a situation which was seen to be common to the setting. In attempting to replicate the laboratory science of their own memories of schooling, teachers felt further inhibited by

the minimal resourcing for science teaching at FLCs, especially in relation to a lack of dedicated science areas, science equipment and materials. While some teachers spoke of the value of 'real' science for FLC young people, particularly in terms of the power of science for improving young people's self-efficacy (Tobin et al., 2006), the lack of priority given to science within the overall curriculum suggested an ill-fit between teacher's representations of science and the form of learning experiences valued within the FLCs.

In order to align the vision of the FLCs with the practice of science education, it was necessary to look to the strategic values framework of the organization that provided a lens for determining which learning experiences should count in the FLC context. This framework made reference to six key dimensions (Safety, Relationships, Learning, Community, Transformation and Eco-Justice) that aligned with the priorities of alternative education settings outlined in Chapter 2. The translation of these values into the domain of science education was understood by leadership staff as being intimately connected with notions of justice – both social and environmental. This concern with justice was reflected in a desire to incorporate a plurality of worldviews in the teaching of science along with an environmental sensibility. It was perceived that this in turn would enable young people to develop a positive sense of their place in the world around them, and engender possibilities for critical engagement and social action. Similarly, teaching staff saw potential in science education for enhancing young people's sense of agency, in terms of developing transferable thinking skills that would enable them to act in a purposeful and proactive way in relation to issues in their everyday lives. The elements of FLC practice that were seen as pathways to a more authentic form of science education included responsiveness to young people's needs, strengths and interests; an orientation towards outdoor and hands-on activities; integration of information and communication technologies; and a focus on ensuring affective engagement. These findings provided possible avenues of enactment that informed the process of answering Research Question 2.

Research Question 2: How do teachers work to engage diverse young people in science education within the FLC context?

The findings relating to this question were primarily reported in Chapters 6-8, in the form of case studies co-authored with three teacher participants at the North Queensland Flexible Learning Centre. The main purpose of these case studies was to explore the possibilities of integrating the innovative pedagogical practices of teachers working in a flexible learning setting with the tenets of a humanistic approach to

science education. The humanistic approach advocated for in Chapter 3 was seen to be characterized as being fundamentally concerned with providing an equitable, transformative and democratic science education for all young people (Aikenhead, 2006). Pedagogical practices considered supportive of such an approach were outlined as those relating to the fields of culturally responsive, critical and place-based pedagogies. The case studies of Chapters 6-8 provided a snapshot of how these theoretical orientations might be realized in the context of a flexible learning setting. As the findings of these case studies were summarized within their respective chapters and the Chapters 6-8 summary, as well as being revisited in Chapter 9, they are only briefly reiterated below.

Case Study 1 (Chapter 6) highlighted the potential of a place-based approach for engaging diverse young people in science. Implementation of such an approach was seen as significant in bridging the disconnect experienced by FLC young people in terms of seeing the relevance between science education and the realities of their everyday lives. A place-based approach was also seen as a powerful tool for creating positive links between self and community Woodhouse & Knapp, 2000) which allowed young people to potentially form new self-identities as capable and contributing community members. The findings of this case study reinforced the work of place-based educators who emphasize the importance of conceptualizing science learning as a bridge to community life (Roth & Lee, 2004).

Case Study 2 (Chapter 7) brought to life the principles of critical pedagogy in providing a practical example of how the typical nature of teacher-student relations in the science classroom might be challenged. The dialogic mode of teaching reported in the study was seen to open up participative spaces for diverse voices and experiences. Young people were positioned as a resource within the classroom and were able to follow lines of inquiry that were of genuine personal interest. The findings of this case study aligned with the work of urban science educators such as Calabrese Barton (2003), Seiler (2001, 2011), and Tobin (2006), who highlight the importance of respecting the cultural resources and practices of diverse youth and in cultivating dialogical educational spaces to facilitate meaningful participation in the science classroom.

Case Study 3 (Chapter 8) drew attention to the principles of culturally responsive pedagogy in terms of responding to the needs, strengths and interests of diverse youth through the integration of ICT in science learning activities. As noted by Gay (2000, p.29), the intention of culturally responsive pedagogy is to teach “to and through” the strengths of diverse students and the findings of this case study indicated that ICT may

be an important medium in achieving this goal. The elements of technology integration, creativity and design thinking that formed important components of the unit of work reported within this case study seem to receive less representation in the responsive science education literature, and so may warrant further investigation as to their role in enhancing engagement.

Overall, the case study findings of this thesis indicated that flexible learning practice is potentially synergistic with the principles of a humanistic approach to science education, and that combining them both contributes to the development of a form of dynamic and responsive practice that works to engage diverse youth. These findings add further strength to the argument that a 'one-size-fits-all' approach to science education is unsuitable to the needs of diverse youth (Brayboy & Castagno, 2009), and that what is instead required is the development of a repertoire of practices that might facilitate authentic engagement. Research Question 3 was intended to explore this topic further by investigating how the somewhat idiosyncratic practice of the case studies might be translated into a broader conceptualization of a reframed practice of science education for disenfranchised youth.

Research Question 3: How can science education be better framed to meet the needs of diverse young people?

The findings relating to this question were reported upon in Chapter 9 and included the presentation of a practice framework built upon the theoretical underpinnings and empirical findings of the thesis. Development of the framework fulfilled the overall aim of the thesis (as stated in Chapter 1) which was:

> *To work with FLC staff to generate a framework to guide science education practice that would demonstrate responsiveness to the context.*

The framework itself was positioned as a pedagogical reflection tool encompassing five key dimensions – Relevance, Place and Community, Experience, Creativity and Problem-Solving, Transfer and Action. These areas were considered synergistic with the pedagogical approach of a humanistic science education (Chapter 3), the values and goals of the FLC network (Chapter 5), and the enacted practice of the case studies (Chapters 6-8). The intention of the framework was to present a forward-looking picture of science education that would support teacher efforts to position the needs of FLC young people at the centre of pedagogical decision-making. This was reflected in the key areas of emphasis within the framework that encouraged an orientation

towards:

- Starting where young people are at in terms of relating science learning to the experiences of their everyday lives;
- Strengthening young people's relationship with others and their local environment through use of a place and community lens;
- Providing opportunities for young people to 'learn by doing' through use of an experiential approach;
- Fostering young people's capacity to think creatively through the integration of problem-solving, technology and design-based activities;
- Working with young people to develop their sense of agency and self-efficacy in terms of acting upon issues of personal and social significance.

Taken together, these key areas were intended to represent a balance between both affective and cognitive concerns in order to enable attention to the broad social, emotional and academic outcomes for young people that FLCs hope to achieve. The framework overall then reflected a form of science learning that attended to the cognitive needs of the learner while being embedded within "an ethos of caring and respect" (Seiler, 2001, p.1001).

10.5 The Future of Science in the EREA Youth+ FLC Network Context

The tenuous position of science education across the FLC network was noted in the early chapters of the thesis. This was attributed to a number of factors including a lack of fit between school science and the practice of FLCs, and a low priority placed on science education as opposed to more pressing concerns such as the development of students' basic literacy and numeracy skills. This necessitated finding a way to enable teachers to see science differently, in order to envision a form of science education that would draw on the strengths of both staff and young people. The case studies of Chapters 6-8 were a first step in providing a vehicle for staff outside of the case study site to see science education through a different lens, but still a lens embedded in the shared practices of their collegial community (Stevenson, 2004). In order to continue to develop staff's capacity to refit science education to meet the needs of the FLC context, a pedagogical reflection tool in the form of a framework was additionally developed (as mentioned in the previous section).

While the framework was positively received, Chapter 9 drew attention to the fact that there still appeared to be a certain amount of ambivalence towards science, made

evident when science-specific terminology was removed from the framework. In order to provide the breadth of curriculum that the FLC network promises for all young people, there exists an imperative to maintain momentum around science education beyond the course of this project, and to work to develop a positive network culture around science teaching and learning. Pragmatic steps that could support such a move include seeking out professional development opportunities to build the confidence and experience of staff, exploring the possibility of mentoring partnerships between science and non-science background teachers, developing a bank of activities deemed appropriate to FLCs, collecting additional case studies of practice to act as professional exemplars, and using the framework developed within this project to encourage ongoing reflection, both individually and collectively. Such practices could assist FLC staff to see more clearly the many opportunities that exist to incorporate science learning in the curriculum that are already in place across the network. With FLCs continuing to offer a broad range of curricula and co-curricula activities including outdoor education, health and fitness, cooking and nutrition, design and technology, and gardening and environmental programs, there would seem to be multiple entry points for embedding and developing an authentic form of science education for FLC young people. The ongoing challenge for the network will be to assist staff to see the value in science for FLC young people, and to find ways to create space for science learning in light of the competing priorities of high demand contexts.

10.6 Implications for Educators

As noted in Chapter 9, the framework and associated findings of this thesis are a first step towards capturing the elements of practice that might work to engage diverse youth in science. While it has been a small study in terms of scale, it is a significant study in that it shines the spotlight on an issue that appears to have been subsumed by wider concerns of the science education community in relation to the general issue of engaging students with science. It may yet still contribute to this wider discussion as the practices that work to engage the most disenfranchised young people in the Australian community may have import in mainstream settings. The experience of disconnect reported within this study is not one limited to young people attending FLCs, and there is abundant evidence to demonstrate that traditional school science continues to fail to deliver to the needs of a diverse student population (Aikenhead, 2006). As such, there is a pressing need for all educators to consider how science might be done differently to ensure that every Australian young person has the opportunity to develop a positive affect towards science learning that will encourage

them to seek, understand and reflect upon science knowledge connected to their everyday lives.

The findings of this study have indicated that the key to engaging diverse young people in science is innovative pedagogical practice that demonstrates responsiveness to the needs of individual young people and their communities. The fact that teachers were able to trial a variety of approaches to science education is testimony to the culture across the EREA Youth+ FLC network that supports and encourages innovation and experimentation. Staff within the flexible learning environment are gifted a large amount of professional freedom in relation to making decisions around the content, form and location of teaching and learning activities. Teachers in mainstream environments however find themselves contending with increasingly standardized forms of curricula and assessment practices (Luke, 2010), and are in many ways constrained from exploring different and more responsive forms of practice. The introduction of the Australian Curriculum has resulted in added pressure for teachers to direct the majority of their attention towards ensuring that students are covering prescribed science content within the required timeframe (Haeusler, 2013). Suggestions to include science in national standardized testing regimes (Masters, 2009) has the potential to further narrow the curriculum focus of science teachers in both primary and secondary classrooms. These outside influences threaten to support, rather than disrupt, maintenance of the status quo in relation to the traditional transmissive pedagogies associated with school science (Tytler, 2007). The argument of this thesis is that more of the same is not likely to be effective in engaging diverse students in science, and that it is instead necessary to look to more expansive views of science education, as embodied within the principles of a humanistic approach.

While the context-bound nature of this project likely makes difficult the replication of the forms of activities and projects represented within the case study chapters, it is hoped that some of the key dimensions of practice that form the framework presented in Chapter 9 may in fact demonstrate some usefulness to educators working in other settings. The dimension of relevance is one that can be interpreted in multiple ways, in order to ensure that students are able to make connections between the science of their classrooms and the science of everyday life. The ideas behind place and community may encourage educators to develop a more contextualized form of science learning that contributes to a sense of seamlessness between the spheres of school and community. While the dimension of experience may seem self-explanatory, a focus on more experiential forms of learning could counter the reliance on textbook

based activities that seem to dominate many secondary science classrooms. An emphasis on creativity and problem-solving provides opportunities for students to develop higher order thinking skills that have usefulness within and beyond the science classroom. Finally, a focus on transfer and action encourages students to recognize and engage with science related concerns as a process of making sense of the world around them, and for contributing the means to more active forms of citizenship. While the framework developed has not intended to be prescriptive in any form, it is hoped that consideration of even some of these dimensions might inspire educators to explore opportunities to reframe science education practice into a form that more readily resonates with the needs, interests and concerns of diverse young people.

10.7 Critical Reflections

In reflecting on the process of engaging with this study, the common theme that recurs personally is that of seeking common ground. 'Common ground' is a principle that underpins the approach of the Flexible Learning Centres in their aim to provide an education experience that emphasizes the democratic and relational (as mentioned in Chapters 2 and 7). Throughout the course of implementing the methodology of this project, I was challenged to discover what a democratic and relational form of research practice might entail. As an initial outsider to the setting, it was necessary to find ways to engage with practitioners and young people in order to firstly understand, and then work with participants, to support science education practice. This involved a process of coming to know the EREA Youth+ FLC network as a whole, as well as the individual setting of the North Queensland Flexible Learning Centre, and the staff and young people who inhabit these sites. It took a considerable amount of time of simply being present in this setting to develop a full picture of how these places work, to reconcile the different way of educating that were at odds with my own experiences of schooling, and to know how to act – as a researcher and eventually a colleague. My formal move to a collegial position occurred at the completion of the data collection component of the study, when I moved into a part-time teaching role at the North Queensland Flexible Learning Centre. The experience of holding actual teaching responsibility at the site provided a useful reality check, and tempered any tendency towards idealizing the available opportunities for science education. The findings of the thesis have then been quite pragmatically grounded in what is realistically possible within FLC settings, both from observation and experience.

The idea of common ground was also central to the intellectual inquiry of the thesis project overall. In searching for a meeting place between the philosophy of alternative

education and science education, many approaches were reviewed and discarded. It was indeed challenging to find material that could answer a fundamental question – will this learning be of value to FLC young people? The more time that I spent at the North Queensland Flexible Learning Centre, and the more I saw of the complexity of life circumstances that FLC young people were dealing with on a daily basis, the less relevant traditional science education seemed to be. There were times when I questioned whether science education in fact did deserve a place in the FLC curriculum at all. However, seeing young people engage in science learning, through the course of working alongside the teacher participants in the study, provided hope that science learning could be of value to disenfranchised young people, if delivered in an appropriate form. Some of the most powerful moments to observe were those times when young people seemed to have surprised themselves with their ability to comprehend more complex ideas and concepts then they would have previously thought themselves capable of. The agency afforded by science learning appeared particularly pronounced in the FLC setting, where young people evidenced a very low sense of self-efficacy in terms of their ability to learn and succeed in the activities of school. The link between science learning and improvements in self-esteem and identity for disenfranchised young people is one that has been touched upon within this thesis, but would benefit from further investigation and the capturing of young people's own voice in relation to this matter. As noted in Chapter 9, the scope and circumstances of this study did not allow for a phenomenological investigation of the experiences of FLC young people with science education but this would certainly be of interest in relation to examining in more depth the meaning young people draw from a reframed science education. As noted by Tobin et. al (2006, pp.310-311), "If students are provided with opportunities to learn science in forms that are relevant and significant to everyday life, then there is an opportunity for them to designate their own symbolic markers on their participation and success in science". This is one of many stories still to be told about the experiences of engaging diverse youth in science, and I hope to continue to explore these as part of my long term relationship with the EREA Youth+ FLC network.

10.8 Chapter Conclusion

This thesis has addressed the educational issue of engaging diverse youth in science in the context of a flexible learning setting. The findings of the thesis have explored teachers' work in this form of setting, and have produced a framework to act as a guide for future practice. In this way, they have addressed the research questions guiding the project and have fulfilled the aims and intentions stated in Chapter 1. The thesis

overall has attempted to engage in a form of ‘re-imagining of science education’ as recommended by Tytler (2007), in the specific context of meeting the needs of disenfranchised young people. In this way, it has involved “a re-thinking of the nature of science knowledge dealt with in schools, moving away from authoritarian knowledge structures to more flexible, and more challenging, conceptualisations of classroom activity and more varied ways of thinking about knowledge and learning” (Tytler, 2007, p.67). This has necessitated the interweaving of two quite disparate learning traditions – alternative education and science education – in order to find a common ground of engaging pedagogical practice. The way forward for the EREA Youth+ FLC network lies within its willingness to embrace its own vision of science education, as encapsulated within this thesis, in order to continue to provide the critically engaged learning experiences that complement the network’s holistic concern with young people’s well-being.

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Appendix A *Youth Studies Australia* Copyright Policy (Australian Clearinghouse for Youth Studies)

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Title: Re-engaging young people with education and training: What are the alternatives?

Abstract

Alternative education programs are one way of responding to the disengagement of young people from mainstream schools. While there are a great variety of programs, those where young people experience success have incorporated a number of elements of best practice (Mills & McGregor 2010). This article reviews the attributes of effective alternative programs with a particular focus on those programs situated in Queensland, Australia. Establishing what constitutes a successful alternative program becomes increasingly important in an education climate that includes rapid movement toward a standardized educational experience with the attendant potential to further alienate those young people already existing on the margins of mainstream schooling.

Disengagement as a Social Concern

Engagement in schooling is a key factor in producing equitable social and employment outcomes for all young people. School retention is an issue of growing concern highlighted in international social inclusion agendas and prioritised at a national and state level through educational reform policy targeted at the senior phase of learning. In 2009, the Council of Australian Governments (COAG) responded to concerning low national rates of Year 12 completion by mandating participation in school until completion of Year 10 with a further requirement for young people to remain in full-time education, training or employment until the age of 17 (COAG 2009). Substantial funding has been allocated to support the implementation of these school retention reforms yet a significant proportion of young people continue to disengage prior to achieving their Senior Certificate or equivalent.

In 2009, 16% of teenagers (15-19 year olds) nationally were identified as not fully engaged in work or study and this evidenced a sharp increase from 2008, reversing a previously downward trend. This rise has been attributed to a downturn in the labour market with no off-setting increase in education participation. Early school leavers who do not continue in education are disadvantaged in the labour market and are less likely to be in full-time work and more likely to be unemployed or not in the labour market (Robinson & Lamb 2009). According to the Department of Education, Employment and Workplace Relations (DEWR), 80% of available jobs in Australia require post-school qualifications yet only 50% of the workforce has such qualifications (2010).

In discussing school retention, it must be noted that there are concerns in relation to the accurate identification of early school leavers. There is limited data available to track young people who have disengaged from school prior to the age of 15 and who comprise a significant cohort generally not reflected in studies focused on measuring senior school retention. Younger students might fall between the cracks if they experience long absences through suspension and/or school exclusion which create ripe grounds for complete disengagement. Another shortcoming of school retention studies is the focus on retention from one year to the next which also omits those highly mobile students who might cease enrolment at one school yet fail to re-enrol at another school or experience an extended period of absence before re-enrolment.

Factors Related to Youth Disengagement

It is common to find in any discussion centred on youth disengagement a list of individual factors that predispose a person to being "at risk" of early school leaving. Curtis & McMillan (2008, p.8) identify "not having an intention to complete school, coming from a non-nuclear family, being a below average academic achiever, being male, having an unfavourable attitude towards school and perceiving student-teacher relations as unsympathetic" as personal attributes associated with a greater likelihood of non-completion of school. Low-skilled parental occupation and non-completion of post-secondary education and training are also considered to be contributing factors.

A more detailed exploration of school-based factors related to student disengagement is provided by Lange & Sletten (2002) who highlight three influential factors that impact upon engagement in the school context, namely - academics, relationships with teachers and peers and school size. The academic aspect takes into consideration suspensions, missed classes and academic failures that leave some students "weary of the school experience and distrustful that the education system can be a tool for their success" (Lange & Sletten 2002, p.11). The relationship dynamic in the school setting is related to the strength of students' connections to their peers and adults as well as to the overall school climate which has a significant impact on the academic investment of at-risk students. School size as a factor is linked to research that consistently demonstrates that large school size is an important dimension contributing to student alienation from the traditional schooling system (Lange & Sletten 2002).

A number of authors (see, for example, Smyth 2002; Croninger and Lee 2001) find a middle ground between the concepts of student/family contextual risk factors and school inadequacy in putting forward the idea that students who experience complex life experiences may be further disadvantaged by a lack of "school" capital. Some

young people struggle to connect with the culture of the traditional school and therefore require an empathetic and supportive school response to ensure both academic success and social well-being (Mills & McGregor 2010). It is suggested that schools could mitigate disengagement risk factors by transforming relationships for learning to those that are inclusive of students' families and communities and as such holistically support and enable young people to build social capital (Leadbeater 2008). However, this is not the typical education experience for many young people, with the result that many are disengaging from education completely without the resources required to fully participate within their community.

Consequences of Disengagement for Individuals and Communities

The consequences of youth disengagement from education for young people and their communities are significant. Long-term effects include marginal participation in work, further education and training and skill development (Zyngier 2003) with a requisite higher likelihood of future reliance on government assistance (Peace 2006). This in turn increases the risk of extended social dislocation and physical and mental health problems (Mission Australia 2006). Additionally, research demonstrates a positive relationship between truancy and crime as well as failure to complete high school and criminal activity (Purdie & Buckley 2010). Even in the event of achieving full time employment, adults who have not completed school earn less than those persons who have fully completed their formal schooling (Alexander, Entwisle & Kabbani 2001). As reported by Curtis & McMillan (2008), the majority of school non-completers in Australia find employment in the 'blue collar' work industry, however the availability of this type of employment opportunity is highly dependent on the health of the economy.

The consequences of disengagement are magnified for Indigenous communities in that the proportion of Indigenous young Australians not fully engaged in work or training is almost three times that of non-Indigenous teenagers. The unemployment rate for Indigenous young Australians is twice that of non-Indigenous youth and Indigenous young people face a greater range of difficulties in finding secure and meaningful employment opportunities (Mission Australia 2006).

Addressing Disengagement Through Alternative Approaches

In light of the serious consequences of disengagement and the political push to increase retention rates, a wide variety of alternative learning programs have been developed in Australia (see, for example, te Reile 2007), particularly in the last decade. There is a growing realisation that flexible and socially inclusive education services are a necessary component of engaging those young people who face the most challenges

in fulfilling the “learning or earning” agenda of the current educational climate. The COAG National Partnership Agreement (2008) highlights three main areas of reform focus - multiple learning pathways, career development and mentoring - which are intended to maximise student engagement and attainment and align well with an alternative approach to schooling.

Alternative education is a term used to broadly encompass educational activities that fall outside the traditional schooling system (Aron 2006) and is most commonly used in the Australian context to reference programs serving vulnerable youth who are no longer enrolled in mainstream schools. The academic integrity of alternative programs has been questioned in the past, primarily as a result of the general emphasis placed on attainment of ‘basic skills’ and vocational education training. There have been calls for long-term studies of student outcomes to ensure that students are transitioning from alternative programs to either further education or meaningful employment (Lange & Sletten, 2002). With little data available in this area, it is indeed difficult to measure the success of alternative programs, aside from anecdotal reports from those working in the field. However, it is also important to note that notions of ‘success’ may be interpreted differently from the perspective of the student, the student’s family, the school or an outside institution.

Establishing the integrity of alternative programs is essential to ensure their very survival, in that many programs (particularly in the public sector) rely heavily on government funding to meet operational costs and in such, must demonstrate the ability to operate within an accountability framework (Queensland Department of Education and the Arts (DETA), 2004). In addition, and perhaps most importantly, the learning experiences of students will be invalidated if community members and potential employers question the academic integrity of the alternative education program. If alternative programs are conceptualised by the wider public as ‘second best’ to mainstream schooling (te Riele, 2008), there is a strong likelihood that students themselves will become aware of this deficit view and will devalue their own educational experience as not comparable to that of mainstream schooling.

Re-Engagement and Flexible Learning Options in Queensland

Reforms to the senior phase of learning designed to improve student engagement and retention gathered momentum in the state of Queensland in 2002 under the influence of the Queensland “Smart State” strategy which incorporated a renewed emphasis on education, employment, training and youth affairs (Harrevald & Singh 2011). The Education and Training Reform (ETRF) agenda saw the passing of the “Youth

Participation in Education and Training Act 2003" enacting a legal requirement for young people to remain formally enrolled in education and training until the age of 17 with a concomitant promise to "*enhance learning options that provide greater flexibility to meet the needs of even more 15-17 year olds*" (State of Queensland 2002)**.** The enactment of this agenda saw the provision of sizeable funding to support strategies and programs catering for those students considered at serious risk of disengaging from education or training.

In 2003, the Queensland Department of Education and the Arts conducted the *Flexible Learning Services Survey* in order to undertake a scan of the education services that currently respond to young people who have disengaged or who are at risk of disengaging from mainstream schooling (DETA 2004). A total of 121 services were identified and indicated a range of flexible learning services being offered in Queensland including; services within state schools, annexes to state schools providing long-term education programs; flexi-schools (state and non-state), community based youth services; short and long-term education, training and employment preparation programs; TAFE and other training providers and behaviour management programs (DETA 2004).

In 2009, The Youth Affairs Network of Queensland (YANQ) provided a snapshot of Queensland's re-engagement services which involved a survey of 128 services that were then categorised into a few different types based on their focus and aims. Services related specifically to the provision of educational support include Flexi Schools (Government), Flexi Schools (NGO), Community Based VET, TAFE-School Linkage and In-School Support. Additional programs identified included Mentoring, Teaching Culture, Wilderness Program, Youth Justice Learning Program and Community-Based Learning (Powel & Shafiq 2009).

In 2010, Edmund Rice Education Australia established the Youth+ organisation which administers a suite of flexible education initiatives including the Edmund Rice Education Australia Flexible Learning Centre Network (EREAFLCN) in Queensland as well as programs tailored specifically for young people in care and for those requiring support to transition to further education and training (EREA 2010). The Youth + suite of programs currently cater for the following young people:

- Those who have had contact with the juvenile justice system;
- Those in the care of the Department of Child Safety;
- Those with a history of extended periods of unexplained absences;

- Those who are Indigenous;
- Those who are highly mobile;
- Those who have had repeated difficulty conforming to the behaviour requirements of mainstream education and training;
- Those with mental illness or at risk of engaging in self harming behaviours or substance abuse;
- Those with chronic illness leading to extended absences;
- Those who have been excluded from school;
- Those who are homeless;
- Those who are young parents;
- Those who have repeatedly suffered from severe negative schooling experiences;
- Those with a generational history of early school leaving; and
- Those searching for a different educational experience (EREA 2010, p.3)

While providing a comprehensive and growing suite of programs, Youth+ have highlighted concerns in meeting the current demand for flexible learning options with more than 2000 young people on waiting lists in Queensland (EREA 2010). There is unquestionably a need for further expansion of quality flexible learning programs to cater for an increasing number of young people who find themselves disenfranchised from the mainstream schooling experience.

Best Practice Alternative Education Approaches

Provision of a wide range of flexible learning options, as indicated in the surveys reported above, results in diversity rather than homogeneity in relation to the goals of programs, student demographics, program resources and facilities, management and administration models and relationships with mainstream education and community agencies. This makes problematic a concise definition of "what works" for disengaged young people but a number of authors have attempted to highlight elements of best practice that both engage and improve the educational and social outcomes of marginalised young people.

Spielhofer, White, O'Donnell & Sims (2005) have identified the following characteristics as being best practice in the delivery of projects and activities for disengaged young people:

- Offering activities that are meaningful and relevant that they can participate in voluntarily.

- Delivering learning in an environment that is not like school.
- Providing one-on-one support for young people, tailored to individual needs and circumstances.
- Employing staff with the skills and qualities necessary to develop meaningful and supportive relationships with young people.
- Establishing strong links with school and other agencies to support transition of young people into further education or training.

In relation to alternative programs that operate formally as schools, some of the traits commonly attributed to successful educative programs have been identified as that of:

- Choice - Voluntary participation by teachers, students and families.
- Autonomy and Control - Horizontal rather than vertical hierarchy of authority and decision-making.
- Curriculum and Skills - Curriculum relevant to students' needs and life experiences.
- Spirit of Common Enterprise - Purposeful emphasis on school as community (Raywid 1982).

Additionally, authors such as Lange & Sletten (2002) and Leadbeater (2008) emphasize the importance of providing integrated, relevant and individualised learning plans for marginalised young people attending alternative education settings. As a local Australian exemplar, the education model that underpins the EREAFLCN approach integrates these characteristics through an emphasis on flexible pedagogy and incorporation of a learning framework which is relevant and responsive. This learning framework "emerges from openness, negotiation, experimentation and the interaction of mindsets which seek the common good of the young person within a context of individual skills and potential" (EREA 2010, p.5). Learning choices within the framework encompass the whole of the young person's needs and incorporate literacy and numeracy skills, rich humanity key learning areas, vocational and employment focused outcomes, sport and recreation activities, relationship development and community participation. The intention is to enable young people to develop an appropriate skill base that will empower them to fully participate in community life (EREA 2010).

Mills & McGregor's (2010) recent study examined best practice from the perspectives of the young people who actually attend alternative education settings in Queensland and found that students consistently identified the following as of key importance:

- Learning Programs – Opportunities to undertake traditional subjects and curricula as well as workplace training and access to vocational qualifications;
- Learning Environment – Relaxed school climate, flexibility, staff-student dialogue and negotiation, voluntary attendance, sense of community;
- Teaching Relationships – Accepting students for who they are, respect between staff and students, young people feeling 'celebrated', receiving sufficient time and assistance to complete work, 'connected' and 'conversational' teaching strategies.

To guide best practice curriculum delivery in alternative education settings, Mills & McGregor (2010) provided recommendations indicating that there should be:

- Provision of appropriate curricula that suits the needs of students and provides them with pathways towards work and further education.
- Flexibility to develop diverse curricula responsive to the needs and aspirations of young people who choose to attend alternative settings.
- Curriculum connected to young people's worlds that values the diversity of the student population while maintaining concern with learning that is intellectually challenging (refer to Wilson & Stemp (2010) for a practical example of the application of a place-based learning approach to engage young people attending an alternative setting).

Mills & McGregor also noted the importance of alternative education settings acting in the capacity of "full-service" schools which is enabled through cooperation between alternative schools and welfare agencies in order to provide wrap-around services such as "the provision of crèches, housing support, advocacy services, meals and physical and mental health counselling" (2010, p.9). The provision of transport assistance is also an important component of alternative approaches and a key recommendation of Mission Australia's Youth Employment Strategy Report (2006) is to encourage greater use of mobile outreach service delivery options, particularly in rural and remote areas, to both reduce social exclusion and enable the provision of integrated employment, training and community service to young people.

The Ideal Alternative School

In summary of the best practice literature, it is possible to construct a picture of what the ideal alternative school might look like in the modern educational context. It would, in the first instance, be physically located within the community place of the young people it intended to serve. This would enable strengthening of the ties between school and community and make possible an exchange of resources and capital. If possible, the school would employ teaching and non-teaching staff from the same community to further strengthen local bonds. Student numbers would be limited to a maximum of 100 students (preferably less) to enable the development of a cohesive inner school community and the fostering of personalised relationships between staff and students. Teaching staff would be highly qualified professionals with experience in working with young people from disadvantaged backgrounds. They would have the necessary skills to identify the strengths that each young person brings to the educational setting and would be able to develop individualised learning plans to ensure that each young person reached their full potential. Teaching staff themselves would be supported by a range of qualified support staff such as Youth Workers and Guidance Counsellors to ensure that young people might achieve both academic and social outcomes. Diverse cultural backgrounds and other dimensions of difference would be celebrated as a rich component of the cultural fabric of the school. The school itself would operate in an open and democratic manner that would invite participation by marginalised young people and their families. This would then fulfil the primary criteria of the successful alternative school – that young people choose to attend and to actively re-engage with the learning process.

Conclusion and Recommendations

Current inadequate methods of tracking young people who have disengaged from formal schooling, particularly very early school leavers, makes it difficult to ascertain the exact numbers of young people who have fallen through the cracks of the mainstream schooling system. However the data that is available indicates that youth disengagement remains a significant social concern and this is verified by the experiences of alternative service providers who find themselves unable to meet the growing demand from young people which at times results in extensive waiting lists such as that experienced by the Youth+ organisation (EREA 2010).

While it is highly concerning that many young people are currently not engaged in either education or training, the creation of a successful alternative program is one that cannot be rushed for the sake of expediency. Successful programs are built on the

foundation of a well-defined philosophy that integrates the principles of best practice alternative approaches and clearly articulates to both staff and students the nature, purpose and intent of the program. Mills & McGregor (2010) make a very clear point that alternative schooling sites are not aspiring to mainstream models and neither are they behaviour management centres nor 'dumping grounds' for troublesome students. The authors in fact state that "the alternative practices of flexible learning centres should be supported as models of effective teaching and be used to inform practices within mainstream schools" (Mills & McGregor 2010, p.10). In order for this to be accomplished, alternative programs must continue to embrace a holistic and integrated approach to teaching and learning that encompasses the entire needs of the marginalised young person. This requires consideration of:

- Physical Structures (such as well-equipped school buildings that allow for the provision of diverse curricula options e.g. kitchens and manual work spaces)
- Transport/Mobile Services (such as vans with appropriate carrying capacity)
- Staffing (appropriately qualified teaching, welfare and support staff)
- Strategic Planning (long term vision for the program)
- Curriculum (best practice curriculum and culturally responsive pedagogy).

To implement a "full-service" program, it is often necessary to enlist the assistance of local agencies that might work in partnership to enable the provision of this additional support for young people. Partnerships can also reduce the burden of funding alternative programs which remains a persistent issue for most service providers (McGregor & Mills 2010) as the intense support provided for young people is costly in relation to human resources. Community support is also critical to the long term success of the program as "education is, at its essence, learning about life through participation and relationship in community" (Cajete 1994, p.25). Participation, relationship and community must always remain central to the alternative approach.

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Appendix B Observation Template

Observation Details	
Date	
Time	
Place	
Participants	

Sensitizing Concept	**Field Notes**
Program Setting – Replicable description.	
Social Climate – Ways in which people organize themselves into groups and sub-groups, Patterns of interactions, frequency of interactions, direction of communication patterns (from staff to participants and participants to staff), Characteristics of people in different groups – male groupings, female groupings, male-female interactions and interactions among people with different background characteristics, different cultural characteristics and of different ages, Decision-making patterns.	
Program Activities and Participant Behaviours – Complete Overview of Unit of Activity (Beginning: How is the activity introduced? Who is present? How did participants respond? Middle: What is being said by staff? What is being said by participants? What are participants doing? What are the variations is how participants are engaging in the activity being observed? How does it feel to be engaged in this activity- observer inference included. How did	

behaviours and feelings change over course of activity? End: What are signals that the activity is being ended? How do participants react? How is the completion of this unit of activity related to other program activities and future plans?	
Informal Interactions and Unplanned Activities – Unstructured time.	
Native Language of Program Participants - Exact language used by participants.	
Non-Verbal Communication – Fidgeting, moving about, trying to get comfortable (communication of attention and concentration on group process), How participants dress, express affection, physically space themselves in discussions and arrange themselves in their physical setting.	
Program Documents	
Participant/Observer Reflection Influence of researcher self, cross-roads for decision-making.	

Appendix C *Teaching Science* Guidelines for Contributors (Australian Science Teachers' Association)

Guidelines for contributors to *Teaching Science:*

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Appendix D *The Australian Educational Researcher* Copyright Transfer Statement (Springer)

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