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**EVALUATION OF
ENVIRONMENTAL LITERACY OF
PRE-SERVICE TEACHERS IN NEW ZEALAND**

A thesis
submitted in fulfilment
of the requirements for the degree

of
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at
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By

OLUWASEUN DEBORAH DADA



THE UNIVERSITY OF
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Abstract

Environmental education (EE) has been recognized as a vital tool that could help to alleviate the prevailing environmental and sustainability issues facing our world today. One of the goals of environmental education (EE) has been recognized as the development of environmental literacy (EL). The development of environmental literacy for pre-service teachers (PSTs) is critical if they are to be confident and competent to deliver EE in schools. This study sought to examine the preparedness of PSTs to teach EE in New Zealand primary schools, after completing a compulsory EE paper in their first year of a three-year teacher education programme, in a New Zealand public university. This research is relevant as EE in New Zealand primary schools is recommended to be taught through integration into the core learning areas.

This study was conducted using a case study strategy within an interpretive paradigm to seek the meanings of the experiences of PSTs and their learning in the EE paper. Data was gathered from different cohorts of pre-service teachers and their lecturers using a mixed method approach that involved administration of questionnaires, focus group discussions, interviews, observations, and document analysis. The cohorts included Year 1 PSTs taking the paper at the time the research was conducted, Year 3 PSTs looking back on the paper they had previously taken two years ago, and beginning teachers who had recently completed the degree. Quantitative data were analyzed using descriptive and inferential statistics such as t-test, ANOVA, Pearson product moment correlation and path analysis. Statistical Package for the Social Sciences (SPSS) was used to run undertake these tests. The qualitative data were analyzed thematically using content analysis.

Findings from this study showed that the EE paper has an immediate impact on PSTs' EL, especially on their knowledge and concern for issues extensively discussed during the paper. The PSTs also believed that, amongst other experiences or papers taken at the University, the EE paper contributed the most to their EL. However, the EL developed seem to have waned two years after taking the EE paper as indicated by the findings from the Year 3 PST cohort. Upon graduation, at least six months into teaching, experiences of the beginning teachers indicate that school

managements' priorities played a major role in whether EE is implemented into their teaching or not. Other factors identified are issues with approaches for integrating EE into teaching, knowledge of EE, overcrowded curriculum and lack of time, teachers' interests and a novel factor identified as 'rituals'.

This research highlights the vital role teacher education programmes play in developing EL of PSTs and their preparedness to teach EE in primary schools. It also contributes to an understanding of current issues associated with the challenges of teacher education programmes in achieving the goal of developing environmentally literate teachers. This research concludes that in order to successfully implement EE in New Zealand primary schools, there is the need for amendments to the current EE policies in New Zealand primary schools. Also, teacher education programmes need to modify their curriculum and pedagogical approaches to enhance the development of PSTs' EL to ensure that teachers are well equipped and confident to teach EE before they begin their teaching career.

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Dada, D. O., Eames, C., & Calder, N. (2017). Impact of Environmental Education on Beginning Preservice Teachers' Environmental Literacy. *Australian Journal of Environmental Education*, 33(3), 201-222.

This is to acknowledge that the above publication was produced during the course of this study and some materials drawn from it can be found throughout this thesis. These materials are mostly related to aspects on the evaluation of Year 1 Preservice teachers' environmental literacy.

Publication arising from this thesis

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Chapter One: Introduction

1.1 Chapter Outline

This study sought to examine the environmental literacy (EL) of New Zealand pre-service teachers (PSTs). The focus of the study was on examining the development of PSTs' EL at two stages of their teacher education: immediately after completing an environmental education (EE) paper and two years after completing the EE paper. These PSTs were made up of Year 1 and Year 3 PSTs respectively. The preparedness of each cohort of PSTs to teach EE upon graduation was also investigated. Finally, the experiences of beginning teachers in integrating EE into their teaching were explored in this study.

The first part of this chapter introduces the rationale for this study, the researcher's journey, and the motivation for the research. The research questions guiding the study and significance of the research are then discussed followed by an overview of the research design used in this study. The Chapter ends with an overview of the thesis chapters.

1.2 Rationale for the study

The environmental and sustainability issues facing our world today may never have been more pressing. Orr (1992, p. 48) described our world as being in the midst of a global crisis and twenty-five years on, this portrayal still holds. The magnitude and complexity of the environmental and sustainability issues facing our world are substantive and pervasive. These issues include climatic changes (Doney et al., 2012; Min, Zhang, Zwiers, & Hegerl, 2011; Paterson, 2010), depletion of the ozone layer (Andersen, Andersen, Sinclair, & Sarma, 2012; Caron, 2014), desertification and degradation of agricultural land (Barrow, 2014; Geeson, Quaranta, Salvia, & Brandt, 2015), loss of biodiversity (Chapin et al., 2000; Hooper et al., 2005; Magurran, 2013), pollution of the atmosphere, waterways and ocean (UNEP, 2012); waste disposal; population growth; poverty; famine; and social injustice. Despite the advancements that technology and economic growth bring in terms of standards of living, they come at a cost that threatens the sustainability of our natural and social systems (Cutter & Smith, 2001; Goldman, Yavetz, & Pe'er, 2006). A more threatening aspect to the prevailing condition of our world is the lack or limited

awareness of the influence of humans on the environment and social systems. Published literature has reported that human activities often inflict irreversible damage on the environment (Cortese, 2003; Esa, 2010; Goudie, 2013; Tuncer Teksoz, Boone, Tuzun, & Oztekin, 2014). If this trend continues, the impacts would not only be felt by the current generation but well into the future. Hence, there is the need for changes that would enhance the sustainability of our natural and social systems.

Education has been identified as a tool that could play a crucial role in bringing about change. It has the potential to raise awareness about environmental and sustainability issues, increasing knowledge and equipping citizens with the needed skills, as well as shaping their attitudes and behaviour towards the environment (Dobrinski, 2008). Although the extent to which education can contribute to the solution of the existing global crisis is debatable, the potential of the education sector to play an important role is clear (Lugg, 2007). Education in general, and EE specifically, have been recognized for some time as having an essential role in the solutions to the environmental and sustainability issues of our day (Erdoğan, 2009; Ernst & Monroe, 2004; Hungerford & Volk, 1990; Liefländer, Fröhlich, Bogner, & Schultz, 2013; Lukman, Lozano, Vamberger, & Krajnc, 2013; Morrone, Mancl, & Carr, 2001; Roth, 1992; Tuncer Teksoz, Boone, Tuzun, & Oztekin, 2014; Yavetz, Goldman, & Pe'er, 2014). Through EE, present unsustainable conditions are challenged, creating ways for new paradigms and behaviours that promote more sustainable ways of living (Teksoz, Sahin, & Tekkaya-Oztekin, 2012; Tilbury & Wortman, 2008). Comprehensive and meaningful EE is therefore pivotal in addressing the global crisis facing our world (Hollweg et al., 2011).

One of the goals of EE is the development of Environmental Literacy (EL) (Erdoğan, 2009; Hungerford & Volk, 1990; Morrone et al., 2001; Roth, 1992). Although there is no consensus on the definition of EL, previously published frameworks (Harvey, 1977; Hollweg et al., 2011; Hungerford, Peyton, & Wilke, 1980; Simmons, 1995b) agree that EL draws on four major components: knowledge, affect, skills and behaviour. Although behaviour features as one of the EL components, it is also the end goal: EL is expressed through observed environmentally-responsible behaviour (Roth, 1992). Therefore, it is essential that

the goals of educational systems should encompass EE that aims at the development of environmentally-literate citizens (Hungerford & Peyton, 1976; Roth, 1992; UNESCO, 2009).

In advancing EE efforts to develop EL, the role of teachers cannot be overemphasized. Teachers are crucial to active EE in the classroom, as they are the link between curriculum, pedagogy, assessment, and social and learning outcomes (Jones et al., 2014). The regular interaction of students with their teachers could play a significant role in promoting and improving the capacity of the students to address environmental and sustainability issues (Liu, Yeh, Liang, Fang, & Tsai, 2015). However, teachers may not be able to meet these expectations if they have incomplete conceptions about environmental and sustainability issues, if they manifest low levels of EL, and do not themselves engage in environmentally-responsible behaviour. It follows then that teacher education institutions are crucial for equipping teachers to address EE (Hill, 2016; McKeown, Hopkins, Rizi, & Chrystalbridge, 2002; Tilbury, 1992; Tuncer Teksoz et al., 2009; Van Petegem, Blicck, Imbrecht, & Van Hout, 2005; Yavetz, Goldman, & Pe'er, 2009). Increasingly, teacher education through higher tertiary institutions is seen as a significant contributor to the development of environmentally-literate citizens (Mintz & Tal, 2014; Orr, 1992; Daniella Tilbury, A Keogh, A Leighton, & JC Kent, 2005). Adequate EE preparation of teachers in teacher education programmes is essential to help them to design and implement effective EE curricula (Cutter-Mackenzie & Smith, 2003; Tomas, Girgenti, & Jackson, 2017). It also prepares them to be able to integrate EE into their school curriculum (Tilbury, 1992). Inadequate teacher preparation during teacher education programmes has been identified as one factor that contributes to the deficiencies in EE efforts and EE curriculum in schools (Knapp, 2000; UNESCO, 1997).

As stated by Orr (1992), “all education is EE. By what is included or excluded, emphasized or ignored, students learn that they are part of, or apart from, the natural world.” (p. 90). On this basis, the education that PSTs receive during their teacher education programme could determine whether the goal of EE in developing their EL is achieved or not. There is also the possibility that the EL that they develop would be passed on to their future students. As in many countries, most universities

offering teacher education programmes in New Zealand offer papers related to EE at both primary and secondary levels. However, these are often limited in scope and restricted to specifically enrolled student populations (Eames, Bolstad, & Robertson, 2008). Ten years ago, it was reported that no teacher education institution in New Zealand guarantees that every teacher graduate in any programme has had access to EE during his or her study, except at the University of Waikato (Eames, Bolstad, et al., 2008), and anecdotally this situation remains today (C. Eames, pers. Comm. November 2017). After completing their teacher education programme, they are faced with the reality of the teaching world, particularly in a policy environment where schools have autonomy over their local curriculum and may or may not include EE into the curriculum in a way that meets the learning needs of the students. Given this background, for teachers to be effective, they need to be adequately equipped to be confident in their teaching abilities in EE. Upon completion of teacher education and subsequently entering their profession, early career teachers may struggle with diverse pressures and new experiences and may even overlook incorporating EE into their teaching. What are the realities then for pre-service teachers in New Zealand tertiary education today with regards to EE? The study reported here contributes to addressing this question by evaluating the impact of completing an EE paper on PSTs' EL, the retention of the EL developed (if developed), and their experiences applying their EL into their teaching during the early period of their teaching career.

1.3 Personal journey of the researcher

Unlike other researchers in EE, my interest in this research was not entirely due to my connectedness with nature. Instead, my motivation arose from realizing my disconnectedness with nature and my curiosity to learn more and become a part of the change the world needs. I felt that I might be able to contribute towards this change with my newly gained knowledge. I was motivated to conduct this research as a result of my master's degree programme in environmental studies. During this period, I learned about the environment, its associated problems, and the relationships that exist between humans and the environment, as well as the roles of humans in protecting the environment. This sort of new learning opened up an unfamiliar world to me (having gained a BSc in microbiology), caught my interest,

and provoked in me a willingness to be an agent of change. My master's project was to research the EL of students in a public university in Malaysia; my findings startled me as I discovered that some young people were not aware of the environmental and sustainability issues facing our world, despite the campaign going on at the university at that time. Interestingly, those individuals who were knowledgeable about environmental and sustainability issues because of prior exposure to EE did not necessarily engage more in environmentally-responsible behaviour. My interest in working with young people, especially university students, who are potential leaders and who will be involved in future planning, policy decision making, advocacy, and capacity building, was aroused. Unsurprisingly, when I decided to further my education by undertaking Ph.D. studies, I was drawn to examining a topic that dealt with EL in young people who might influence future generations. Researching this topic has had both professional and personal effects on me. On the one hand, seeking to explore the impact of exposure to EE on individuals who have the potential to be agents of change in their society has been an intriguing experience. On the other hand, doing this research has led me to examine myself in the light of the study and to seek ways to be more environmentally responsible in my personal and family life.

1.4 Research questions

Based on the rationale for the study presented in Section 1.2, this research addressed the following questions.

Main Question:

What is the impact of completing an EE paper on EL levels of New Zealand PSTs?

Sub Questions:

- 1) What is the immediate impact of completing a first-year core paper in EE on EL levels of PSTs?
- 2) What are the environmental literacy levels of ready-to-graduate PSTs and how prepared do they feel to teach environmental education based on their exposure to environmental education during their pre-service teacher education?

- 3) What relationships exist between components of EL (knowledge, concern, affect, and behaviour) among PSTs?
- 4) Upon exit from university and integration into the teaching workforce, what are the experiences of graduate teachers in applying their EL?

1.5 Significance of the research

Given the awareness and growing concern about increasing environmental and sustainability issues, there is much attention on EE and EL as potential panaceas for the restoration, nurturing and protection of our environment and improvement of the society at large (Liefländer et al., 2013; Lukman et al., 2013; Yavetz et al., 2014). The incorporation of EE into teacher education programs could produce a multiplier effect, as EL developed in PSTs can ultimately influence the promotion of EL in future generations, when these teachers become involved in teaching and mentoring of their future students (Knapp, 2000; Tuncer Teksoz et al., 2014). However, the question is whether teacher education programs in EE are achieving the goal of producing environmentally-literate citizens. This makes it essential to understand the relationship between EE and the development of EL among PSTs (McKeown-Ice, 2000).

Despite the global recognition of the importance of EE and EL within the formal educational framework and the significant role teacher education could play in improving EL, a review of the literature suggests that in New Zealand, there is a dearth of EE research addressing the EL of PSTs. More specifically, no studies have been published on the impact exposure to EE has on PSTs' EL and their subsequent practice as teachers within schools.

On the international front, several studies from different countries have reported on PSTs' EL, such as in Australia (Effeney & Davis, 2013; Evans, Tomas, & Woods, 2016; Kennelly, Taylor, & Maxwell, 2008; Taylor, Kennelly, Jenkins, & Callingham, 2006; Tomas et al., 2017), Malaysia (Esa, 2010; Ismail, 2011), Israel (Goldman et al., 2006; Goldman, Yavetz, & Pe'er, 2014; Pe'er, Goldman, & Yavetz, 2007; Tal, 2010; Yavetz et al., 2009, 2014), Turkey (Koc & Kuvac, 2016; Özden, 2008; Timur, Timur, & Karakas, 2014; Tuncer Teksoz, Boone, Tuzun & Oztekin,

2014) and the United States (Ashmann & Franzen, 2017; McKeown-Ice, 2000; Moody, Alkaff, Garrison, & Golley, 2005). However, most of these studies stop at the exploration of the development of PSTs' EL through exposure to EE. This present study is significant to EE research as it seeks to go beyond investigating the development of PSTs' EL upon completing an EE paper to investigating the retention of the EE developed and subsequent application in their early years of teaching.

The findings from this study can assist curriculum and programme developers to have a better understanding of the impact of EE in pre-service teacher education, including ideas for improvement where necessary. The study also aimed to provide valuable feedback to teacher educators by evaluating an existing programme and suggesting approaches for more effective EE in teacher education. This possibility was explored, as the PSTs in the current study were followed into their first teaching position to determine how effectively they were implementing EE in their day-to-day teaching. In this way, the findings of this study suggest changes that could help future teachers to be willing and competent to meet the needs of their students and their societies with respect to EE.

1.6 Overview of Research Design

This study employed an interpretivism paradigm to evaluate the EL of PSTs upon exposure to an EE paper. Given the aims and purpose of this study, as exemplified by the research questions, a case study methodology was considered the most appropriate strategy. Hence, the teacher education programme at the University of Waikato, and more specifically, the EE paper being offered was used as a case study. Two cohorts of PSTs enrolled in a compulsory EE paper at the University of Waikato were involved in this study. These cohorts comprised of Year 1 PSTs who were undertaking the EE paper and Year 3 PSTs who took the EE paper two years previously. Since the study aimed at investigating the experiences of beginning teachers in applying their EL, some of the Year 3 PSTs were followed up at least six months into their teaching career to examine how they had been able to apply their EL into their teaching.

The data collection process in this study was carried out on a cohort basis, as guided by the research questions. A pre-test and post-test design was used to gather data from the Year 1 PSTs to examine the immediate impact of completing an EE paper on their EL and preparedness to teach EE upon graduation. Focus groups, discussion, and classroom observations, were also employed to gather data from the Year 1 PSTs. The retention of EL and preparedness of the Year 3 PSTs to teach EE upon graduation were examined using questionnaires and focus group data. Finally, the experiences of beginning teachers were investigated through interviews. Some triangulation of data was achieved by using multiple methods of data collection involving questionnaires, focus group discussion, classroom observation, and interviews.

1.7 Overview of thesis chapter

This thesis is comprised of seven chapters. Synopses of the remaining chapters are outlined below.

Chapter 2 This chapter presents a review of literature relevant to this study with a close examination of topics that would provide further insight into EL and PSTs' preparedness to teach EE in New Zealand primary schools. This begins with the historical roots of EE, and its evolution and status in New Zealand schools; the definition of EL, its assessment, its components (environmental knowledge, environmental affect, environmental concern and environmental behaviour); relationships between PSTs' EL components; and PSTs' preparedness to teach EE and the experience of teachers in their initial teaching years. The chapter concludes with the conceptual framework underpinning this study.

Chapter 3 This chapter details the methodology used in this study. Paradigms underpinning educational research are discussed followed by the research approach and design employed in this study. The data analysis methods employed are also discussed. This chapter

concludes with discussions around validity and reliability, and ethical considerations of the study.

- Chapter 4 This is the first of three findings chapters. This chapter presents the findings of the first research sub-question on the immediate impact of completing an EE paper on the EL of PSTs in New Zealand.
- Chapter 5 This is the second findings chapter, which seeks to answer the second research question of this study related to the EL levels of ready-to-graduate PSTs (Year 3) and their preparedness to teach EE based on their exposure to EE during their pre-service teacher education.
- Chapter 6 This is the final findings chapter and it presents an analysis of the experiences of beginning teachers in applying their EL, six months into their teaching careers.
- Chapter 7 This final chapter discusses the findings of the study and draws some conclusions and recommendations for practice and future research.

Chapter Two: Literature review

2.1 Chapter Outline

This chapter presents a review of existing literature relevant to this study. Firstly, the historical events that contributed to the development of environmental education (EE) globally are presented. The literature on the definitions, goals, and characteristics of EE is also examined. These aspects of EE are presented to conceptualize a clear picture of environmental literacy (EL), the development of which is considered one of the ultimate goals of EE. The next two sections focus on the development of EE in New Zealand, with an emphasis on its status and evolution in primary schools. To understand the place EE holds in New Zealand primary schools, the context of primary school education in New Zealand is then presented. Next, a conceptualization framework for EL is presented, including definitions of EL, its evaluation, and its components. The EL components considered in this study are environmental knowledge, environmental affect, environmental concern and environmental behaviour. A review of the literature on these EL components and their relationships is also presented. Since this study explores PSTs' EL and preparedness to teach EE upon graduation, based on the EL developed during their teacher education programme, the next section presents the literature on teacher education programmes globally and in New Zealand. The review is then narrowed to PSTs' teacher education in EE globally, and in New Zealand, as guided by the purpose of this study. This is followed by a summary of the literature on PSTs' development of EL and preparedness to teach EE. Finally, the experiences of teachers in their initial years of teaching are explored. The chapter concludes with summaries of the key ideas presented in the literature review and a presentation of the conceptual framework underpinning this study.

2.2 Historical Roots of Environmental Education

Environmental education (EE) is not a new field; it dates back to the 18th century and continues to evolve. As EE evolves, its definitions have been researched, revisited, and expanded. However, its focus on developing environmentally literate citizens remains unchanged (Cole, 2007). Consequently, of interest to this study is the place of EE in developing environmental literacy (EL). This section seeks to

understand the history behind EE to present a clear picture of EL, as one of its expected outcomes.

The development of EE can be traced to writers whose publications have been influential. Although no list can do justice to all of them, however, from the perspective of this study, McCrea (2006) pays tribute to the following writers who have contributed significantly to the development of EE: Jean-Jacques Rousseau, who wrote *Emile* in 1762, an educational standpoint written as a novel, which advocates for education to have its focus on the environment, Louis Agassiz (1857), who encouraged students to study nature, not books; John Dewey (1938) who promoted a more student-centered and holistic approach to education, and also pioneered many educational approaches that are important aspects of EE today, such as learning by doing, lifelong learning, integrated and interdisciplinary efforts; and L. B. Sharp, who in the 1940's was one of the earliest advocates of outdoor education. Added to this list are Aldo Leopold, regarded as the father of conservation study, who emphasized in his writing in 1949, *A Sand County Almanac*, that "the essential purpose of education is to inform the citizen about his or her place in the ecosystem as a basis for the intelligent and sustainable use of lands and natural resources" (Kessler & Booth, 1998, p. 707); and Rachel Carson, (1970) who published *Silent Spring*, which came out of the heightened concern about environmental degradation of the day.

An early, concise and widely used definition of EE, was given by Stapp (1969). He defined EE as the "process of developing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (pp. 30-31). The main objectives of EE, according to Stapp (1969), are to encourage in citizens:

- (1) a clear understanding that man (sic) is an inseparable part of a system, consisting of man, culture, the biophysical environment, and that man has the ability to alter the interrelationship of this system,

- (2) a broad understanding of the biophysical environment, both natural and man-made, and its role in contemporary society,
- (3) a fundamental understanding of the biophysical environmental problems confronting man, how these problems can be solved, and the responsibilities of citizens and government to work toward their solution and,
- (4) attitudes of concern for the quality of the biophysical environment which will motivate citizens to participate in biophysical environmental problem-solving (Stapp, 1969, p. 31).

Stapp's line of thought held emphasizes the interconnections between humans, his culture and nature. He also highlights the need to understand the operation of, and problems in, the system, as well as identify and engage in potential solutions to these problems. In these early definitions and objectives of EE, elements such as knowledge, affect and motivation to participate in solving environmental problems are alluded to. These are of relevance to this study as discussed in Section 2.4.

Another way to trace the origin of EE has a lot to do with decisions from a number of conferences initiated by the United Nations. For instance, in 1970 at a meeting sponsored by the World Conservation Union and UNESCO, a widely accepted definition of EE was adopted which stated that EE is:

...the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture, and his biophysical surroundings. Environmental education also entails practice in decision-making and self-formulation of a code of behaviour about issues concerning environmental quality (World Conservation Union [IUCN], 1970 (as cited in Hart, 2007).

This definition of EE highlights the role of values and attitudes (described as affects in this study) in understanding (knowledge) and appreciation of human-environmental-sociocultural relationships. The emphases in these definitions are slightly different, as Stapp's definition accentuates the place of knowledge (understanding) in different aspects of human-environmental relationships. It could

be argued that both definitions of EE discussed propose that EE involves, but is not restricted to, knowledge about environmental problems, affective components such as attitudes, concerns and values, and skills, as well as the behavioural dimensions, which begin with the motivation to contribute to solving environmental problems. The component (knowledge or affect) that manifests first might vary, but consistent with the definitions, the end result is a contribution towards the solution of environmental problems or, in the context of this study, environmental behaviour. Internationally, it was not until 1972 that EE was formally recognized at the United Nations Conference on the Human Environment, held in Stockholm, Sweden. The role of EE as a vital tool in addressing environmental issues all around the world was affirmed and documented (Stevenson, 2007) in the *Stockholm Declaration*. The document, containing seven proclamations and 26 principles, was produced in order "to inspire and guide the people of the world in the preservation and enhancement of the human environment" (Palmer, 2002, p. 7).

Following the Stockholm conference, the United Nations Education Scientific and Cultural Organization (UNESCO) and the United Nations Environment Programme (UNEP) generated two more declarations that have since guided the path of EE (McBride, Brewer, Berkowitz, & Borrie, 2013; Ogunyemi & Ifegbesan, 2011; Palmer, 2002). These were the *Belgrade Charter* (UNESCO, 1976) and the *Tbilisi Declaration* (UNESCO, 2009). The Belgrade Charter, which was the product of the International Workshop on EE held in Belgrade in the former Yugoslavia (now Serbia) in 1975, improved upon the Stockholm Declaration by setting the goals, objectives and guiding principles for EE programmes. According to the Belgrade charter, the goal of EE is to:

... develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones (UNESCO, 1976, p. 1).

The most notable addition this definition made to previous definitions was the concept of action by individuals and groups. The goal made it clear that a person

cannot be regarded as environmentally literate by just being aware of environmental issues; rather, there is the need for the interconnections between knowledge, and affect that could translate into the exhibition of environmentally responsible behaviour.

Two years following the release of the *Belgrade Charter*, the *Tbilisi Declaration* was produced as an outcome of the world's first Intergovernmental Conference on EE held in Tbilisi, Georgia. The *Tbilisi Declaration* expanded and elucidated on The *Stockholm Declaration* and The *Belgrade Charter* by adding new goals, objectives, characteristics, and guiding principles for EE. These goals defined as the basis for EE are:

- (1) to foster clear awareness of, and concern about, economic, social, political and ecological, interdependence in urban and rural areas;
- (2) to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
- (3) to create new patterns of behaviour of individuals, groups, and society as a whole towards the environment (UNESCO, 2009, p. 2)

These goals, which are also of interest in this thesis, incorporated the dimension of sustainability into EE, although the term sustainability was not used at that time. The *Tbilisi Declaration* further broke down the goals into specific objectives of EE:

Awareness – to help individuals and social groups acquire an awareness of and sensitivity to the total environment and its allied problems.

Knowledge – to help individuals and social groups gain a variety of experiences in, and acquire a basic understanding of the environment and its associated problems and humanity's critically responsible presence and role in it

Attitudes – to help individuals and social groups acquire social values, strong feelings of concern for the environment and the motivation for actively participating in its improvement and protection.

Skills – to help individuals and social groups acquire the skills for identifying and solving environmental problems.

Participation – to help individuals and social groups develop a sense of responsibility and urgency regarding environmental problems to ensure appropriate action to solve those problems (UNESCO, 2009).

These goals and objectives have been recognized as the backbone of EE (UNESCO, 1978, p. 3) and they continue to be relevant to the resolution of environmental issues today (Monroe, Andrews, & Biedenweg, 2008). Recommendation for the promotion of a deeper understanding of the natural environment in both formal and non-formal EE settings was also encouraged at the conference (UNESCO, 2009, p. 29). Building on the earlier definitions, the *Tbilisi Declaration* stressed the need for individuals and society to take appropriate actions when participating in the resolution of environmental problems. Taking appropriate actions towards a problem cannot be feasible without having the required knowledge and affective dispositions towards such problems. Hence, by implication, a recognition of the interrelationships between knowledge and affect in exhibiting an environmentally responsible behaviour is alluded to, which is of relevance to this study. Specifically, the components of EL considered are knowledge, concern, attitude (affect), and behaviour. The scope of this study does not provide for the evaluation of skills; therefore the skills of the participants involved in this study were not considered.

As discussed, EE over the years has been mostly concerned with the resolution of environmental issues and this might have been due to the significant movements, including nature study, conservation study, and environmental quality, which influenced its origins. However, in 1987, the World Commission on Environment and Development published the Brundtland Report, also known as '*Our Common Future*'. The report recognized the importance of sustainable development and regarded environmental protection, economic growth and social equity as interdependent concepts (WCED, 1987). The Brundtland Report defined sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 8). Following this report, the focus of EE was shifted politically towards sustainable development, encompassing the environmental, economic and socio-cultural dimensions.

Five years later, in 1992, the United Nations Conference on Environment and Development organized *The Earth Summit*, which took place in Rio de Janeiro, Brazil (McBeth & Volk, 2009; UNESCO-UNEP, 1992). At the Summit, the concept of sustainability was further supported and expounded (Tilbury, 1995). A noteworthy feature of the Rio Earth Summit was Chapter 36 of *Agenda 21* which focused on "reorienting education towards sustainable development; increasing public awareness; and promoting training" (Chapter 36, Agenda 21). Specifically, in relation to this study, it emphasised the need for the integration of environmental and development concepts into all educational programmes (Chapter 36 of Agenda 21 on Education, Awareness and Training). To date, *Agenda 21* is viewed as one of the most important documents in EE (Tilbury, 1995). Additionally, it refutes the notion regarding the environment as a separate system and places emphasis on the holistic perception of the environment, incorporating our surroundings and well-being while making use of nature and its resources. In line with discussions from the Brundtland Report and *Agenda 21*, EL as used in this study is not limited to the 'environment' or environmental aspect alone. Rather it encompasses the three aspects of sustainability.

In 2002, world leaders met at the World Summit on Sustainable Development in Johannesburg, South Africa and "declared education as critical for promoting sustainable development" (Gough, 2006, p. 74). The Summit reviewed progress in the implementation of *Agenda 21* since its adoption in 1992. Expansion of the key principles of sustainable development to include social justice and fight against poverty (Gough, 2006) was undertaken. In December the same year, the UN General Assembly declared 2005–2014 to be the UN Decade of Education for Sustainable Development (UNDESD), highlighting the crucial role of education in achieving sustainable development (UNESCO, 2012). The purpose of the Decade was to "integrate values, activities and principles that are inherently linked to sustainable development into all forms of education and learning and help usher in a change in attitudes, behaviours and values to ensure a more sustainable future in social, environmental and economic terms" (UNESCO, 2007, p. 5).

The Rio+20 United Nations Conference on Sustainable Development held in 2012 in Rio de Janeiro, Brazil, produced a document called *The future we want*. During

the conference, world leaders renewed their commitment “to sustainable development and to ensuring the promotion of an economically, socially and environmentally sustainable future for our planet and for present and future generations” (UNESCO, 2012, p. 1). The importance of an integrated approach to sustainable development was recognised (UNESCO, 2012, p. 10). The conference report noted the need “to integrate sustainable development more actively into education beyond the Decade of Education for Sustainable Development” (UNESCO, 2012, p. 60). Most recently, the Global Action Programme (GAP) on ESD, a follow-up programme to the Decade of ESD (2005-2014), seeks to scale-up ESD and hasten progress towards sustainable development. The GAP aims to contribute substantially to the 2030 agenda by providing everyone the opportunity to develop EL that would help them contribute to a sustainable future, while providing support to education and learning programmes and activities that promote sustainable development (United Nations General Assembly, 2015). Overall, these conferences emphasised the vital role of EE in promoting EL which is necessary to confront the environmental and sustainability issues facing our world today. This research thus explores and discusses the place of EE in developing EL among teachers who are influential in aiding the EL of our future generations.

There has been a range of terms used to describe education in the environmental and sustainability space: Education for Sustainability (EfS), Education for Sustainable Development (ESD), Environmental and Sustainability Education (ESE) (Brignall-Theyer et al., 2009). While some advocate for a distinction between these terms (Pavlova, 2011), others seek for convergence between them (UNESCO, 2009). The positions taken by these advocates have been influenced by the historical role of EE in their countries (whether marginalized or prominent) and the way EE is interpreted (broadly or narrowly) in their countries. UNESCO (2009) recognised three models of EE-ESD relationships. They are ‘EE equals ESD’ (e.g., USA, Brazil, Taiwan), ‘EE as a part of ESD’ (e.g., Vietnam, Arab countries) and ‘ESD as distinct from EE, although they do overlap and both are legitimate and necessary’ (e.g., The Netherlands, Canada, Greece). Despite the debates around the most appropriate term, there is a growing consensus about the shared similar outcomes between EE, EfS and ESD. According to Gough (2006), elements reflecting the role of education in balancing environmental protection, quality of

human life and economic growth can be traced back to the *Belgrade Charter* written over 40 years ago. In a similar vein, the Parliamentary Commissioner for the Environment (PCE) argued that it is how words are used and what they actually mean to people that is important (PCE, 2004). In New Zealand, as opined by Eames et., al (2008) “While the language of ‘sustainability’ has taken root in many sectors in New Zealand, the older term ‘environmental education’ has, for better or worse, tended to linger as the dominant discourse in the school sector” (p. 35). As such, in this study, in order to have consistency and to simplify matters, EE will be used as a broad concept encompassing education and sustainability and the ideas around EfS and ESD. Having reviewed the existing literature related to the historical roots of EE, EE definitions, goals, and characteristics, and the key events that have shaped the field of EE globally, the next section reviews the literature on the evolution of EE in New Zealand.

2.3 Evolution of Environmental Education in New Zealand Schools

As in many countries, international conferences and declarations on the environment and sustainability influenced the development of EE policy in New Zealand schools (Eames, Cowie, & Bolstad, 2008). Prompted by *Agenda 21*, changes to New Zealand's environmental policies and legislation, and the New Zealand government's obligations to the Treaty of Waitangi, both the Ministry of Education and the Ministry for the Environment developed policies on EE in the 1990s (Ministry of Education, 1999). At this time, “grass-roots” support for EE was also building up in some New Zealand schools and communities (Eames, Cowie, et al., 2008). Actions carried out by these EE communities of interest involved organizing meetings, conferences, and developing their own school-based EE curricula.

The most successful of these school-based initiatives was the Enviroschools Programme (Eames, Roberts, Cooper, & Hipkins, 2010). Enviroschools is an “eco-school” model, which supports schools to develop a whole-school approach to EE. In 1993, the first three “Enviroschools” were established by a task force comprised of teachers, the local and regional councils, and other EE groups. By 2002, the Enviroschools programme was available to schools in all regions of New Zealand (Hamilton City Council, 2001, p. 7). Eames, Cowie, et al. (2008) reported that by

2008, the Enviroschools programme had been implemented in over 400 schools in New Zealand. By 2017, over 1000 schools and early childhood centers were involved nationwide (Enviroschools, 2017). Following the introduction of the Enviroschools initiative, the Sustainable School Organic Gardens project began to develop. This involved 24 urban schools and 12 Kura Kaupapa Māori throughout New Zealand. The project aimed to assist teachers and schools to create and maintain organic gardens, to develop policies and programmes that support organic gardens, and develop curriculum integration plans that integrate EE across the learning areas. The programme also emphasised Māori perspectives on the environment. Training provisions aimed at developing school facilitators' understanding of EE and sustainable growing from Māori and Western perspectives (Davies, Delidjani, & Moed., 2002 cited in Eames, Cowie, et al., 2008) were also put in place.

The goals of initiatives such as the Enviroschools programme, which are to promote young learners who value, care for, and are connected to the environment (Enviroschools, 2017), align well with the aims of EE, producing environmentally literate citizens. A recent update of EE in New Zealand schools suggests that the Enviroschool initiative continues to grow, with increasing demands from schools for Enviroschools programmes and other structures to support school-based EE practices (Bolstad, Joyce, & Hipkins, 2015). Some of these requests come from schools already involved in various forms of EE, which would like to add more structure to their delivery of EE. This is because teachers are more confident when they have support, resources, guidance, and networks to assist them with their practices. However, the Enviroschools' facilitators do not seem to be able to meet all the demands, mainly due to lack of funding. For example, the Ministry of Education no longer funds EE facilitators to provide school-based support (Bolstad et al., 2015). Thus, there appears to be a gap in the effective extension of such initiatives to “willing” schools. Therefore, the need to equip more teachers with the necessary knowledge, skills, and confidence to train their future students cannot be overemphasized, despite the political influences that seem to impact the delivery and status of EE in New Zealand. The next section, therefore, reviews the status of EE in New Zealand and how it has impacted EE in schools and initiatives such as Enviroschools.

2.3.1 Status of Environmental Education in New Zealand schools

Although informal opportunities for EE in New Zealand schools have long been provided by enthusiastic teachers, formal inclusion in the country's national curriculum has been slow. However, growing awareness of the importance of the environment, influences from international conferences and declarations on the environment and sustainability led to the development of EE policy in New Zealand schools (Eames, Cowie, et al., 2008). The Ministry for the Environment and the Ministry of Education both developed EE policies in the 1990s, partly due to the impetus from *Agenda 21* and the New Zealand government's obligations to the Treaty of Waitangi, and also as a result of changes to New Zealand's environmental legislation (Ministry of Education, 1999). These developments required that the New Zealand Government took action for the environment in both international and national contexts. On a global scale, New Zealand committed to international agreements to promote EE (Eames, Bolstad, & Robertson, 2008). Meanwhile, at the local scale, international concerns about sustainability were also mirrored in the Resource Management Act 1991 (Council, 2011). This Act makes provision for a legislative framework within which New Zealand's natural and physical resources are managed on a sustainable basis. Also highlighted in this Act is the unique position of Māori as it ensures their right to exercise rangatiratanga (authority) and kaitiakitanga (guardianship) in managing the environment and its natural resources (Ministry of Education, 1993).

The position of EE in *The New Zealand Curriculum Framework* was largely influenced by the political situation/government's interest at the time the curriculum was released (Chapman, 2011). Before the release of *The New Zealand Curriculum Framework* in 1993, a draft curriculum in 1991, stimulated by the then-government, which favoured "caring for the environment" included a suggested learning area entitled "science and environment" (Chapman, 2011) with the intention of incorporating EE within science. However, when the *New Zealand Curriculum Framework* was released (Ministry of Education, 1993), it was at a time in which there was new governance with a neo-liberal stance and as such, "the environment faded from its emerging position in the subject area headings within the curriculum in the face of an economically-driven educational agenda" (Chapman, 2011, p. 197). Since the initial proposal failed, there were debates as to

whether EE should stand alone or be infused across the curriculum (Eames, Cowie, et al., 2008). By default, the *New Zealand Curriculum Framework* took the infusion approach, but there were no EE guidelines at the time the framework was released to help teachers to provide EE in schools. The *New Zealand Curriculum Framework* (Ministry of Education, 1993) also did not make formal provisions for EE in the school curriculum. Instead, it stated that the curriculum should accommodate diverse indigenous needs and priorities in such a manner that environmental concerns were not neglected (Dowling, 1993; Eames, Cowie, & Bolstad, 2008).

The Ministry of Education, which oversees curriculum development and support, development of assessment standards and the whole school sector, has recently had a strong focus on priority areas such as literacy, numeracy and Māori achievement (Nusche, Laveault, MacBeath, & Santiago, 2012). There has been little provision, or governmental support, for teachers trying to carry out sustainability imperatives in the curriculum (Chapman, 2011; Eames, Cowie, et al., 2008). For example, the Minister for the Environment's response to the removal of funding to the Enviroschools' programme, captured on October 18, 2009, by Radio New Zealand National, states:

Environmental sustainability is very important, that is why it has been added to the national curriculum, but in these tough economic times, the Government's focus has to be on its core priorities for the education system of raising literacy and numeracy achievement, and increasing the number of students leaving school with qualifications. Programmes such as Enviroschools are nice to have but do not contribute directly to these priorities (Chapman, 2011, p. 199).

This response, despite admitting the importance of EE in the New Zealand curriculum, characteristically stresses the emphasis of the government on economic growth, which in some ways clashes with the aims of EE. It is important for environmental educators to be aware of the political influences on EE in order to make informed decisions when appropriate

Guidelines for EE in New Zealand schools (Ministry of Education, 1999) were released in 1999 (Eames, Cowie, et al., 2008). This created a formal opportunity for

schools that showed interest to incorporate EE into their school curriculum. While the *Guidelines* recognized EE within the structure of the *New Zealand Curriculum Framework*, they did not make its inclusion in the apparently already 'overcrowded' curriculum compulsory (Chapman, 2011). The *Guidelines* instead presented opportunities for the linkage of EE teaching to the seven essential learning areas of the curriculum, as well as to the 'essential skills' that all New Zealand students were to develop throughout their compulsory education (Ministry of Education, 1999). Although the curriculum had strong statements about the inclusion of environmental topics with science, technology and social studies (Ministry of Education, 1993), the release of the *Guidelines* emphasised that EE was not mandatory, thus watering down its potential in the curriculum (Chapman, 2011).

Schools in New Zealand were given some autonomy in developing their local curriculum, enabling them to infuse EE into the curriculum in a way that met the learning needs of the students in their school. However, a study in Israel, where an infusion approach was employed to teach EE by integrating environmental topics and units into other learning areas, indicated that the approach was not successful. One reason for the ineffectiveness of the infusion approach was the insufficient training of teachers to implement EE in this manner (Goldman et al., 2006). Similarly, a recent study that examined the integration of EE in a Botswana secondary school argued that trying to implement EE by infusion seemed to be in a state of confusion due to the ineffective professional development of teachers and negligence on the part of educational authorities (Velempini, 2017). When students are not assessed on EE, it seems easy for teachers to omit EE from their teaching, despite the expectation of it being included. These studies are relevant to the New Zealand context as EE in New Zealand is expected to be taught using the infusion approach, and for teachers to be effective, they need to be equipped adequately to be confident enough to do so. Due to a huge range of factors, including the priorities of the school authorities, and teachers' personal interests and experiences, this approach seems to give room for EE to be circumvented (Stevenson, 2007). Factors that affect the implementation of EE are discussed in more detail in Section 2.8. The *Guidelines* built on the goals identified in the *Tbilisi Declaration* (UNESCO, 1978), suggesting five aims for EE in New Zealand. This involved the development of students' (1) awareness and sensitivity to the environment; (2) knowledge and

understanding about the environment; (3) attitudes and values towards the environment; (4) skills needed to identify and solve environmental problems; and (5) sense of responsibility through participation and action. Chapman (2004) opined that although “these *Guidelines* originated from the *Tbilisi Declaration*, the five aims of the document appeared ‘as a neutralised form’” (p. 25). As previously discussed, the goals identified in the *Tbilisi Declaration* and pinpointed in the *Guidelines* closely align with characteristics expected for individuals who could be regarded as being environmentally literate. The *Guidelines* also indicated four main concepts that should underpin EE: interdependence, sustainability, biodiversity, and personal and social responsibility for action. PSTs’ knowledge of these main concepts was examined in this study. Also, the *Guidelines* made provisions for the incorporation of Māori worldviews into these concepts (for example, these included rights of ownership of their lands, forests, fisheries and other prized possessions, as well as assurances of Crown protection).

The *Guidelines* (Ministry of Education, 1999) also emphasised that three dimensions of EE: education in the environment, education about the environment, and education for the environment, are needed to achieve a balanced EE programme. Some authors have argued that only ‘education for the environment’ actually achieves the goals of EE (Fien & Corcoran, 1996). In ‘education for the environment,’ the achievement of EE goals involves going beyond being knowledgeable about the environment and its issues. Instead, it extends into a demonstration of concern, as well as the acquisition of the skills required to resolve environmental issues. It mainly involves engaging in actions targeted towards environmental sustainability (Bolstad, 2003). Nevertheless, education ‘in the environment’ and ‘about the environment’ are essential as supplementary approaches to ‘education for the environment’, since they equip individuals with the knowledge and skills needed for actions to take place (Edwards & Cutter-Mackenzie, 2011; Fien & Corcoran, 1996). Some scholars, however, claim that ‘education for the environment’ could be likened to indoctrination since individuals are forced to believe some concepts rather than being treated as intelligent beings (Bolstad, 2003; Bolstad et al., 2004; Qablan, Southerland, & Saka, 2011). In the context of this study, an environmentally literate teacher is one who understands and practices the three dimensions of EE. Education about the environment aligns

with the knowledge component of EL; education in the environment aligns with environmentally friendly attitudes; while education for the environment refers to being intentionally involved in taking actions or exhibiting behaviours that will not hurt the environment. It follows that PSTs would need to develop these in order to guide the learning of their future students.

A stocktake of the *Curriculum Framework* was made in 2002, partly in response to the perceived crowding of the curriculum. An outcome of the stocktake (Ministry of Education, 2002) was the decision to revise the curriculum, and a draft for consultation emerged in 2006 (Ministry of Education, 2006). A final version of the *New Zealand Curriculum* (NZC) was published in November 2007 (Ministry of Education, 2007) and in 2010, this became the official curriculum. The 2007 NZC is considered to provide a stronger message and create greater opportunity for inclusion of EE in schools than the preceding curriculum. This is because it is less prescriptive and empowers schools to make educational decisions that are most appropriate for their students and communities (Chapman, 2011). It presents sustainability as a theme within the “future-focus” principle (Bolstad et al., 2015). It highlights sustainability as one of the values expected of young people. The NZC aims include “our young people who will seize the opportunities offered by new knowledge and technologies to secure a sustainable social, cultural, economic, and environmental future for our country” (Ministry of Education, 2007, p. 8). It also includes environment and sustainability ideas in the values and vision statements, and encourages schools to engage in their own curriculum design (Bolstad et al., 2015; Eames, Roberts, et al., 2010). The 2007 curriculum has also supported a range of overall shifts in practice in schools that are likely to enhance their existing capability to integrate EE within and across the curriculum. These include general pedagogical and curriculum developments around the ‘front end’ of the NZC that is vision, values, key competencies, the future-focused principle, the emphasis on inquiry learning—and teaching as inquiry—and support for schools to develop curriculum coherence (Bolstad et al., 2015). The ‘Future focus’ principle includes issues such as sustainability, citizenship, enterprise, and globalisation. The NZC vision statement claims that young people will be actively involved as “contributors to the well-being of New Zealand – social, cultural, economic, and environmental”; among the values is “ecological sustainability, which includes care for the

environment”; while among the key competencies is “participating and contributing”, which again states sustainability and this time refers to the social, cultural, physical, and economic environments (Ministry of Education, 2007, pp.9-13).

Recently, the government released a document ‘Environmental Education for Sustainability: Mahere Rautaki Strategy and Action Plan 2017 – 2021’ (Ministry of Education, 2017). The document recognized the need for the enhancement of citizens’ knowledge of the environment and its related issues and their ability to make connections between the three aspects of sustainability (environmental, economic, social cultural). The document however placed more emphasis on practical, hands-on EE that would help all New Zealanders learn how they can take action to address both local and global sustainability challenges. Three Priority areas: ‘Enabling coordination of EE’ through engagement with agencies, collaboration and research; ‘Growing capability and capacity in EE delivery’ by facilitating professional learning and development and ‘Strengthening pathways in sustainable practice’ through the promotion of opportunities for EE in tertiary, vocational and non-formal education were highlighted. The document also provided five guiding principles that would help to achieve its vision. These are ‘Growing knowledge skills and understanding’, ‘sharing values’, ‘taking collective actions’, ‘thinking for the future’ and ‘adopting uniquely New Zealand perspective’ (Ministry of Education, 2017).

The Ministry of Education also provided an EE curriculum resource page on Te Kete Ipurangi (TKI), also known as The Online Learning Centre, a web-based educational resource for teachers, schools and the wider education community. The EE TKI site is available to provide help for teachers to engage students in relevant sustainability learning and action by making connections between all areas of the *New Zealand Curriculum* (Ministry of Education, 2011). The central concepts of EE on the TKI website were refined from the key concepts in the senior secondary guideline to better reflect the way the world was going. The latest update of the senior secondary guideline was made available to New Zealand teachers of EE in 2015 (Ministry of Education, 2015). The guideline provided educators and students with a deeper understanding of sustainability. Four key concepts: sustainability,

equity, interdependence and responsibility for action, were identified. However, sustainability became the overarching theme. The environmental, social, cultural and economic dimensions of sustainability were alluded to in all four key concepts (see Table 2-1).

Table 2-1 Key concepts of EE (Ministry of Education, 2007)

Key Concepts of EE	Environmental	Social	Cultural	Economic
Sustainability	Environmental	Social	Cultural	Economic
Equity	Respect for all life	Social justice Inter-generational equity		Finite resources
Interdependence	Ecosystem	Community	Cultural diversity Democracy	Fair trade
Responsibility for action	Guardianship/ kaitiakitanga	Citizenship Action orientation	Informed decision-making Resilience and regeneration	Consumerism Enterprise and entrepreneurship

The senior secondary guideline also supports assessment of EE (referred to as EfS) and the provision of resources for the study of EE at secondary school level. The development of National Certificate of Educational Achievement (NCEA) Achievement Standards for EE in 2008 and 2009 supports the delivery of EE in secondary schools (Brignall-Theyer, Allen, & Taylor, 2009). However, primary schools are yet to experience such developments or support for curriculum and assessment in EE. As teacher education for primary schooling in New Zealand is the focus of this study, this review now examines literature on the context of primary education in New Zealand.

2.3.2 Context of Primary Education in New Zealand

Primary education for New Zealand students, according to the Education Act of 1989 (New Zealand Government, 1989), is free and mandatory. New Zealand's egalitarian stance is reflected in its educational sector by emphasising the right of all students to the same educational standards regardless of school location and size

(Nusche, Laveault, MacBeath, & Santiago, 2012). All children have to be enrolled at a primary school between the ages of 6 and 13 years, but most children begin school when they turn 5. Depending on the type of primary school, primary education for children spans Year 1 to Year 8. Contributing primary schools provide education for years 1-6, intermediate schools provide education for years 7 and 8, while full primary schools, especially in rural areas where there are no intermediate schools, provide education for years 1 to 8 (Ministry of Education, 2011)

Before 1989, New Zealand primary schools were governed at the district level by regional education boards. This system, however, faced much criticism as a more flexible, less bureaucratic medium, which was more responsive to the needs of students and the local community was desired (Nusche et al., 2012). Reacting to this request, the Tomorrow's Schools (1988) reform dismantled the regional education boards and handed over the administrative and management responsibilities of each school to its Board of Trustees. New Zealand now has one of the most decentralised educational systems in the world, with individual schools being governed by Boards of Trustees, made up mainly of parents (Hornby & Sutherland, 2014; Nusche et al., 2012). However, concern for social justice and equal opportunities for all, especially disadvantaged groups such as Māori, Pacific Islanders, and students with learning disabilities, contributed significantly to the development of an education system that retained at least some centralised curriculum development.

While benefits linked to these self-managing schools can include flexibility, encouragement of local initiatives and a high degree of professional autonomy for teachers, there are potential implications for the implementation of EE in primary school teaching, such as school priorities being placed on areas of learning other than EE. As discussed earlier (Section 2.3.1), given the somewhat marginalised position EE occupies in New Zealand's primary schools, as reflected in the national curriculum, the self-managing operation of schools can mean that no consideration may be given to EE if the Boards of Trustees are not interested in it. This autonomy may, therefore, make it difficult for teachers to implement EE in their teaching.

More insights on the implementation of EE in New Zealand schools are provided in the findings of a nationwide study conducted in 2002 and 2003 to investigate practices and future possibilities for EE in New Zealand schools (Eames, Bolstad, & Cowie, 2004). This study can be regarded as landmark research on the status of EE in New Zealand schools as it extensively highlighted the characteristics, achievements, and challenges of EE in New Zealand schools. A recent research update on EE in New Zealand schools (Bolstad et al., 2015) referred to the findings from the 2002 and 2003 research as still valid and relevant. In the study, over 200 schools in New Zealand were surveyed using a mixed methods approach involving an extensive survey and case stories of eight schools presumed to be involved in some forms of EE. Findings showed that only a quarter of the respondents reported that EE was included in their school charter or Board of Trustees policy. Teachers (over 60%) were largely left to decide on the timetabling of EE into their teaching schedules, as most of the schools did not have EE timetabled school-wide. These teachers, however, didn't have the time to include EE into their teaching; nor did they appear to be familiar with the theories and pedagogy of EE (Eames, Cowie, et al., 2008). After investigating characteristics of EE in New Zealand schools in 2002 and 2003, there was concern that there was an “apparent lack of understanding of what sustainability means, and the equally problematic notion that it means different things to different people” (Eames, Bolstad, et al., 2008). These findings suggest that there is a need for teachers who are environmentally literate and adequately prepared to handle the challenges associated with the implementation of EE in schools. The next section reviews literature on what can be conceived as EL.

2.4 Conceptual framework of Environmental Literacy

Development of an ‘environmentally literate citizenry’ has been claimed to be one of the main outcomes of EE (Erdoğan, Kostova, & Marcinkowski, 2009; Ernst & Monroe, 2004, 2006; Hungerford & Volk, 1990; Innes et al., 2016; Levy, Orion, & Leshem, 2016; Monroe et al., 2008; Tuncer Teksoz et al., 2014). This assertion is either directly or indirectly observed from the goals and objectives of EE (Stapp, 1969; UNESCO, 1978), definitions and frameworks for EE (Disinger & Roth, 1992; Hollweg et al., 2011; Roth, 1992; Simmons, 1995a), and reviews of previous research in EE (Hines, Hungerford, & Tomera, 1987; McBeth & Volk, 2009). For

EE to achieve the goal of developing environmentally literate citizens, it is essential for individuals to go through a process that allows them to explore environmental issues, engage in problem-solving, and take actions that impact the environment positively (Environmental Protection Agency [EPA], 2017; Goldman et al., 2014). EE does not promote a particular perspective or course of action; rather it teaches individuals in a manner that promotes critical thinking, which will enhance their problem-solving and decision-making skills (EPA, 2017).

The term ‘environmental literacy’ (EL) may have first been used by Roth in an article written for the Massachusetts Audubon Society in 1968. Roth (1992) asked the question: “How shall we know the environmentally literate citizen?” (p. 7) in response to the need for increased awareness of some persons, regarded as environmentally illiterate, who were responsible for polluting the environment at that time. Roth’s question initiated dialogue around the concept of EL. While the concern then was limited to pollution of the environment, the scope of EL today has been greatly expanded. Furthermore, EE summits and declarations (e.g. UNESCO-UNEP, 1977), which played vital roles in setting the agenda for EE, also opened up the way for definitions of EL. As discussed in Section 2.2, these summits identified the issues facing our environment, identified education as a solution, and highlighted the characteristics of an environmentally literate citizen in line with the aims of EE. There was, however, no reference to the term EL.

Harvey (1977) was one of the early scholars who attempted to conceptualize EL, as well as suggesting it as an outcome of EE. He defined EL as the “possession of basic skills, understandings, and feelings for the human-environment relationship” (p. 67). In addition to the development of EL as a result of EE, Harvey suggested two more outcomes: environmental competence, and environmental dedication. While recognizing this early definition and notions about EL, the present study, in line with Roth (1992) and previously published literature (Genc & Akilli, 2016; Goldman et al., 2006; Saribas, Kucuk, & Ertepinar, 2016; Yavetz et al., 2009) explores EL (on a continuum) as one of the goals of EE.

Hungerford and Peyton (1976, p. 11) proposed that an environmentally literate citizenry is one “that is both competent and willing to take action on critical

environmental issues.” Hungerford and Peyton (1976) built in the idea of willingness to take action as a further step in Harvey’s definition. Hungerford et al. (1980) later acknowledged four developmental levels for an environmentally literate citizen. According to them, these levels involve the development of ecological foundation knowledge; awareness of issues and values; the skills required for investigating and evaluating environmental issues; and promotion of skills that will encourage individuals to participate in actions that will improve their quality of life and the environment (Hungerford et al., 1980). In 1985, Hungerford and Tomera took this still further in defining EL by positing that:

The environmentally literate citizen is able and willing to make environmental decisions which are consistent with both a substantial quality of human life and an equally substantial quality of the environment. Furthermore, this individual is motivated to act on these decisions either individually or collectively (p. 205).

This definition highlighted willingness to make environmentally friendly decisions, about both people and the environment, and to take action at both individual and collective levels.

As with EE, the term EL has evolved. Orr (1992, p. 92) defined EL as the knowledge necessary “to comprehend relatedness and an attitude of care and stewardship.” Orr (1992) argued that EL is primarily concerned with “knowing, caring and practical competence” (p. 92). Roth also suggested a new definition of EL with the intention of overriding the seeming vagueness over what the outcome of EE should be. Roth’s (1992) definition became widely accepted, setting the standard for future concepts of EL. He defined EL as “the capability to perceive and interpret the relative health of environmental systems and take appropriate actions to maintain, restore or improve the health of these systems” (Roth, 1992, p. 17).

Roth also refuted the binary label supposedly ascribed to EL as for other types of literacy; that is, you are either literate or not. He recognised EL as a continuum of

competencies ranging from zero or inability to a more advanced level of ability, with points along the continuum representing levels of understanding, skills, and actions. He termed these points along the continuum *nominal*, *functional* and *operational*. Those at the **nominal level** have a basic knowledge of environmental terms and meanings. As Roth (1992) wrote:

They are able to recognise many of the basic terms used in communicating about the environment and able to provide a rough, if unsophisticated, working definition of their meaning. Persons at the nominal level are developing an awareness of and sensitivity toward the environment along with an attitude of respect for natural systems and concern for the nature and magnitude of human impacts on them. They also have a rudimentary knowledge of how natural systems work and how human social systems interact with them (p. 20).

At the **functional level**, a person has a broader knowledge and understanding of the interrelationship between the human social system and natural systems. Individuals at this level also show knowledge of, and concern for, the negative interactions between the human and the social systems about an environmental issue (at least one or more issues). They have also developed the skills to analyse, synthesise, and evaluate information about these issues using various primary and secondary sources of information and ideas. They should, at either individual or group level, exhibit some environmentally responsible behaviour (ERB), such as persuasion, eco-management, consumer behaviour, legal action, or political action.

According to Roth (1992), individuals at the **operational level** of EL have moved beyond being functionally environmentally literate in terms of depth and breadth of skills, knowledge, and understanding. An individual who has attained this level of literacy is aware of, and sensitive to, the total environment and is motivated to act and participate in its improvement. This individual has reached a state where they have a sense of personal responsibility for the wellbeing of the environment by recognising impacts of their personal behaviour, accepting personal responsibility for impact and being willing to correct and avoid negative impacts. Such a person also has a personal environmental ethic, and is willing to curtail personal temporary

enjoyment for long-term benefits. For the operationally environmentally literate, the characteristics of the functionally literate have become a lifestyle (Roth, 1992). This study seeks to assess EL on this continuum, up to the functional level, as an assessment of participants' EL at the operational level is not feasible based on the context of this study.

A further key contribution came from Simmons (1995b), who identified seven major components of EL after he reviewed 26 relevant sources of definitions, frameworks and/or models of EL. According to Simmons, despite the various assumptions and principles underlining these frameworks, significant commonalities were found among them: (1) affect; (2) ecological knowledge; (3) socio-political knowledge; (4) knowledge of environmental issues; (5) cognitive skills; (6) ERBs; and (7) additional determinants of ERB (Simmons, 1995b).

Using previous definitions of EL and the work of (Simmons, 1995b), the North American Association for Environmental Education (NAAEE) have recently proposed a definition for EL in the 2011 NAAEE document, *Developing a Framework for Assessing EL*, which stated that:

Environmental Literacy is knowledge of environmental concepts and issues; the attitudinal dispositions, motivation, cognitive abilities, and skills, and the confidence and appropriate behaviours to apply such knowledge in order to make effective decisions in a range of environmental contexts. Individuals demonstrating degrees of environmental literacy are willing to act on goals that improve the well-being of other individuals, societies, and the global environment, and are able to participate in civic life (K. S. Hollweg et al., 2011, p. 59).

This definition has an inclusive scope that builds on the earlier definitions of EL. References are made to the core elements of EL or the essentials of an environmentally literate citizen, who the authors define as an individual who individually and together with others makes informed decisions concerning the environment, and who is willing to act on these decisions to improve the well-being

of other individuals, societies and global environment by participating in civic life (Hollweg et al., 2011). These elements are attitude, motivation, cognitive abilities, skills, confidence, behaviours, application of knowledge acquired to decision making, and collective action at the individual, societal and global levels.

The document also supported the discourse on the developmental nature of EL, by the inclusion of the phrase 'degrees of EL'. As an illustration, it is often practically impossible for citizens to be knowledgeable in all disciplines related to the environment. Arguably, a person cannot be regarded as being either environmentally literate or not. Rather, the key components of EL as mentioned in the NAAEE definition are interactive and developmental in nature, implying that individuals develop along a continuum of literacy over time, and a person's EL, therefore, continues to evolve (Pe'er et al., 2007; Roth, 1992). To be considered as having the desired level of EL, the educational sector has a role to play in providing sound EE (Coyle, 2005). The desired level of EL, according to Roth (1992), is the operational level that has its focus on depth rather than accuracy; however, this takes time, and it should not be put in an 'environmental microwave programme' to speed things up (Tuncer Teksoz et al., 2009).

After studying the various definitions of EL, it could be argued that two features are common to them all (McBeth & Volk, 2009; Thomas, McGarty, & Mavor, 2009): (a) EL is defined and measured according to its components – knowledge, attitudes, and environmental behaviour – and (b) EL refers to three primary subjects; nature, environmental problems, and sustainable solutions. This study combines these characteristics in exploring the development of PSTs' EL. The next section presents existing approaches used in the literature to evaluate individuals' EL.

2.4.1 Evaluating Environmental Literacy

Evaluating an individual's EL is important in order to understand its development through education (Roth, 1992). As in many fields, the literature on EL contains both theoretical and applied elements (Morrone et al., 2001). Although there have been many attempts to define what EL is, there are commonalities about what an environmentally literate person should know and be able to do (McBride et al., 2013), and in the various ideas about evaluating EL (Simmons, 1995b).

It is clear that it is challenging to assess a person's EL. Previous studies have aimed at assessing different aspects or components of EL, usually knowledge, attitudes or behavioural components, or their interconnections (Janovec, Kroufek, Chytrý, Jíšová, & Moravová, 2015). The diversity in the range of EL components might at times create confusion about what needs to be included in an EL assessment. For example, should knowledge and attitudes alone be assessed? If so, what components of knowledge and attitudes should be included? Daniš (2013) has argued that the scope of EL assessment can vary and may be dependent on the context in which the EL is being developed. Issues addressed in EL assessment could range from local to global ones, or be unique to the country's environmental, cultural, political, educational and economic context (Chu et al., 2007; Goldman et al., 2006). Therefore, for assessment and curriculum purposes, researchers need to define EL in the context of their research (Disinger & Roth, 1992; Erdogan & Ok, 2011; Onel, Onel, Mukherjee, & Mukherjee, 2016; Yavetz et al., 2009). In this study, assessment of EL was influenced by the scope of the paper used as a case study, and reference was made to issues of relevance in the local context in which the research was being conducted; for instance, inclusion of questions related to water quality, which is a local issue.

From a review of the literature, most studies that have examined EL included components such as environmental affect, environmental behaviour and environmental knowledge (see Table 2-2) and their interrelationships with each other. These components may have elements linked together in some studies. For example, Disinger and Roth (1992) classified locus of control (LOC) and personal responsibility (PR) as elements of environmental affect. Some other studies, as shown in Table 2-2, assess LOC and PR as separate constructs. Deciding on which elements should be included depends on the context and aim of the study in question. Described next are the components of EL (knowledge, concern, affect and behaviour) and how they are interpreted in the context of this study.

2.5 Components and Sub-Components of Environmental Literacy

Environmental literacy has been described as a product of interrelationships between its components. This section reviews the literature on each of the components of EL used in this study: environmental knowledge; environmental affect; environmental concern; intention to act; and environmental behaviour, before an examination of the interrelationships between these can be undertaken.

2.5.1.1 Environmental Knowledge

Environmental knowledge is a term used to describe the degree of information an individual has about environmental issues and their associated solutions (Farmer, Knapp, & Benton, 2007; Zsóka, Szerényi, Széchy, & Kocsis, 2013). Although environmental knowledge is sometimes used interchangeably with ecological knowledge (Orr, 1992), it is evident from the literature that environmental knowledge is not limited to knowledge of ecology (e.g., biosphere, biodiversity, ecosystem). Environmental knowledge encompasses knowledge of local and global environmental issues (K. S. Hollweg et al., 2011), the interrelationship between social systems and natural systems, and environmental issues that arise from these complex interactions. It also includes knowledge of environmental action strategies, incorporating the ability to identify and critically evaluate alternative options for remediation.

Hungerford and Volk (1990) described environmental knowledge as knowledge about the issue, knowledge about the action strategy and action skill. In research that seeks to evaluate an educational programme, in addition to those knowledges, it is important to assess the knowledge of the participants in line with the emphasis of the programme being evaluated (Goldman et al., 2014).

Table 2-2 Environmental literacy components examined in previous studies

Author(s)	Year	Environmental literacy components							
		EA	EB	ITA	EC	EK	LOC	PR	ES
Hsu et al.,	1998	✓	✓	✓		✓	✓	✓	✓
Morrone et al.,	2001					✓			
Moody et al.,	2005								
Chu et al.,	2007	✓	✓			✓			✓
Pe'er, et al.,	2007	✓	✓			✓			
Negev et al.,	2008	✓	✓			✓	✓		
Özden, et al	2008	✓						✓	
McBeth et al.,	2009		✓	✓		✓			✓
Tuncer Teksoz et al.,	2009	✓			✓	✓			
Yavetz et al.,	2009	✓	✓			✓			
Esa, Norizan;	2010	✓	✓			✓			
Tal, Tali;	2010					✓			
Ogunyemi et al.	2011					✓			
Fielding et al.,	2012		✓	✓	✓	✓	✓	✓	
Levine et al.,	2012	✓	✓	✓		✓			
Daniš, Petr;	2013								
Goldman et al.,	2014	✓	✓		✓	✓			
Shephard et al.,	2014	✓				✓			✓
Carmi et al.,	2015		✓			✓			
Liu et al.,	2015	✓	✓	✓		✓			
Fettahlioglu et al.,	2016	✓	✓	✓		✓			
Koc et al.,	2016	✓							
Öztürk et al.,	2016	✓			✓	✓		✓	
Saribas et al.,	2016	✓			✓	✓			

Where **EA**-Environmental affect, **EB**-Environmental behaviour, **ITA**-Intention to Act, **EC**-Environmental concern, **EK**-Environmental Knowledge, **LOC**-Locus of control, **PR**-Personal responsibility, **ES**- Environmental skills.

The literature has shown that knowledge is an important predictor of ERB since it is usually regarded as a prerequisite to intentional action (Frick, Kaiser, & Wilson, 2004; Vicente-Molina, Fernández-Sáinz, & Izagirre-Olaizola, 2013). Because of the recognised importance of knowledge in exhibiting ERB, it is not surprising that environmental knowledge is a common target of interventions (Duerden & Witt, 2010; Onel et al., 2016). Environmental knowledge is a necessary component of EL for the exhibition of ERB; it is, however, not a sufficient requirement for ERB by an individual (Bamberg & Möser, 2007; Hungerford & Volk, 1990; Stern, Powell, & Hill, 2014; Zsóka et al., 2013)

Appraising the relationship between knowledge and ERB has led to some questions on what knowledge really is, or whether knowledge really contributes to the

development of EL (Kollmuss & Agyeman, 2002). Challenging the notion of knowledge as it relates to EL, Orr (1992) commented that:

The crisis of sustainability and the problems of education are in large measure a crisis of knowledge. But is the problem as is commonly believed, that we do not know enough? Or that we know too much? Or that we do not know enough about some things and too much about other things? Or is it that our scientific methods are in some ways flawed? Is it that we have forgotten things we need to remember? Or is it that we have forgotten other ways of knowing that lie in the realm of vision, intuition, revelation, empathy, or even common sense? Such questions are not asked often enough (Orr, 1992, p. 155)

Jensen (2002) argued that for knowledge to translate into ERB, four components are important. An action-oriented knowledge requires individuals to have knowledge about effects (reality and prevalence of environmental problems), knowledge about root causes (causal perspective), knowledge about strategies for change (individually and as part of a community), and knowledge about alternatives and visions (seeing possibilities that can act as a source of motivation towards personal vision). He further acknowledged that although knowledge alone does not lead to pro-environmental behaviour, it still plays a significant role in the exhibition of ERB. In most cases, pedagogical approaches used in schools are not action-oriented; nor do they offer students the possibility of actively adopting the knowledge being conveyed (Jensen, 2002). This suggests that environmental knowledge is not a single coherent factor but instead is complex and multidimensional.

Two years later, however, Frick et al. (2004) opined that just two of the components highlighted by Jensen (2002) are essential for achieving the goals of EE in developing an environmentally literate citizen: knowledge about what (the natural states and processes within it); and knowledge about how (action-oriented knowledge). This kind of knowledge is important for teachers if they are to be able to help their future students develop the same knowledge. Furthermore, Frick et al. (2004) proposed that there is another form of knowledge, which is regarded as knowledge of benefits. According to their study, this kind of knowledge comes into

play when an individual has to choose between several action options. In most cases, individuals go for options with the perceived highest benefit for them, without considering the consequences of such decisions. A recent study examining the EL of adults also indicated that people will engage more in ERB when they know their environmental behaviour will personally impact them (Levy et al., 2016). From an EL standpoint, individuals with this type of knowledge, which exalts self-interest over preserving environmental quality, might not engage in ERB. Interestingly, this kind of knowledge might dominate other kinds of knowledge and could contribute to understanding of the gap between knowledge and ERB. Frick et al.'s (2004) research findings indicated that knowledge, regardless of type, explained only 6% of the variance in behaviour. They commented that "this figure should not be underestimated since influences of knowledge of behaviour are thought to be indirect, which means that they are mediated by other variables" (Frick et al., 2004, p. 1609). They suggested that investigating the roles of other factors (such as cultural factors) might aid our understanding of the role of knowledge in environmental behaviour.

Varied findings have been reported in the literature on the relationship between knowledge and other EL components. In some studies, increasing an individual's environmental knowledge has been observed to result in more positive attitudes toward the environment (Öztürk & Teksöz, 2016; Zsóka et al., 2013) and more concern for the environment (Newman & Fernandes, 2016). In a few cases, elicitation of pro-environmental behaviour (Hsu, 2004) has been associated with increased knowledge. In contrast, some studies find no or weakly significant relationships between environmental knowledge and pro-environmental behaviour (Alcock et al., 2017; Paço & Lavrador, 2017). Among the studies that indicated a deeper knowledge of environmental issues and how to solve them increases the likelihood of individuals taking actions to protect the environment (Hwang, Kim, & Jeng, 2000) was that of Kennedy, Beckley, McFarlane, and Nadeau (2009) in Canada. They found that more than 60% of respondents felt that their pro-environmental behaviour was often constrained by a perceived lack of knowledge. If such individuals are more aware of environmental problems and their causes, they could become motivated to exhibit more environmentally responsible behaviour (Barber et al., 2009). Similarly, in a study of primary school teachers in

Australia, Cutter-Mackenzie and Smith (2003), who used Roth's framework, found that the majority of the teachers were probably functioning at the nominal EL level, which was the lowest available level in the study. Possible reasons for this included a low level of environmental knowledge (possibly linked to their minimal exposure to EE). Generally, studies that have evaluated environmental knowledge of individuals in conjunction with other components in response to EE teaching have, reported an overall low level of environmental knowledge among the participants (Coyle, 2005; NEEFT, 2000; Saribas et al., 2016; Tal, 2010). This might be linked to pedagogical approaches employed in teaching EE or the methods used in assessing environmental knowledge.

A review of the literature showed that assessing the environmental knowledge of individuals can be achieved through two main approaches: a focus on either or both of objective and subjective knowledge (Barber, Taylor, & Strick, 2009; Carmi & Arnon, 2014). Objective knowledge, regarded as actual knowledge, refers to how much a person knows about an issue or object. Objective knowledge has been described as a real assessment of individuals' knowledge about a specified scope. Multiple-choice questions, with one correct in the context of the research, or open-ended questions related to the knowledge being assessed, have been used. In contrast, subjective knowledge, referred to as perceived knowledge, is how much a person thinks he/she knows (Dodd, Laverie, Wilcox, & Duhan, 2005). The individual involved usually reports it. Most of the scales for measuring (environmental) knowledge have been developed on the basis of either subjective (self-rated) knowledge (Vicente-Molina et al., 2013) or objective (actual) knowledge. In this study, both objective and subjective knowledge of participants were evaluated. Subjective knowledge in this study was related to questions seeking environmental information from participants. Specifically, participants were asked to rate how informed they thought they were on seven environmental and sustainability issues. The objective knowledge of participants was also tested using multiple choice questions, with a correct option in regard to the context of the research and open-ended questions evaluating the conceptions of participants about the environment and sustainability.

One important form of knowledge, the conceptions held by individuals about the environment and sustainability, has been found to be central to their exhibition of ERB or their EL. The next section provides a review of the literature on individuals' conceptions of the environment and sustainability.

2.5.1.2 Conception of the environment

Clarifying the conceptions of individuals about the 'environment' is essential because the way people perceive the environment, their impact on it and other social systems might influence their behaviour towards the environment (Loughland, Reid, & Petocz, 2002; Yavetz et al., 2014). Since EE seeks to empower learners to make decisions that influence the environment and other social systems, it is necessary to explore the way people view the environment as it reflects their worldview and attitudes regarding environmental issues, as well as their place in it (Yavetz et al., 2014). Analysis of these conceptions may promote the development of more effective EE programmes and teaching approaches targeted at broadening learners' understandings.

Individuals' conceptions about the environment are reflected in their level of ERB (Loughland et al., 2002; Palmer et al., 1998). Marton and Booth (1997) suggested that one's actions towards the environment are often related to how one has experienced it. Therefore, individuals' conceptions about the environment can predict their actions towards it. In addition to exhibiting ERB, Payne (1998) argued that understanding how children view or conceive the environment would make learning more grounded in the reality of children's conceptual frameworks, thus making EE more relevant and effective. Payne further suggested that understanding students' conceptions of the environment could also help curriculum development, and ultimately broaden their knowledge of the environment and their place within it. This suggests that EE could be more effective if there is an understanding of how students conceptualise the environment (Yavetz et al., 2014).

Previous studies that sought to assess young people's conceptions about the environment indicated that the term environment seems ambiguous to some of them (Loughland et al., 2002). Some study participants completely excluded humans in their explanation of the environment (Filho, Harris, & Blackwell, 1996) and in

most cases, young people's conceptions of the environment relate to how the environment affects them, or to their personal experience of the environment (Yavetz et al., 2014). Understanding individuals' environmental conceptions can reveal and challenge the underlying ideas shaping their environmental learning. This may open up potential opportunities for the development of meaningful and relevant EE pedagogies (Sauvé, 1996). This is relevant for teacher education programmes, to ensure that teachers are well equipped during their training.

Conceptions about the environment have also shown people's orientations about the human-environmental relationship (Liu, Yeh, Liang, Fang, & Tsai, 2015; Palmer et al., 1998; Sauvé, 1996). Studies have shown that there are predominantly two environmental orientations: anthropocentrism and ecocentrism (Kortenkamp & Moore, 2001; Thompson & Barton, 1994). Anthropocentrism regards humans as superior to other forms of life and sees the environment, not for its intrinsic value, but as something to be used to achieve goals. In contrast, ecocentrism values nature for its own sake and the environment is viewed independently of its contributions to human materialistic goals (Thompson & Barton, 1994).

Researchers have devised frameworks aimed at conceptualising the environment based on the conceptions individuals have about it. Sauvé (1996) conducted a phenomenographic study of discourses and practices in EE. She identified six typical environmental conceptions of the environment as: nature to be appreciated, respected, preserved; a resource to be managed; a problem to be solved; a place to live, to know and learn about, to plan for, to take care of; the biosphere in which we all live together, into the future; and a community project in which to get involved. Loughland et al. (2002) analysed the environmental conceptions of Australian primary and secondary students and came up with two categories (object focus and relational focus) encompassing six environmental conceptions. The conceptions that made up the object focus were environment as a place; environment as a place that contains living things, environment as a place that contains living organisms and human beings. The relational focus category concepts were the environment as something that does something for people; people are part of the environment and are responsible for it; and people and the environment are in a mutually sustaining relationship. Loughland et al. (2002) reported that an object focus conception of the

environment was more prevalent among the group of students regardless of their level (primary or secondary) and only a few (about one-eighth) viewed the environment from a relational focus perspective. They suggested that it would be unlikely for students who understand the environment as an object to take actions that would protect it. Reinforcing Marton and Booth (1997) assertion that one's actions are related to one's experience, students who have a relational conception of the environment might take personal responsibility for the environment and act in a more environmentally responsible manner than their counterparts who have an object conception of the environment. This study seeks to explore PSTs' conceptions of the environment as it may either aid or inhibit the development of their EL.

Apart from understanding peoples' conceptions about the environment, to achieve the goal of EE in developing environmentally literate citizens, it is important to understand their conceptions of sustainability. This is because the quality of life and Earth's ecosystems cannot be maintained without embracing sustainability. Understanding the concept of sustainability could encourage individuals to act in ways that exert less negative impact on the environment and other social systems. The next section, therefore, reviews the literature related to conceptions of sustainability.

2.5.1.3 Conceptions of sustainability

Given the socio-ecological crisis facing our world, the quest for sustainability is crucial. It has been suggested that sustainability involves economic viability, ecological prudence and a socially just society (Cavagnaro & Curiel, 2012). Despite this recognition, defining the concept of sustainability has been difficult (Walshe, 2008). This poses a challenge to teachers saddled with the responsibility of helping students understand the concept of sustainability. For instance, understanding students' conceptions of sustainability could be an important first step toward introducing a more effective pedagogical approach and encouraging students towards intentional sustainability behaviours (which is, in the context of this research, ERB).

The Brundtland Report defined sustainability as “meeting the needs of the present generation without compromising the ability of future generations to meet their needs” (WCED, 1987). Although the original term was “sustainable development,” there have been objections to the use of the term in that it is closely associated with continued development, and should be reserved only for development activities (Nolet, 2009). Sustainability appears to be a more suitable term for all human activities. Despite the differing definitions of sustainability, there is a consensus that sustainability must be conceptualised as involving three dimensions: environmental, social, and economic.

Individuals’ understanding of the environment cannot be separated from their understanding of social and economic interactions associated with it (Gough & Gough, 2002). EL serves as the foundation for actions aimed at protecting resources for the future, for ourselves and other species we share the Earth with. As shown in Figure 2-1, the causes of environmental impacts are linked to the socio-economic and political systems that drive our societies. EL, which gives us a larger understanding of how things connect and are interdependent, starts by addressing the root causes of our negative impacts on the environment. Unless we understand why our actions may cause negative impacts on our natural environment, it will be difficult to know how to create positive impacts instead. EL provides people with the knowledge and skills for taking intentional actions to contribute to a better world and future. Sustainability underpins EL and understanding the concept of sustainability could enhance the elicitation of more ERB among individuals.

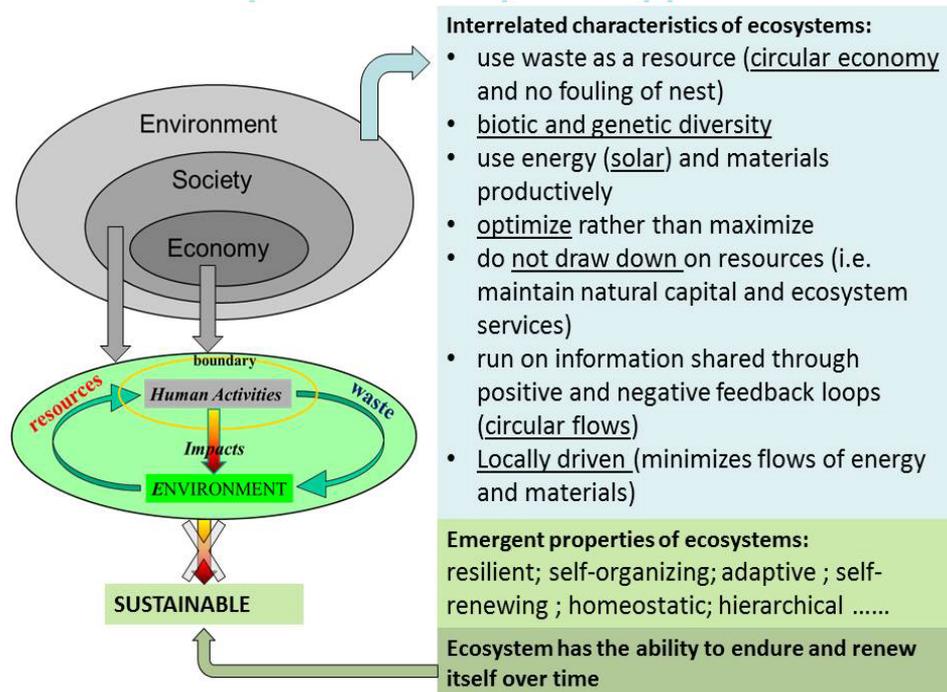


Figure 2-1 Sustainability and environmental literacy (Source: ELIA-Ecological Living In Action, 2012)

Individuals who are environmentally literate are more likely to live sustainably, knowing that the choices they make as humans have impacts on many levels, and knowing how those choices can either help or harm the environment. They understand Earth's ability to sustain human and other life, and they are empowered and motivated—individually or as part of a community—to keep the environment healthy and sustain its resources so that people can enjoy a good quality of life for themselves and their children (Figure 2-1).

A review of literature that has explored students' conceptions of sustainability reinforces the complex nature of sustainability and the varied range of students' understandings of the concept, regardless of the age or experiences of those involved (Birdsall, 2014; Summers, Corney, & Childs, 2004; Walshe, 2008). Summers et al. (2004) assessed geography and science postgraduate student teachers' conceptions of sustainable development in the UK (see *Table 2-3*).

Table 2-3 Conceptions of sustainability (adapted from Summers et al. (2004)).

PURPOSE	TIME SCALE
1 Improvement (progress, benefit)	14 Long term (long term strategies, over time, permanently, indefinitely)
2 Preservation (avoiding damage, not detrimental, protection, minimum negative impact, not detracting or taking away, not depleting)	15 The future
3 Conservation (use of renewable resources)	GEOGRAPHY SCALE/LEVEL
4 Balance (replacement, recycle, self-sustaining, replanting)	16 Global/all countries
5 Meeting needs	17 LEDCs only/focus on LEDCs*
6 Self-sufficiency (independence)	18 Local
7 Other (e.g. survival, saving the planet, awareness, management, consideration of impact)	19 Area/scale—undefined
NATURE of the development	CONTROVERSY
8 Environmental (resources)	20 Controversy (conflicting issues)
9 Economic (less debt, standard of living, inequalities)	AESTHETIC
10 Social (preservation of cultures, quality of life, inequalities, political)	21 Aesthetic (maintaining beauty)
HUMAN FOCUS (who for)	
11 Human populations/people	
12 Future generations only	
13 Future and current generations	

*LEDC means Less Economically Developed Countries

Seven categories identified from the analysis of their responses included purpose, nature, human focus, timescale, geographical scale/level, controversy, and aesthetics. The categories also had 21 subcategories. For example, the category *nature of sustainability* had the sub-categories environment, social and economic. Summers et al. (2004) reported that the highest proportion of the students (87%) thought about sustainability in regard to the environment, while less than half of them related sustainability to its social dimension. Only about a third of the student population, with a higher proportion among the geography postgraduate students

than their scientific counterparts, was able to relate sustainability to all of its three components. Another study, conducted in the UK by Walshe (2008), used concept maps and semi-structured interviews to assess 12- to 13-year-old geography students' ideas on sustainability. Although she observed a broad range of understanding of sustainability among the students, their conceptions of sustainability could be categorised as the nature, purpose, and timescale of sustainability. In both studies, students' conceptions of sustainability were related primarily to its nature (environment, economic, social) and among these three; most of the students aligned their understanding towards the environment. Similar findings were reported by Birdsall (2014) in a study that measured 77 New Zealand PSTs' understanding of sustainability and the level of self-awareness of their understanding. PSTs in Birdsall's study were also observed to have simplistic understandings of sustainability with many of them relating the definition of sustainability to only a conception. Those who provided a range of conceptions did not show in-depth understanding in the ways these were expressed or linked together. Exposure to EE could improve students' understanding of sustainability. However, as Fisher and McAdams (2015) observed in their study, there is a tendency for students to orientate their understanding of sustainability towards the academic area where their coursework is located. Students might also perceive the meaning of sustainability more in relation to the aspect emphasized the most in their learning. A recent study conducted in New Zealand by Piasentin & Roberts (2017), where the subjects were eight masterate students enrolled in some sustainability courses focused primarily on the socio-economic aspect of sustainability, indicated that all the participants in the study showed improved knowledge of sustainability, especially in the socio-economic aspect, following exposure to the EE course.

Since sustainability concepts are interdependent, there is the need for educators to ensure that a balanced view is presented to learners regardless of the likely inclinations their teaching route might have. It is important to note that knowing *per se* does not automatically evoke an individual's environmental emotions, leading to action, but once the affective system is activated, action is much more likely (Carmi, Arnon, & Orion, 2015). The next section focuses on the affective components of EL.

2.5.2 Environmental Affect

The theory of planned behaviour (Ajzen, 1991) conceptualizes affect as a part of attitude. However, a number of studies in EE have evaluated environmental affect as a distinct concept and incorporated it into their theoretical framework alongside other EL components (Bradley, Waliczek, & Zajicek, 1999; Milfont & Duckitt, 2010; Öztürk & Teksöz, 2016; Vicente-Molina et al., 2013).

Individuals' affective dispositions can be recognised in the way they respond in a consistent evaluative manner towards an object or class of object. The expression "consistent evaluative manner" refers to a dimension characterized as pro-con, positive or negative, favourable or unfavourable (Ajzen & Fishbein, 1975). Evaluation is usually viewed from a unidimensional continuum with a positive and negative pole. It could, therefore, reflect a person's interests and disinterests, and degree of favour or disfavour (Liu et al., 2015; Milfont & Duckitt, 2010). Hines (1987) related environmental affect to the psycho-social factors connected to an individuals' personality which includes their perceptions about themselves and others. These are those intrinsic qualities that allow individuals to reflect on environmental problems at the interpersonal level and, where necessary, take action on those problems/issues (Erdoğan et al., 2009). The more positive a person's affect is towards the environment, the more likely it is that the person will be involved in ERB. Liu et al. (2015) argued that people with negative affective dispositions towards environmental issues are less likely to take part in ERB.

The affective dispositions of an individual are latent constructs and as such cannot be observed directly. They are in most cases inferred from explicit responses (Schwarz, 2008), thus the techniques for measuring affect are broadly self-reported and implicit (Krosnick, Judd, & Wittenbrink, 2005). Methods used for direct self-report include interviews and questionnaires, while much less frequently used implicit techniques include observations. In evaluating environmental affect, some studies have reported a positive relationship between environmental affect and pro-environmental behaviour (Tilikidou, 2007). In other studies, a negative relationship was found (for example Cottrell, 2003). In the work of Kollmuss and Agyeman (2002) and Olli, Grendstad, and Wollebaek (2001), a weak relationship between environmental affect and environmental behaviour was observed. Other studies

have indicated that the relationship between environmental affect and behaviour is moderate (Bamberg & Möser, 2007; Hines, Hungerford, & Tomera, 1987). These studies suggest environmental affect alone is a poor predictor of intentional environmental behaviour.

The constructs that constitute the environmental affective domain are varied and numerous; it is not feasible to assess all the various affective components in a single study, regardless of how comprehensive the assessment might be (Hollweg, 2011). These constructs include worldview (e.g., Dunlap, 2008; Hawcroft & Milfont, 2008, 2010), values, personal and social norms, self-efficacy, locus of control, and intention to act (e.g., Ajzen, 1985; Bamberg & Möser, 2007; Fishbein & Ajzen, 1975; Stern, 2000). Constructs that make up the affective component of EL in this study are environmental worldview, personal responsibility, and locus of control. A review of the literature on these constructs is discussed next.

2.5.2.1 Environmental Worldview

A worldview is defined as the set of essential beliefs and values possessed by an individual about the way the world is (Meadows, 2009). An individual's environmental worldview affects how he/she perceives and interprets the world, and how he or she acts upon it, shaping, in turn, the world itself (Hedlund-de Witt, 2012). Although worldviews can be developed through learning, they are difficult to change because they are socially constructed and may be strengthened by society through social interactions (Dunlap 1992).

An environmental worldview, therefore, represents how people think about the environment they live in. This thought pattern or belief could be human-centered (anthropocentric worldview) or earth-centered (ecocentric worldview), while in some cases it could be a mixture of both. The main difference between anthropocentric and ecocentric views is the value attached to nature (Kronlid & Öhman, 2013). Those who hold anthropocentric worldviews value humans more than nature. They believe that non-human elements have value only because of their usefulness to humans. To them, humans have intrinsic value and they regard the rest of nature as having instrumental value. Human beings are viewed as superior to other species (Kronlid & Öhman, 2013). On the other hand, individuals who hold

ecocentric worldviews believe that all forms of life have intrinsic value regardless of their uses to humans. They also believe that nature exists not only for humans, but also for all Earth's species (Kronlid & Öhman, 2013; Lundmark, 2007).

The NEP scale developed by Dunlap in 1978 has been widely used to measure environmental worldview or proenvironmental orientation (Dunlap & Van Liere, 1978). The NEP scale replaced the then-current *Dominant Social Paradigm* (DSP) and the *Dominant Western Worldview* (DWW). The DSP assumes humans' distinction from, and supremacy over, nature, while the DWW embraces the certainty of human growth and views technology as the vehicle for that growth, while ignoring the catastrophes that have befallen humans and the environment as a result of technology. The NEP scale was developed because of increased awareness of the environment and its associated problems. It assumes that humans are not distinct from nature; nor are they exempted from natural laws. The NEP scale rather views humans as part of the natural world, not as superior to other forms of life (Piasentin & Roberts, 2017).

Various researchers have used the NEP scale in different ways. It has been used to measure environmental concern (Best & Mayerl, 2013; Hardesty, 2015), environmental attitudes (Ogunbode, 2013; Pienaar, Lew, & Wallmo, 2013), and anthropocentrism versus ecocentrism (Gangaas, Kaltenborn, & Andreassen, 2015; Thompson & Barton, 1994), to mention but a few. Dunlap (2008), however, stated that the NEP scale is increasingly treated as a measure of environmental beliefs, which he believes is the most precise interpretation. He emphasised that using the NEP scale as a measure of ecological/environmental worldview is his personal preference for a descriptor because, to him, the NEP Scale measures the degree to which respondents view the world ecologically. On this basis, this study uses the NEP scale to assess the environmental worldview of the study's participating PSTs.

The NEP scale is made up of 15 items, 8 are pro-NEP and 7 are anti-NEP items. Each item is built on opposing values (DSP vs. NEP); that is, an anthropocentric position at one end and, an ecocentric position at the other. This anthropocentric–ecocentric difference can be used to assess people's environmental orientation or worldview (Dunlap, 2008; Dunlap, Van Liere, Mertig, & Jones, 2000). It is

assumed that scoring high on the NEP scale might indicate more proenvironmental beliefs or worldviews on a comprehensive range of issues (Yavetz et al., 2014), and that such beliefs or orientations could influence behaviour. The relationship between the NEP scale and exhibition of ERB has not been established, and therefore Dunlap (2008) advocates using the NEP Scale alongside other measures in assessing behaviour.

The NEP scale certainly has its strengths. The use of general environmental topics that cannot be outdated (Milfont & Duckitt, 2010) and the measurement of the overall relationship between humans and the environment adds to its reliability and validity (Dunlap, 2008; Dunlap, Van Liere, Mertig, & Jones, 2000). It is, however, not without some criticisms. Despite the NEP scale claiming to be a single component measure of environmental attitude, its uni-dimensional aspect (a single dimension factor) has been severely questioned. It has been used to measure other dimensions such as the limits of growth, the balance of nature, and humans over nature (Kaiser & Fuhrer, 1996). Dunlap et al. (2000) argued that despite the debates about its multidimensionality, the NEP scale can still be successfully used to assess the consistency of environmental worldviews and the relationships between those worldviews. Further criticisms focus on the fact that the NEP scale is not likely to be applicable outside the developed western nations (Chatterjee, 2008) and cannot be a strong predictor of environmental behaviour (Scott & Willits, 1994), but these criticisms are not germane to the context of this study. This study was conducted in a developed western nation, and other components are employed to assess the level of ERB of the study participants.

Lalonde and Jackson (2002) provided the most serious criticism of the NEP scale (Dunlap et al., 2000), asserting that the NEP scale item wordings were outdated and did not fully capture the latest understanding of nature with respect to the intensity of prevailing environmental problems. According to these authors, it is most likely that their alleged criticism of the NEP scale has not been palpable in previous research because researchers often reword the NEP statements to suit their research focus. However, extracting items from the scale has not been recognized to significantly affect the precision of the scale (Gooch, 1995). Acknowledging these criticisms and defenses, a small number of NEP items were used and reworded to

align with the focus of the research in this study, and their validity and reliability were tested (see Chapter 3). The next section reviews the literature on another element of affective disposition, personal responsibility.

2.5.2.2 Personal responsibility

Personal responsibility refers to an individual's feelings of duty or obligation (Hines et al., 1987). Obligation (or lack of it) is expressed with regards to the environment as a whole (personal responsibility to help the environment), or to only an aspect of the environment (e.g., personal responsibility felt for recycling or reducing air pollution). Personal responsibility could also be considered an individual's "personal commitment to environmentally corrective behaviours" (Borden, 1984, p. 14).

The literature indicates that individuals who feel some degree of personal responsibility toward the environment are more likely to exhibit ERBs than individuals who do not feel responsible towards the environment (Hines et al., 1987). Babcock (2009) emphasised the role personal responsibility could actively play in overcoming the barriers to behavioural change. According to his study, the prevalent misconception among individuals about their roles in contributing to environmental problems or viewing their contributions to environmental problems as small or insignificant, could encourage resistance to behavioural change, especially when it is associated with some level of inconvenience, or is expensive. This is exemplified by accusing industries of being the cause of environmental degradation rather than individuals' behaviour. Individuals, a lot of the time, ignore the impact of seemingly small daily habits, like driving powerful cars, production of waste, and high consumption of electricity, on the environment. These daily impacts appear minute, but the aggregate impact affects the environment in a negative way. The extent of an individual's personal responsibility for the environment, therefore, reflects in such individuals taking more environmentally responsible actions (Fielding & Head, 2012). Doremus (2001) maintained that to develop personal responsibility towards the environment, individuals must have a level of care for the environment and this can be achieved by the recognition of nature (the environment) as a gift. This perception makes it easier to make some sacrifices for its protection.

An individual's personal responsibility can be influenced by priorities or values (Kollmuss & Agyeman, 2002). Although the role of values in influencing personal responsibility is not explicitly explored in this study, studies have shown that when ERB aligns with an individual's personal priorities (e. g., buying organic food for personal/ family well-being), there is increased motivation to carry out such actions. On the other hand, if there is a contradiction between an individual's priority and implementing ERB (e.g., living in a smaller house, even though one could afford to live in a big one), it is most likely that such actions will not be carried out. In further support of this argument, personal responsibility has been viewed as a function of personal investment. Individuals tend to have the feeling of more responsibility towards issues they are interested in and would be willing to put their resources into (Hungerford & Volk, 1990). People with a greater sense of personal responsibility are more prone to carry out ERB (Kollmuss & Agyeman, 2002). An individual can be regarded as being at the operational EL level if he/she accepts personal responsibility for impact on the environment, shows willingness to correct and avoid negative impacts, has a personal environmental ethic, and is ready to curtail personal temporary enjoyment for long term public good, among other things (Disinger & Roth, 1992). The challenge, however, could be that an individual's contribution to the solution sometimes is unnoticeable and it thus becomes increasingly difficult to convince people that changing their behaviour can actually make a difference. This points to the notion of locus of control, which is discussed in the next section.

2.5.2.3 Locus of control

One of the aims of EL is to empower people with the belief that they can, at an individual or group level, contribute to environmental solutions through their personal behaviour. The presence or absence of such belief in an individual is regarded as locus of control (Hungerford & Volk, 1990; Hwang et al., 2000; Kollmuss & Agyeman, 2002). Hungerford and Volk (1990) claim that a locus of control in agreement with other personal factors (e.g., personal responsibility, attitude) plays a significant role in an individual's desire to act in an environmentally responsible manner. The framework of Disinger and Roth (1992) categorised locus of control and assumption of personal responsibility under the 'affect' strand, while other models of categorization place these components under

the category 'additional determinants of ERB' (Hungerford et al. 1994). However, locus of control is placed under the affect domain in this study.

Locus of control has internal and external dimensions. With an internal locus of control, individuals believe that their actions are likely to have an impact or bring about a change (Peyton & Miller, 1980). People with an internal locus of control are more apt to behave in a manner that is environmentally friendly than individuals with an external locus of control (Kollmuss & Agyeman, 2002). Individuals with an external locus of control ascribe change to chance, luck or some powerful others (such as God, parents or the government). They do not believe that change could be as a result of their behaviour; nor can their actions bring about an outcome. Believing that there are powerful others who have the responsibility of bringing about a change weakens individuals' willingness to act (Alp, Ertepinar, Tekkaya, & Yilmaz, 2008). These 'externals' feel they do not have control over the situation; thus they sense a disconnection between their behaviour and a preferred outcome (Kalamas, Cleveland, & Laroche, 2014). This sense of powerlessness has been closely linked with individuals becoming pessimistic about the environment and about their ability to contribute to the solutions to environmental problems. (Connell, Fien, Lee, Sykes, & Yencken, 1999). Connell et al. (1999) also suggest that young people experience a sense of 'action paralysis' that potentially makes them cynical about the efficacy of their actions.

In the published literature, locus of control has been found to be closely linked to the exhibition of ERB (Alp et al., 2008; Hwang et al., 2000). Hwang et al. (2000), for example, showed that having a more internal environmental locus of control was related to stronger forest conservation intentions. The next section reviews the literature on environmental concern, which also contributes to the elicitation of ERB.

2.5.3 Environmental Concern

Azjen and Fishbein (1980) suggest that attitude embraces general attitudes toward objects (affective attitude), as well as more specific attitudes toward certain issues, referred to as environmental concern. In other words, two types of attitude exist: attitudes towards the environment or an aspect of it such as endangered species

(usually referred to as environmental concern) and attitudes towards ecological behaviour like recycling (often associated with intention to act). Each type of attitude can be measured independently (Dunlap & Jones, 2002). Environmental concern is an expressed feeling for the natural environment (Hungerford & Volk, 1990). Schultz, Shriver, Tabanico, and Khazian (2004) defined environmental concern as affect related to beliefs about environmental problems. Three fundamental beliefs/values influence environmental concern: egoistic (concern for personal wellbeing or self-interest); humanistic altruism (concern for human beings) and biospheric values (concern for non-human species). In essence, individuals expressing similar levels of environmental concern (e.g., concern for air pollution) could be motivated by extremely different reasons (e.g., polluted air is dangerous to the wellbeing of me and my family; or polluted air is detrimental to forests). This study focuses on a mix of the aspects of concern, as it seeks to examine participants' concerns about biospheric values as well as sustainability issues like child poverty. Environmental concern has also been conceptualized as a general attitude centered on the cognitive and affective appraisal of environmental protection (Newman & Fernandes, 2016).

Weber (2006) claimed that environmental concern might not lead to ERBs, even among those who seem to have a strong environmental concern, because individuals have the capability to allocate just a limited amount of concern to the diverse issues they face. Therefore, if some other competing factors/barriers supersede concern for environmental issues, it is unlikely that ERB will be expressed. These competing factors (e.g., normative experiences) could outweigh environmental concerns and as a result, evoke the elicitation of less ERB (Feilding & Head, 2012). According to Weber (2006), these competing factors range from individual factors (some obligations individuals feel they have to perform, like travelling via plane to see families or loved ones despite concern for global warming), and assuming personal responsibility among others. Other factors influencing concern are closely linked to the value orientation of individuals. Rickinson (2001) suggested that some environmental issues are rated as more severe than others among young people, and this impacts on their environmental concern for such 'low'-rated issues. In some cases, elements of pessimism are reflected in peoples' environmental concern in regards to the future (Hicks &

Holden, 2007). There is evidence in the environmental literature that when individuals are knowledgeable about the enormous environmental issues/problems facing our world (locally and globally), they often tend to feel powerless and cynical or unable to take environmentally responsible actions (Goldman et al., 2014; Jensen, 2002). On the contrary, high levels of environmental concern have also been shown to relate to increased knowledge (Tuncer Teksoz et al., 2009) and personal responsibility (Öztürk, Gökhan, & Teksöz, 2013; Vicente-Molina et al., 2013).

2.5.4 Environmental Behaviour

One of the goals of EE, as established by the Tbilisi conference (UNESCO, 1978), was to “create new patterns of behaviour of individuals, groups, and society as a whole towards the environment” (p. 26). The development of EL cannot be separated from exhibition of ERBs. An individual’s level of EL is reflected in his or her behaviour toward the environment (Yavetz et al., 2009), which implies that variables that promote EL can also predict ERB. Supporting this position, Roth (1992) maintained that an individual’s EL can only be determined from observed behaviour. According to Roth:

The absence or existence of degrees of literacy can best be determined by observed behaviour, i.e., a child either can or cannot read; or the child can read not only simple signs but whole books. EL should be defined likewise in terms of observable behaviours. That is, people should be able to demonstrate, in some observable form, what they have learned: their knowledge of key concepts, skills acquired, disposition toward issues, and the like. (Roth, 1992 p. 23)

Environmental behaviour is a problematic phenomenon and defining "correct" environmental behaviour is tricky, because most behaviour leads to some kind of environmental harm, especially if the indirect effects of such behaviour are included. For example, “using reusable coffee mugs instead of paper cups may be incorrect in a location where water supply is limited, and landfill space is generously available” (Babcock, 2009, p. 118). ERB is also socially constructed, as what makes any behaviour viewed as ‘reducing negative impact on the environment’ depends on the context, meanings and values attached to such behaviour (Birdsall, 2010). A

common goal of ERB has however been perceived as aimed towards protecting the environment (Gatersleben, Murtagh, & Abrahamse, 2014). Several studies have attempted to define, measure and explain environmental behaviour (Bamberg & Möser, 2007; Chao, 2012; Hsu & Roth, 1998; Kalamas et al., 2014). The definition of Kollmuss and Agyeman (2002) was taken as a starting point in this study as it defined environmental behaviour as “behaviour that consciously seeks to minimise the negative impact of one’s actions on the natural and built world (e.g., minimise energy consumption or reduction of waste production)” (Kollmuss & Agyeman, 2002, p. 240).

Environmental behaviour in this study was also understood from the perspectives of Hines et al., (1987), McBeth & Volk, (2009) and Simmons, (1995) . These authors defined environmental behaviour to include:

1. Eco-management: This refers to a physical action. It relates to those environmental actions in which people work directly with the natural world to help prevent or resolve environmental issues. Typical examples of behaviour in the eco-management category are reforestation, recycling and energy conservation.
2. Consumer/Economic Action: This refers to those environmental actions in which people use monetary support or financial means to support or resolve environmental issues. Typical examples of behaviour in the consumer/economic action category are donating money to environmental groups and selective purchase of certain ‘green’ products.
3. Persuasion: This relates to those environmental actions in which individuals or groups appeal to others for help to avoid or resolve environmental issues. Typical examples of behaviour in the persuasion category include engaging in debates and public speeches.
4. Political action: This relates to those environmental actions in which people use political means to help to avoid or resolve environmental issues. Typical

examples of political actions include efforts from political processes and organisations

5. Legal action: This relates to those environmental actions in which people support or enforce existing laws which are intended to help prevent or resolve environmental issues. Typical examples of legal action include instigating lawsuits or reporting pollution violation to authorities.

In agreement with the above classification, Roth (1992) claimed that a person at the functional level of EL must take individual and group action through persuasion, consumerism, political action, legal action or ecomanagement. This claim further shows the link between the exhibition of ERB and development of EL. Assessing an individual's environmental behaviour using these categories is akin to assessing environmentally literate individuals' behaviour at the functional level. This study adapted these categories to assess specific behaviours of the pre-service teachers. Behaviours related to political and legal action were not evaluated as they were acknowledged as not appropriate for the target group in this study. Moreover, this study extends the definition of environmental behaviour as behaviour that seeks to protect the environment by reducing negative action on the natural environment while ensuring a contribution towards the social wellbeing of its inhabitants.

Several models have attempted to explain the concept of environmental behaviour, despite the consensus that what shapes environmental behaviour is complex (Bamberg, 2003; Gotschi et al., 2010; Hungerford & Volk, 1990; Kaiser, 2006; Kaiser & Gutscher, 2003; Kaiser, Hubner, & Bogner, 2005). Despite the differences among the models, there is a consensus that shaping human behaviour is the ultimate aim of EE, and its achievement depends upon a broad and complex range of direct and indirect effects involving both cognitive and affective factors. The earliest models, depicting a linear relationship between knowledge, attitude and behaviour, have been shown to be incorrect, as the validity of such causality relationship between knowledge, affect and behaviour cannot be confirmed (Hungerford & Volk, 1990). This 'early linear model' postulates that acquiring more knowledge about environmental issues will inevitably lead to a more positive environmental affect and elicitation of ERB (See Figure 2-2).



Figure 2-2 Early Linear (K-A-B) model of ERB

It is argued that human behaviour is not a single construct predicted by a limited number of variables (Fishbein & Ajzen, 1995). Despite this understanding, some NGOs and government still promote the stance that more information can lead to behavioural change. Behavioural change is far more complex and the gap between affect and behaviour continues to be investigated by researchers.

Normative influences such as social norms, family values, and students' indirect experiences of environmental issues (as opposed to students having direct experiences of the environmental problems and problems they are being taught themselves) are seen as factors that contribute to the gaps between knowledge, affect and behaviour. Additionally, methodological imperfections in studies that tend to assess these relationships is another factor (Kollmuss & Agyeman, 2002). To have higher correlations between attitude and behaviour, the attitudes measured must be directed towards that specific behaviour (Kollmuss & Agyeman, 2002).

The findings from a meta-analysis performed by Hines et al. (1987) on 128 empirical studies, which sought to assess the variables strongly associated with environmentally-responsible behaviour (ERB), are widely acknowledged and used extensively in understanding variables related to ERB. The fifteen variables that emerged from the findings of Hines et al. (1987) were categorised as cognitive, psychosocial, demographic, and a category of experimental studies comprised of behavioural intervention approaches and classroom strategies aimed at encouraging ERB. Hines et al. (1987) developed a model of ERB based on their findings, as shown in Figure 2-3.

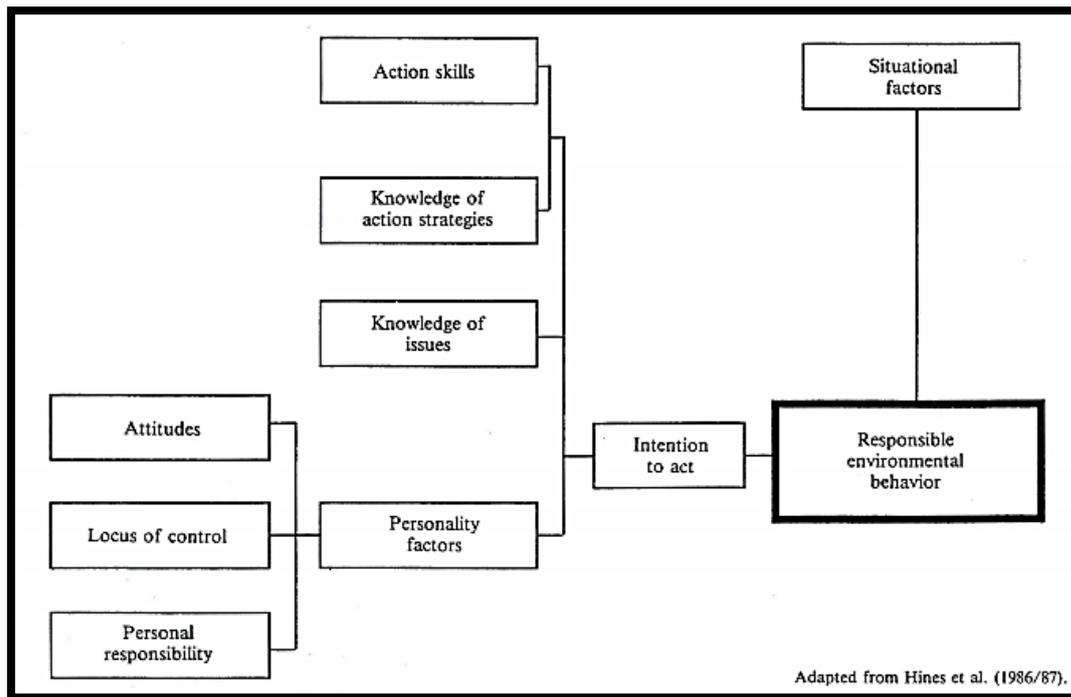


Figure 2-3 Model of predictors of ERB (Hines et al., 1987)

Hines et al. (1987) model showed the role of intention to act in predicting ERB. According to the study, intention to act relies on cognitive and affective components. A person who expresses an intention to act is more likely to act than another individual who does not. An individual cannot, however, have the intention to act on a particular issue without having some knowledge of that issue. Knowledge was therefore seen as a prerequisite for action. In addition, individuals who have affective dispositions (locus of control, personal responsibility and positive attitudes towards the environment) are more likely to take actions that will protect the environment. Situational factors such as social pressures and economic constraints also influence the exhibition of ERB. For example, a recent study exploring environmental behaviour among adults suggests that people will engage more in ERB when they know their environmental behaviour will personally impact them (Levy et al., 2016).

Building on the findings of Hines et al. (1987), Hungerford and Volk (1990) developed their model of ERB and recognised three categories of variables influencing behaviour: entry-level variables; ownership variables; and empowerment variables. Entry-level variables are considered pre-requisites for the

elicitation of ERB. They include environmental sensitivity, knowledge of ecology and attitudes toward pollution/technology/economics. Ownership variables (in-depth knowledge of issues and personal investment) are those variables that personalise environmental issues. In this case, the individual takes personal ownership; such a variable is regarded as critical for ERB. Empowerment variables including, among others, perceived skill in using environmental action strategies, knowledge of environmental action strategies, locus of control and intention to act enable individuals to have a sense that they can make a change and help to provide solutions to environmental problems and issues. The empowerment variables are relevant in training and can be regarded as fundamentals of training in EE. Although they may not be developed in the classroom, they can be improved during training and as such should form part of EE (Hsu, 2004). Measuring actual behaviour could however be tricky. Although self-reported or intended behaviour is used as a substitute for actual behaviour, it has some limitations. However, an attractive feature of intention to act is that it can be used when it is not possible to measure actual behaviour. The next section reviews the literature on intention to act.

2.5.4.1 Intention to Act

Expression of willingness to act upon certain behaviour is often referred to as 'intention to act' (Hines et al., 1986). Intention is often related to affective attitude while intention to act is closely associated with the process of behavioural intention and decision making (Hadjichambis, Paraskeva-Hadjichambi, Ioannou, Georgiou, & Manoli, 2015). Intention to act is therefore viewed as a summation of the relationship between cognitive (action skills, knowledge of issues and action strategies), and affective components (attitudes, locus of control and personal responsibility) (Bamberg & Möser, 2007).

The model of reasoned action (Ajzen and Fishben 1980) postulates intention to act as a direct predictor of behaviour. Intention to act is regarded as a strong predictor of ERB and individuals expressing an intention to act on some environmental issues are more likely to exhibit ERB than those who do not (Hines et al., 1986). Personal factors and social norms have also been identified as two conceptually independent determinants of intention to act and exhibition of ERB (Boeve-de Pauw & Van Petegem, 2017). Edward et al. (2008) highlighted some discrepancies between the

extent to which students felt some action to be useful and their intention to act towards such actions. Specifically, although students did not believe behaviour such as switching off electrical appliances or recycling were really useful actions, they expressed a high intention to act towards those behaviours because of convenience (switching off electrical appliance) or practices that are becoming embedded in social norms (e.g. recycling). On the other hand, while students believed that actions such as using public transport instead of private cars or buying smaller cars are useful actions, they expressed less intention to act. Reasons for this are also linked to personal convenience.

As discussed in Section 2.5.4, the prominent behavioural models (Hines et al., 1986; Hungerford et al., 1990) both emphasise the role of intention to act in predicting environmental behaviour. They also stress the importance of EE in improving the intention to act of individuals. Training through EE can serve as a platform for the improvement of intention to act in a more sustainable manner (Darner, 2009).

2.6 Relationships between Environmental Literacy components

A review of literature has established that neither a knowledge- nor an affect-based education approach in isolation will satisfactorily fulfil the goal of EE of developing EL and exhibition of ERB. Therefore, an approach that recognises the interplay of EL components seeks to promote informed ERB (Ballantyne and Packer, 1996). Exploring these relationships between the EL components has been a central theme in the review of relevant literature on EL. These relationships, as shown in Table 2-4 with their *r* or correlation values, and reported in the published literature, vary between studies (Aminrad, Zakariya, Hadi, & Sakari, 2013; Chu et al., 2007; Erdoğan et al., 2009; Esa, 2010; Genc & Akilli, 2016; Liu et al., 2015; Pe'er et al., 2007; Shephard et al., 2013; Timur et al., 2014; Tuncer Teksoz et al., 2009; Yavetz et al., 2009). This section elaborates on specific relationships between the EL components as they relate to this study.

2.6.1 Knowledge and behaviour

Specified by models of behaviour change already described in Section 2.5.4, most studies that explored the relationship between knowledge and behaviour found either no significant relationship or a weak relationship between them. Alp et al.

(2008) found a negative relationship between elementary students' behaviours towards the environment and their knowledge of the environment. Kibert (2000) found no significant relationship between students' knowledge of environment and their behaviours towards the environment (Kibert, 2000). In the same vein, Negev et al. (2008) found no significant correlation between knowledge and behaviours of the 12th grade and 6th grade students in their study. In a longitudinal study conducted by Yavetz et al. (2009) to assess the EL of 214 students at the onset and towards the end of their studies, in three academic colleges of education in Israel, no significant relationship was observed between their knowledge and behaviour towards the end of their studies. Studies conducted among elementary pre-service teachers (Timur, 2014) and secondary pre-service teachers enrolled in an undergraduate biology teaching methods course (Esa, 2010) both indicated low, positive and significant relationships between their environmental knowledge and behaviour.

The lack of a high correlation between knowledge and behaviour has been reported in other studies in different contexts (Boubonari, Markos, & Kevrekidis, 2013; Carmi et al., 2015; Chu et al., 2007; Kibert, 2000; Pe'er et al., 2007). In studies where, strong correlations between knowledge and behaviour have been reported, the knowledge being measured is often related to an ecological behaviour as against factual knowledge about the environment (Kaiser et al. 1999, p. 4). Kaiser et al. (1999, p. 4) further stated that “[factual] knowledge should not be related with ecological behaviour strongly because its influence is attenuated both by environmental affect and intention.” Carmi et al. (2015) posited that although knowledge is a vital variable, its significant effect is fully interceded by the affective component (emotions). These authors upheld the importance of the influence of other factors on behaviour despite the educational backgrounds of individuals. This is commonly believed to be so since the effect of knowledge is, in a number of cases, weakened by affects, situational factors and subjective norms (Fah & Sirisena, 2014).

Table 2-4 Relationships between EL components as published in literature.

	Studies	r (moderate- high)	Studies	r (low values)
Knowledge and behaviour	Negev et al. (2008)	0.4	Esa (2010)	0.26
			Chu et al. (2007)	0.11
			Pe'er et al. (2007)	0.23
			Boubonari (2013)	0.18
			Kuhlemeier et al. (1999)	0.2
			Hye et al. (2007)	0.11
			Arnon, Orion, & Carmi, (2014)	0.19
			Paco & Lavrador (2017)	0.09
Behaviour and affect	Liu et al. (2015)	0.61	Fah & Sirisena (2014)	0.22
	Arnon, Orion, & Carmi (2014)	0.6	Boubonari (2013)	0.11
	Chu et al. (2007)	0.56	Paco & Lavrador (2017)	0.24
	Esa (2010)	0.26		
	Yavetz et al. (2009)	0.42		
	Negev et al. (2008)	0.56		
	Pe'er et al. (2007)	0.49		
	Kibert (2000)	0.48		
	Makki et al. (2003)	0.45		
	Hye et al. (2007)	0.56		
Meinhold & Malkus (2005)	0.77			
Knowledge and affect	Esa (2010)	0.56	Liu et al. (2015)	0.15
	Teksöz, Sahin, & Ertepinar (2010)	0.48	Aminrad et al. (2013)	0.17
	Pe'er et al. (2007)	0.33	Chu et al. (2007)	0.24
	Boubonari (2013)	0.29	Kibert (2000)	0.22
			Kuhlemeier et al. (1999)	0.26
			Negev et al. (2008)	0.23
			Shephard (2014)	0.12
			Hye et al., (2007)	0.24
			Yavetz et al. (2009)	0.24
			Tikka et al. (2000)	0.28
		Timur (2014)	0.11	
Knowledge and concern	Newman & Fernandes (2016)		Tuncer Teksoz et al., (2009)	0.13
	Teksöz, Sahin & Ertepinar (2010)	0.51		
Affect and concern	Ozturk & Teksoz (2016)	0.1	Mohamed Ternizi (2007)	0.06

r = Pearson correlation coefficient, typically ranges between 0 and 1 inclusive, where 1 is a total positive linear correlation, 0 is no linear correlation (Sedgwick, 2012).

2.6.2 Behaviour and Affect

Most studies evaluating relationships between EL components found the highest correlation between affect and behaviour (Carmi et al., 2015; Chu et al., 2007; Genc & Akilli, 2016; Kibert, 2000; Liu et al., 2015; Negev, Sagy, Garb, Salzberg, & Tal, 2008; Yavetz et al., 2009). Liu et al. (2015) conducted a national assessment of school teachers' EL to establish standards for assessing the effectiveness of EE policy in Taiwan. Their study indicated interesting findings in the correlations between affect and subdivisions of behaviour (action strategies/skills and intention to act). A weak correlation was found between affect and "action strategies/skills" ($r < .30$) while "intention to act" highly correlated with the affective components ($r = .61$ and $.73$). In a study that assessed the EL of 765 first-year student teachers, the highest correlation was observed between affect and behaviour, while the lowest was between knowledge and behaviour (Pe'er et al. (2007). On the other hand, assessment of EL among Malaysian Form 4 secondary school students indicated weak positive correlations between behaviour and affect (Fah & Sirisena, 2014). Weak-to-moderate correlations were also observed between affect and behaviour components in Greek pre-service primary teachers ($r = 0.114$, $p < .05$ to 0.298 , $p < .01$) (Boubonari, Markos, & Kevrekidis, 2013). Similarly, weak-to-moderate correlations were also reported by (Esa, 2010; Paço & Lavrador, 2017).

Relationships between behaviour and affects may be influenced by the types of affect (locus of control, personal responsibility) and behaviour (self-reported or observed) that are being related. For example, a meta-analysis carried out by Hines et al. (1986/87) showed that there was an increase in the correlation between observed behaviour and affect, as compared to the correlation between reported behaviour and affect. This finding is counter-intuitive, as it has been assumed that self-reported behaviour is usually over-reported. The findings of Hines et al. (1986/87) study may have been enhanced because the affects and behaviours that were correlated were precisely related. For example, a question about how someone feels about recycling is directly correlated to how much they recycle, whereas other studies correlate general environmental affects with specific environmental behaviours. The study presented here did not explore the affect-behaviour relationship by presenting closely related questions. The questions were, however, targeted to assess affect and behaviour defined in the context of the study.

2.6.3 Knowledge and Affect

The literature suggested a weak-to-moderate positive correlation between affect and knowledge (Aminrad et al., 2013; Chu et al., 2007; Liu et al., 2015; Negev et al., 2008; Shephard et al., 2014; Yavetz et al., 2009). Bradley et al. (1999) found that upon completing a 10-day environmental course, both the environmental knowledge and affect of the high school students in the study significantly increased. Statistically significant positive correlations were also observed between the pre-test knowledge and affect scores, and the post-test knowledge and affect scores. Conversely, Yavetz et al. (2009) found significant but weak correlations between PSTs' environmental affect and knowledge at the beginning and end of their studies. Other studies also reported significant but weak correlations between environmental affect and knowledge, even upon exposure to environmental courses (Aminrad et al., 2013; Yavetz et al., 2009). Findings from a recent study (Paço & Lavrador, 2017) that sought to assess the environmental knowledge, affect and behaviour of university students in regards to energy issues (savings, consumption, interest, use) found no significant correlation between their knowledge and affect. Similar findings were found among form 4 secondary school students in Malaysia (Fah & Sirisena, 2014). Boubonari (2013) reported that increased knowledge was related to more positive affect, specifically with locus of control ($r = 0.299, p < .01$) and affects relating to the environment ($r = 0.237, p < .01$).

2.6.4 Concern and knowledge, affect, and behaviour

The traditional thought of a direct linear relationship between environmental knowledge and concern has been questioned (Kollmuss & Agyeman, 2002). However, a relationship among environmental concern, knowledge and affective components of EL has been shown (Newman & Fernandes, 2016). Elevated levels of environmental concern have been shown to relate to increased knowledge (Tuncer Teksoz et al., 2009) and affect (Öztürk, Gökhan, & Teksöz, 2013; Vicente-Molina et al., 2013). Factors such as education, younger aged group and political liberality have also been found to promote environmental concern (Newman & Fernandes, 2016). However, the interaction between environmental concern and behaviour is extremely complex (Bamberg & Möser 2007; Kollmus & Agyeman 2002). The literature has reported varied findings on the relationship between environmental concern and other EL components (environmental affect and

behaviour). For example, high correlations between environmental concern and knowledge were reported by Teksöz, Sahin and Ertepinar (2010) and Newman & Fernandes (2016), while Tuncer Teksoz et al., (2009) reported a low correlation between knowledge and concern (see Table 2-4).

Having discussed EL and the interrelationships between its components, the next sections review existing literature on the development of PSTs' EL and their preparedness to teach EE in schools after undergoing teacher education programmes. The next section thus reviews the literature on teacher education programmes globally and in New Zealand.

2.7 Teacher Education programme

This study focuses on the development of PSTs' EL during their teacher education programme and how prepared they are to teach EE upon graduation, based on the preparation they have received. This section, therefore, seeks to review existing literature on the place and mode of teacher education programmes, and PSTs' teacher education programmes in EE with a focus on their development of EL and preparedness to teach EE in primary schools. The section concludes with the experiences of teachers in their initial teaching years.

Teacher education is described as “policies and procedures designed to equip and prepare prospective teachers with the knowledge, attitudes, behaviours and skills they require to perform their tasks effectively in the classroom, school and wider community” (Kumar & Parveen, 2013, p. 1). Teacher education can be at either the pre-service or the in-service phase. While pre-service teacher education is the formal education and training provided to student teachers before they have undertaken any teaching, in-service programmes refer to educational activities aimed at persons already employed in the teaching profession.

Arguments abound in the literature as to the preferred mode of education of teachers, in terms of pre-service or in-service teacher education (Christofferson & Sullivan, 2015; Harris & Sass, 2011; Kunter, Kleickmann, Klusmann, & Richter, 2013; Piwowar, Thiel, & Ophardt, 2013; Sullivan-Watts, Nowicki, Shim, & Young, 2013).

Curriculum-based professional development, which is characteristic of pre-service training, is favoured by one school of thought since it is claimed to have more lasting impact on the student teachers than general professional development (Weiss & Pasley, 2006). For example, Darling-Hammond (2002), in a study that assessed how well different pathways prepare teachers to teach, stated that beginning teachers' feelings about their preparedness varied between the different pathways. These differences were linked to the length of training these teachers received, and the contribution made by the teacher education programme was noticeable on fundamental duties of teaching such as transferring subject knowledge effectively to students and creating a friendly learning environment. Similarly, another study carried out in the United States reported that the vast majority of teachers who received only a few weeks of summer training, and those who joined the teaching profession without prior training, resigned in the first few months of the school year (Darling-Hammond, 2010). These beginning teachers felt overwhelmed; they believed they did not know how to manage the students to get their attention for teaching, and were not willing to shortchange the students as a result of their lack of competence. In contrast, Walsh (2001) argued that there is no relationship between teacher education preparation and a teacher's performance. Hence, Walsh argued that no dedicated learning is needed to improve teachers' knowledge and skill, as this can be acquired mostly on the job.

Despite these arguments about whether student teachers enrolled in formal teacher education are more successful than their counterparts who had no access to such training (Zeichner, 1999), there is evidence in the literature that teachers who have previously undergone a teacher education programme, regardless of the mode, are usually more efficient and productive with students (Boe, Shin, & Cook, 2007; Darling-Hammond, 2000; Darling-Hammond, Chung, & Frelow, 2002; Zientek, 2007). The need for some form of formal education for teachers is expressed in the view that, to be successful as a teacher, much of what is required is imperceptible to lay observers. In other words, teacher education programmes can be regarded as a keystone for the preparation of effective teachers. Teacher education programmes provide the opportunity for would-be-teachers to be furnished with certain skills and knowledge essential for their work in schools upon graduation (Eret, 2013). Arguably, the quality of teacher education received has an effect on the quality of

teaching in classrooms as a teacher's competence plays a major role in the quality and extent of students' learning (Goldman et al., 2014). Recognizing the central role teacher education programmes play in preparing teachers for the task ahead then raises the question: "What kind of teacher education is needed to adequately prepare these teachers?"

A range of PST education programmes is used in different countries (Darling-Hammond, 2010, 2017). For example, in Finland, teachers are expected to complete a 2–3-year master's degree before they start teaching. In contrast, the requirement for entering the teaching profession varies in other countries such as Canada, Australia, and United States. Some of these countries offer a combination of undergraduate and graduate-level programmes. A common method of teacher preparation in these countries, especially for primary schools is a 3-4 year undergraduate teacher education provided by universities and colleges of education (Darling-Hammond, 2017). Students enrolled usually experience their education in two phases. The first involves university-based training and the second takes the form of a practicum or school-based training (Eret, 2013). Since this study is located in New Zealand, it is important to explore primary pre-service education in New Zealand.

2.7.1 Primary Pre-Service Education in New Zealand

To become a primary school teacher in New Zealand, qualifications must be obtained from an accredited tertiary institution. There are currently 16 New Zealand tertiary institutions offering qualifications in teaching (Table 2-5). These include seven universities, five wananga, one institute of technology and three Christian-based colleges (Teach NZ, 2018). This is an increase of 25% compared to the numbers of institutions offering teacher education courses reported earlier (Eames, Bolstad, et al., 2008; Kane et al., 2005).

These teachers complete either a three year undergraduate degree, a one year Graduate Diploma or a Masters in Teaching and Learning degree, with education courses offered within a Faculty of Education or college, which is comparable to a university department (Rosin, 2014). In fulfilment of the primary teacher education qualification, PSTs must also engage with the *New Zealand Curriculum's* learning areas (Cameron & Baker, 2004). The Council oversees each of the educational

providers as well as providing sets of graduating teacher standards used to assess teachers before they graduate (Teach NZ, 2018). The recent ‘Code of Professional Responsibility and Standards for the Teaching Profession’ (Education Council, 2017) which serves as a guide for the appraisal of all registered teachers includes the expectation that teachers demonstrate their commitment to “promoting and protecting the principles of human rights, sustainability and social justice” (p. 12). Having discussed an overview of teacher education programmes and PSTs’ education, the next section explores existing literature related to PST education in EE, since the focus of this study is not on teacher education programme in general, but on teacher education programmes in EE.

Table 2-5 New Zealand Institutions offering Qualifications in Teacher Education (TeachNZ, 2017)

S/N	Institution
1	AUT University School of Education Te Kura Mātauranga
2	Bethlehem Tertiary Institute
3	Eastern Institute of Technology
4	New Zealand Graduate School of Education
5	Massey University
6	Laidlaw College School of Education
7	Te Pū Wānanga o Anamata – Anamata Private Training Establishment
8	Te Wānanga o Aotearoa
9	Te Wānanga o Raukawa
10	Te Wānanga Takiura o Ngā Kura Kaupapa Māori o Aotearoa
11	Te Whare Wānanga o Awanuiārangi
12	The University of Auckland Faculty of Education
13	The University of Waikato Faculty of Education
14	University of Canterbury College of Education
15	University of Otago College of Education
16	Victoria University of Wellington Faculty of Education

2.8 Pre-service Teachers’ Education in Environmental Education

The need for inclusion of EE in pre-service teacher (PST) education programmes in order to produce effective EE teachers has been recognised for over four decades (Cutter-Mackenzie & Smith, 2003). Beginning with the *Belgrade Charter* (UNESCO-UNEP, 1976), and followed by the *Tbilisi Declaration* (UNESCO-UNEP, 1978), international support for EE inclusion in teacher education has been described as the priority of priorities (UNESCO, 1990). However, much progress has not been reported in efforts to prepare teachers to implement EE in their

classrooms (UNESCO, 2017). As reflected in the GAP's Priority Action Area 3 of the UNESCO (2017) report, emphasis is placed on developing the capabilities of educators in EE as it relates to the content of EE, its teaching and learning approaches. One of the recommended ways of achieving this goal is to integrate EE into pre-service and in-service teacher education programmes (UNESCO, 2014).

The period between 2005 and 2014 was declared the Decade of Education for Sustainable Development, with the aim of highlighting the crucial need for education in the achievement of a sustainable world (Crim, Moseley, & Desjean-Perrotta, 2017). Teachers could play a major role in implementing this education in schools. Robottom and Kyburz-Graber (2000, p. 157) concluded that "behind every successful EE programme is a committed teacher.". Moreover, "if teachers are not adequately prepared to teach our youth about the environment, then our hopes of the next generation being able to solve these problems has incurred a serious setback. Teachers who are well prepared to teach about the environment can have a lasting impression upon their students" (Ashmann & Franzen, 2017, p. 2).

Despite the support for the inclusion of EE in pre-service teacher education, the extent to which this integration has been achieved is quite uncertain (Wals, 2009). EE is usually taught through separate courses in pre-service teacher education programmes (e.g., Evans 2016; Kennelly & Taylor, 2007) or by inclusion into other learning areas. The question of where EE should sit in teacher education programmes is still debatable. Science disciplines (biology, agriculture, chemistry) have been viewed as most suitable platforms for preparing teachers in EE (Campbell, Medina-Jerez, Erdogan, & Zhang, 2010; Littledyke, 2008; McKeown-Ice & Dedinger, 2000; Van Petegem, Blicek, & Van Ongevalle, 2007). Although these science disciplines in some ways cover the scientific principles that underpin environmental issues, aspects that connect with affective, socio-cultural dimensions may not receive adequate attention. EE is, in principle, equally values education (IUCN, 1970), intended to influence learners' attitudes and behaviours (Pe'er et al., 2013; Scott & Oulton, 1998) and this aspect might not be sufficiently covered through science disciplines. A case study that assessed EE integrated into the university curricula of primary PSTs at the University in Spain showed that EE as a subject was taught in only one field, and it was widely treated as content in

different subjects. However, while the ecological concept prevailed in the teaching of EE, overall, in the study, there was little occurrence of EE in educational projects (Suárez & Teixé, 2007).

Since sustainability has been seen as a focus for improving education's quality and relevance to the society, universities are now looking for ways to equip graduates to think and act in a sustainable manner, regardless of the profession they are in (Anderson et al., 2007; Shephard, Mann, Smith, & Deaker, 2009; Stewart, 2010). This might imply that all student teachers should receive appropriate preparation in the field of EE. A substitute approach is that EE should not be restricted to the science disciplines, but it should be incorporated into all teacher education programmes. This method provides an added advantage of preparing a wider range of teachers, as well as developing affective dispositions, which constitute a central part of EE (Yavetz et al., 2014). Consequently, this approach provides a central means for educating for values and achieving a broad range of educational goals.

Findings from an Australian study determining the perceptions of 131 second- and third-year PSTs based on their experiences in the EE training undertaken indicated that, EE classes contributed more to the PSTs' experiences in EE than any other school practice (Miles, Harrison and Cutter-Mackenzie (2006). However, despite PSTs' interest in teaching EE, their knowledge of EE and preparation to teach was insufficient. This implies that the teacher education programme did not adequately prepare these PSTs for the challenges ahead.

A nationwide study was conducted to investigate the inclusion of EE into educator preparation programmes across the United States (McKeown-Ice & Deding, 2000). Findings from teacher educators indicated that the infusion of EE into educator preparation programmes was limited and differed widely across the country. In addition, more barriers than supports for the inclusion of EE were identified. The study also indicated that there was only minimal knowledge and use of the North American Association for Environmental Education (NAAEE) guidelines for the preparation and professional development of environmental educators. The study also reported that most state licensure programmes have few or no requirements related to EE, and in most educator preparation programmes,

EE is not institutionalised. These findings pointing to inadequate teacher training align with the submissions of Álvarez-García, Sureda-Negre, and Comas-Forgas (2015), a literature review of 24 documents encompassing two doctoral theses and 22 journal articles. The systematic review suggests that there seems to be a lack of environmental competencies amongst PSTs.

The challenges associated with successfully preparing PSTs to teach about the environment are well known (Heimlich et al. 2004; McKeown-Ice 2000; Powers 2004). For instance, Cardona (2012) examined undergraduate pre-service teachers using questionnaires, written documents and interviews. Findings suggested that PSTs do not have sufficient knowledge and skills to advance EE in their classrooms. Moreover, EE seems to be poorly incorporated into teacher education curricula (Falkenberg & Babiuk, 2014). In places where it is incorporated, there is a lack of specific training through a consistent or systemic approach (Ferreira, Ryan, & Tilbury, 2007; Daniella Tilbury, Amanda Keogh, Amy Leighton, & Jennifer Kent, 2005), resulting in lack of progress in the delivery of EE (Esa, 2010; Ferreira, Ryan, Davis, Cavanagh, & Thomas, 2009).

These challenges were captured in a recent study by Ashmann and Franzen (2017) that assessed preparedness to teach EE among primary and secondary school PSTs from 33 teacher education programmes in Wisconsin (USA). Findings from the study indicated that only nine of the teacher education programmes had EE as a separate course. The remaining teacher education programmes supposedly infused EE into the science or social science syllabus and gave PSTs an opportunity to peer teach and develop a unit to teach primary or secondary students and/or investigate an issue. Using an environmental topic for this inquiry/investigation was optional, which implied that those who were not interested in using an environmental topic were allowed to use other topics and might achieve no learning in EE, because EE makes its way into the course only if students decide to use an environmental topic as the unit of inquiry. Moreover, findings from the Wisconsin study showed that the inclusion and/or quality of EE education provided to these PSTs was dependent on the instructor's passion and interest, which strongly influenced how much attention was given to EE. In the study, EE was also seen as being more closely suited to the science disciplines, considering that little or no connection to social

studies was observed among the participating teacher education programmes. Another observation from the study was that there was no follow-up with the graduates to assess the impact of the EE training they received. Hence, there was no indication of the impact the teacher education preparation might have had on PSTs. This current study attempts to overcome this challenge by following up some of the graduated PSTs in their schools six months into their teaching career to examine the impact of the EE training.

Other challenges highlighted in the survey carried out by McKeown-Ice (2000) with 715 teacher education institutions in the United States still seem relevant today. These include lack of time for EE as it conflicted with compulsory course content (as also suggested by Paige, Lloyd, & Chartres, 2008); numerous priorities competing for time and attention (Moore, 2005); lack of communication among subject areas (Littledyke, Taylor, & Eames, 2009); and lack of content, pedagogical knowledge, and skills in teaching in outdoor settings (Kim & Fortner, 2006). Some studies also identified overcrowding of the curriculum (Eames et al., 2004) and the lack of resources and marginalisation of EE in education as challenges to inclusion of EE in pre-service teacher education programmes (Crim et al., 2017; Summers, Childs, & Corney, 2005)

Similar to requests from some New Zealand schools for some sort of structure for EE (Bolstad, 2015), Ashmann and Franzen's (2017) research also concluded that for effective EE in a teacher education programme, and in primary schools, there is a need for a human resource (an individual to champion the EE cause). There are also some institutionalised barriers that might hinder the effectiveness of EE even in the presence of a dedicated human resource. Human resources, material resources (money and anything money can buy), and social resources (including relationships, values, and social norms) are identified as all working together to prepare PSTs to teach EE effectively. How have the discussed factors played out in New Zealand? The next section therefore explores primary PSTs' education in EE in New Zealand.

2.8.1 Primary PSTs' Education in Environmental Education in New Zealand

Most universities offering teacher education programmes (see Table 2-5) offer a paper related to EE at primary and secondary level. However, these are often limited in scope and enrolled student populations (Eames, Bolstad, et al., 2008). Eames, Bolstad, et al. (2008) concluded from their study that there is no teacher education institution in New Zealand that guarantees every teacher graduate in any programme has had access to EE during their study, except the University of Waikato. However, nine years after these findings were published, studies do not exist that report on recent trends, although as noted earlier, anecdotally little has changed. Very few published findings exist on the PST education delivery of EE in New Zealand tertiary institutions (Eames, Bolstad, et al., 2008).

Another critical issue regarding PSTs' education in New Zealand has to do with policy. EE is a non-mandatory subject for which the Ministry of Education has produced specific guidelines but no curriculum document (Chapman, 2011). As discussed previously, The *New Zealand Curriculum* released in 2007 emphasized the importance of EE, yet EE is not mandatory in New Zealand primary schools. Teachers might not be able to integrate EE into their teaching upon graduation if schools do not have expectations for them to integrate it into their teaching. This has implications for PSTs' education in that there is a need for teacher education programmes to equip these PSTs with the knowledge, skills, and other dispositions needed to meet the challenges that might arise in their schools. Teacher education programmes have the potential to bring about significant change through the education of would-be teachers (UNESCO, 2012). However, adequate training of pre-service teachers is needed to achieve the competencies of an environmentally literate teacher and the professional competencies of an environmental educator (Álvarez-García et al., 2015). The next two sections, therefore, review the literature on PSTs' development of EL and preparedness to teach EE.

2.8.2 PSTs' development of Environmental Literacy

Incorporating EE into teacher education programmes could lead to the development of EL among PSTs (Hill, 2016; Liu et al., 2015; Ogunyemi & Ifegbesan, 2011; Tuncer Teksoz et al., 2014; Yavetz et al., 2009). Some studies assessed PSTs only

at one point of their teacher education programme (Esa, 2010; Koc & Kuvac, 2016; Tuncer Teksoz et al., 2014), while others employed the use of a pre-test and post-test design to evaluate PSTs' EL (Tal, 2010; Yavetz et al., 2009). Both approaches have contributed to the understanding of the impact of EE on PSTs' EL.

Globally, varied findings have been reported by studies that assessed PSTs' EL. For example, a number of studies reported increased levels of environmental knowledge among PSTs who had taken an EE course (Evans et al., 2016; Moody et al., 2005; Özden, 2008; Öztürk et al., 2013; Swanepoel, Loubser, & Chacko, 2002; Tal, 2010; Timur et al., 2014), but in some instances PSTs portrayed limited knowledge, even after completing an EE course (Puk & Stibbards, 2010; Tuncer Teksoz et al., 2014). Overall, a common theme observed in studies that reported increases in environmental knowledge of PSTs upon exposure to an EE course is that PSTs generally have limited environmental knowledge, especially when viewed from the standpoint of them being future environmental educators. This limited environmental knowledge is often associated with the non-mandatory position of EE in the school curriculum and ineffective teaching of EE during their teacher education programme (Ashmann & Franzen, 2017). A study by Puk and Stibbards (2010) in Ontario, Canada strengthens this assertion. Their study involved a cohort of 15 PSTs enrolled in a nine-month Bachelor of Education teacher education programme. The goal of the study was to evaluate the understanding of these PSTs on various environmental and sustainability concepts, especially the definitions they gave for environmental concepts, as their understanding would possibly be transmitted to their future students. Findings indicated that most of the PSTs had very vague understandings of the environment and its related concepts, despite supposedly having been previously exposed to EE courses at school.

Typically, PSTs seem to be very knowledgeable about some aspects of environmental and sustainability issues and at the same time demonstrate shallow knowledge of some other aspects after being exposed to EE. A study carried out in Nigeria among 199 social studies PSTs (Ogunyemi & Ifegbesan, 2011) using a survey questionnaire indicated that the PSTs had a high level of environmental knowledge concerning local issues, but comparatively low levels of knowledge about global environmental issues. Despite a high level of affective disposition to

environmental issues among the PSTs, the study concluded that an individual's environmental stewardship could still be hindered because of the knowledge gap observed. Similarly, findings from another study in Malaysia that assessed 115 biology PSTs enrolled in an undergraduate course indicated that they demonstrated high levels of environmental knowledge of topics related to biodiversity, the ozone layer, ecology, the greenhouse effect and sustainable development, while a low level of environmental knowledge was associated with carrying capacity and ecological footprint. The PSTs also demonstrated positive affective dispositions towards the environment but in contrast, exhibited low levels of ERB (Esa, 2010).

Despite evidence of limited environmental knowledge in evaluations of PSTs' EL, positive environmental attitudes are often observed, regardless of the group being assessed. For example, studies of elementary school students (Alp et al., 2008), secondary school students (Aminrad et al., 2013; Negev et al., 2008), college and university students (Shephard, 2014) and PSTs (Pe'er et al., 2007; Tuncer Teksoz et al., 2014; Yavetz et al., 2009) all reported positive affective disposition towards the environment upon completing an EE course, regardless of the level of environmental knowledge acquired. Elaborating on the relationships between knowledge and attitude, Al-Dajeh (2012) assessed the EL of 124 PSTs in a pre-vocational education programme using close-ended questionnaires. In another study, Saribas, Teksoz, and Ertepinar (2014) examined the level of 61 Turkish science PSTs' EL and self-efficacy beliefs using questionnaires. Findings from both studies indicated that although participants demonstrated low knowledge of environmental issues, they had positive attitudes towards the environment. An explanation for the gap between knowledge and attitudes may be normative influences as reviewed in Section 2.6.4. There is also the likelihood that PSTs do not fully understand the underlying principles of ecological and environmental concepts, despite having a positive attitude towards the environment.

A review of studies that employed pre-test and post-test designs has been found relevant, especially in understanding the impact of taking an EE course on PSTs' EL. For example, Tal (2010) assessed the environmental knowledge and perception of 75 PSTs enrolled in a teacher-training programme in Israel. A pre-test and post-test design with the use of questionnaires and reflection sheets was used to assess

the PSTs' environmental knowledge and perceptions about the course over three consecutive years. Increased environmental knowledge, especially in areas focused on in the EE course, was observed. The course also seemed to enhance PSTs' environmental awareness, as well as helping them discover new teaching methods for their practice. The PSTs also expressed increased learning as a result of the field trip made during their teacher education programme. Although behaviour was not intended to be assessed in the study, it was observed, via the PSTs' reflections, that only a few made changes in their behaviour as a result of the course. Teacher education programmes seem to impact PSTs' environmental knowledge more than they do their environmental behaviour. This is somewhat worrisome if the goal of developing EL is to be achieved. There may be a need for teacher education programmes to revisit approaches that would help develop PSTs' environmental behaviour.

The longitudinal study conducted by Yavetz et al. (2009) to compare the EL of 214 PSTs at the beginning and end of studies in three teacher education programmes in Israel showed significant increases in PSTs' EL after completing the EE course. Although PSTs seemed to demonstrate pro-environmental attitudes before taking the EE Course, increases were observed in their attitude after taking the EE course. However, a closer look at their findings showed that overall, PSTs' environmental knowledge could be regarded as low even after taking the EE course. While there were indications of more ERB after completing the course, involvement in behaviours that reflected a high commitment to the environment remained low and could be considered as inadequate for those who are future environmental educators, who would serve as role models for their students. Their conclusion was that the EL of the examined PSTs at the end of their course seemed discouraging and inadequate for educators. In 2014, Yavetz et al. published their assessment of the same group of PSTs' perceptions about the environment (Yavetz et al.). Their findings indicated that there was no difference in the perceptions of PSTs about the biophysical qualities of the environment before and after taking the EE course. However, the students demonstrated increased perceptions in terms of their connection with nature.

While PSTs' EE in the development of EL seems necessary (Hollweg et al., 2011), it should also be recognised that regardless of the EE received, other factors such as gender, grade level, membership of an environmental association, socioeconomic status and location have also been found to influence individuals' EL (Goldman, et al., 2006; Moody, et al., 2005; Ogunyemi & Ifegbesan, 2011; Tuncer Teksoz, Sungur, Tekkaya, & Ertepinar, 2007; Tuncer Teksoz, et al., 2013). A study that investigated the EL of PSTs at one of the largest public universities in Turkey (Tuncer Teksoz, 2009), using canonical analysis, a type of regression analysis concerned with determining the relationships between groups of variables in a data set, showed that the environmental backgrounds of PSTs were positively related to their EL. This current study also sought to investigate the role of background factors on the EL of PSTs.

2.8.3 PSTs' Preparedness to Teach Environmental Education

An outcome of an effective teacher EE programme is that at the end of the programme, teachers should be adequately prepared to teach EE (Knapp, 2000; Tuncer Teksoz et al., 2013). For effective implementation of EE in schools, teachers must be confident and willing to incorporate EE programmes in their classroom. PSTs' self-confidence, a dimension of their self-representation, is often associated with their impression of their own competence in a specific domain, context or situation (Maclellan, 2014). A major barrier to the effective preparation of PSTs, which could have a resultant effect on their confidence, is the lack of necessary pedagogical content knowledge for teaching EE (Cutter-Mackenzie & Tilbury, 2002; Summers, Kruger, Childs, & Mant, 2000; Tilbury, Keogh, Leighton, & Kent, 2005).

Pedagogical content knowledge is pivotal to the effectiveness of PSTs as it involves knowledge about teaching methods and practices coupled with knowledge about the subject matter to be taught (Van Driel & Berry, 2012). To achieve the goal of developing environmentally literate PSTs, there is the need for appropriate pedagogical content knowledge in teacher education programs (Richardson, Byrne, & Liang, 2017). Tomas and Mills (2011) surveyed a sample of 142 primary PSTs to investigate how informed and concerned they were about a range of sustainability issues such as the enhanced greenhouse effect, premature species extinction and

land clearing. Their study reported that while all respondents believed that the issues were of serious concern to them and to other Australians, 75% of the PSTs felt that they would not be able to explain what the issues were about. This study supports the need for PSTs to acquire the necessary pedagogical content knowledge for teaching EE during their teacher education programme, as the demonstration of concern towards the environment is not enough to engage with EE in the classroom. As Tomas and Mills (2011) noted, “If [PSTs] are to be confident in engaging with sustainability issues ... they must have a sound understanding of these issues in order to do so” (p. 6).

Training PSTs should be balanced to involve experience through practice and knowledge of subject matter (Aslı Özgün-Koca & İlhan Şen, 2006). It has been suggested that high-quality teacher education programmes should have a shared and holistic vision of quality teaching integrated into coursework and field experiences, well-developed curriculum, subject matter pedagogy taught in the context of practice, and a variety of assessments that ensure learning is applied to practice (Darling-Hammond, 2000; Rots, Aelterman, Vlerick, & Vermeulen, 2007). PSTs do not feel prepared to be efficient EE educators when they have restricted access to EE methods and content (McKeown-Ice, 2000). For instance, a study carried out by Taylor et al. (2006) indicated that the introduction of EE in the curriculum of PSTs at the University of New England had a positive impact on the environmental knowledge of the PSTs. Those who completed teacher education training were also found to be more confident and effective in successfully delivering quality EE teaching to their students (Darling-Hammond et al., 2002). In another study (Kennelly & Taylor, 2007), a decision was made to revise the existing EE papers following criticisms that EE for sustainability was poorly represented in Australia’s teacher education courses at that time, and that teachers become ineffective when teaching EE in-service because of the lack of pedagogical content knowledge at the pre-service stage. The revision involved incorporation of concepts from a previously tested education philosophy framework. The framework involved five components: espoused educational aims supported by the appropriate institution; the epistemology used to recognize what counts as knowledge; curriculum content; the learning theory through which learners learn; and accepted teaching practices. Findings from the study indicated that at the onset, the confidence of the PSTs was

low due to limited pedagogical content knowledge (Kennelly & Taylor, 2007). After exposure to the revised papers, most of the PSTs expressed more theoretical understanding of environmental issues, coupled with pedagogical skills, ideas and resources, which could then impact on the teaching of their future students (Kennelly et al., 2008). Kennelly, Taylor, and Maxwell (2008) found that PSTs' confidence to teach sustainability increased after their participation in an EE unit in their teacher education programme. This change was attributed, in part, to their improved knowledge about the environment.

While some researchers might argue that knowledge and understanding of sustainability may not necessarily lead to action on important issues, nor to the effective teaching of EE in classrooms (Cutter-Mackenzie and Smith 2003; Cutter-Mackenzie and Tilbury, 2002; Kennelly, Taylor, and Maxwell 2008a; Stevenson 2007), it has been suggested that a sound knowledge of sustainability issues – in addition to the necessary pedagogical skills, values and attitudes – will support teachers' confidence and readiness to provide EE in schools (Symons 2008). In some cases, assessing PSTs' confidence based on self-reported data may be difficult as perceived knowledge and actual knowledge may differ. In Australia, a study was conducted to evaluate the relationship between perceived knowledge and actual knowledge, as well as the efficacy of education for sustainability of some PSTs at a large metropolitan university (Effeney & Davis, 2013). An anonymous questionnaire based on education for sustainability was used in the study. Although the teachers professed confidence in their knowledge of education for sustainability, the study did not find a correlation between their perceived knowledge and actual knowledge. The findings might be due to inappropriateness of the questionnaires or overestimation of confidence of their knowledge. Similarly, some Turkish science PSTs' understanding of science concepts and their confidence in its teaching were assessed (Tekkaya et al., 2004). A total of 299 senior science education major PSTs participated in the study. The study indicated that a majority of the participants held misconceptions concerning fundamental science concepts, yet they generally felt confident about teaching. Only slightly more than half (56%) claimed to understand science concepts well enough to teach science, but interestingly a majority (81%) of the participants indicated confidence in their ability to teach science effectively.

Discrepancies between actual and perceived knowledge can pose a considerable challenge to efforts aimed at effectively developing the pedagogical content knowledge of PSTs. This is because it would be difficult to design effective intervention programmes when the actual knowledge level cannot be accurately determined. Nevertheless, accessibility to curricula and provision of quality teacher preparation are important factors in boosting PSTs' commitment to implement EE in their classrooms (Powers, 2004). PSTs' training in EE, when incorporated holistically, can encourage development of EL in PSTs (McKeown-Ice 2000). Also, effective EE training can equip PSTs with the confidence to teach EE, and to help their future students in developing their own EL. The next section reviews the literature on the experiences of teachers in their initial teaching years.

2.8.4 Experiences of teachers in the initial years of teaching

Despite the feelings of preparedness demonstrated by PSTs at the end of their teacher education programme, evidence has shown that most teachers find the first years of teaching quite challenging (Anthony et al. 2008; Bullough et al. 2008; Grudnoff 2011; Langdon 2011; Schuck et al. 2012). The reality of entering the new world of teaching can make them doubt the preparation they have received (Russell & McPherson 2001). In many cases, there are tensions between teachers' expectations and the reality of the teaching world (Draper & O'Brien 2006; Hagger, Mutton & Burn 2011). They then begin the journey of constructing who they are as teachers, during which they are often faced with a feeling of being overwhelmed and become more aware of what they cannot do yet (Feiman-Nemser, 2001). These beginning teachers are faced with responsibilities to their students, colleagues, and school authority, and thus they continue to construct who they are as teachers (Ball and Cohen 1999; Feiman-Nemser 2001; Parr and Timperley 2010; Timperley et al. 2007). These teachers seem not to be adequately prepared for their first year of teaching; most of them found teaching more difficult than they had previously expected (Kane et al., 2013).

It could become even more difficult when these teachers are required to integrate a subject such as EE into their teaching, for the reasons described in Section 2.8. There is a dearth of studies investigating beginning teachers' experiences in teaching EE in primary schools and the present study seeks to fill that gap. Recently,

a study conducted in Australia, investigating 47 beginning teachers' experiences in teaching EE in primary schools was published (Lasen, Skamp, & Simoncini, 2017). The PSTs in the study were asked to interview their supervising teachers (mentors), during their practicum, about their experiences in integrating EE into their teaching as well as the challenges that they encountered. Participants who shared their experiences in the study were not beginning teachers but the findings may be relevant to this study. In addition to some of the barriers already stated in Section 2.8, according to these teachers, the major barriers were lack of time or an overcrowded national curriculum, prioritization of literacy and numeracy, and challenges associated with integrating EE into the main learning areas.

2.9 Chapter summary

The major summits, declarations, and intergovernmental conferences that have shaped EE all point to EL as one of the goals of EE. They have also influenced the recognition of EE in New Zealand, as in many countries. EE in New Zealand has faced and is still facing some contention due to political influences and priorities, as exemplified by the marginalised position it occupies in the *New Zealand Curriculum* (MoE, 2007). Although the recent release of the senior secondary school guidelines may be regarded as progress in terms of providing resources and assessment for EE in secondary schools with a focus on sustainability, primary schools in New Zealand have not experienced such progress. Very few teacher education programmes exist that ensure that all PSTs have had training in EE in New Zealand, and evaluation of the effectiveness of such programmes and later delivery of EE in schools is under-researched.

The review of the literature has established the conceptual basis for the role of education in developing EL. Although there is no consensus on the definition of EL, previous studies and frameworks used to examine EL have shown that EL is a product of interrelationships between its components: environmental knowledge, affect, and concern, which can be expressed in ERB. Although environmental knowledge has been suggested to be a prerequisite for ERB, no linear relationship has been established between the two. Environmental knowledge of specific issues, the natural environment and sustainability is regarded as essential and contributes

to an individual's EL. Constructs such as environmental worldview, personal responsibility, and locus of control are also relevant to an individual's environmental affect. EL can be expressed in ERB, which can be observed through an individual's intention to act or participation in some actions related to persuasion, consumerism, or eco-management. Studies that have attempted to explore the relationships between EL components have reported mixed findings. However, generally, studies that evaluated the environmental knowledge of individuals in conjunction with other components in response to EE teaching have reported an overall low level of environmental knowledge among the study participants. EL is developmental in nature and thus an individual's EL can be regarded as lying on a continuum. Hence a person cannot be regarded as being either environmentally literate or not. To be considered as having the desired level of EL, the educational sector has a role to play in providing sound EE knowledge as an important predictor of ERB.

The quality of education, however, depends on the quality of teaching; there is a need to train future educators in such a way that their EL can be developed so that they can help their future students to develop theirs. Several studies reveal that pre-service teacher education programmes can be regarded as cornerstones for effectively preparing teachers in EE in such a way that their EL is developed and they are prepared to help develop the EL of their future students. However, teacher education programmes seem to have more impact on PSTs' environmental knowledge and affective dispositions than on behaviour, since behaviour has been established as a complex phenomenon. Teacher education programmes still need to develop pedagogical approaches that could aid PSTs' ERB.

The literature reveals a dearth of studies in New Zealand that have investigated PSTs EL, their preparedness to teach EE in schools, and the application of their EL upon graduation. However, barriers identified in previous studies worldwide that hinder teachers from engaging in EE include the lack of pedagogical content knowledge of EE, school priorities, issues with integrating EE into other learning areas, and an emphasis on literacy and numeracy. Synthesizing the aforementioned ideas on EE, EL, and teacher education programmes in EE in relation to the

development of PSTs' EL and preparation to teach EE, the concluding section presents the theoretical framework used in this study.

2.10 Conceptual framework for this study

A conceptual framework involves the synthesis of existing views in the literature concerning a specified situation, using both theoretical and empirical findings. It represents an 'integrated' way of looking at the problem (Liehr and Smith 1999). This "process of arriving at a conceptual framework is akin to an inductive process whereby small individual pieces (in this case, concepts) are joined together to tell a bigger map of possible relationships." (Sitwala, 2014, p. 189)

The conceptual framework drawn from the literature (Hollweg et al., 2011; Hungerford & Volk, 1990; Roth, 1992; Simmons, 1995), which will inform this study, is based on the propositions that one of the goals of EE is the development of EL, and that EL can be developed through education. The EL of an individual is not just a single construct; rather it is a combination of components such as environmental knowledge, affect, concern, and intention to act, which can lead to the expression of ERB. In addition to developing EL, the literature review has established that pre-service teacher education programmes may increase PSTs' confidence to teach EE (Abramovich and Loria (2015). Upon graduating, improved confidence to teach EE as a result of the teacher education programme could improve the willingness of PSTs to integrate EE into their teaching. The model shown in Figure 2-4 has been designed to illustrate the conceptual framework guiding this study.

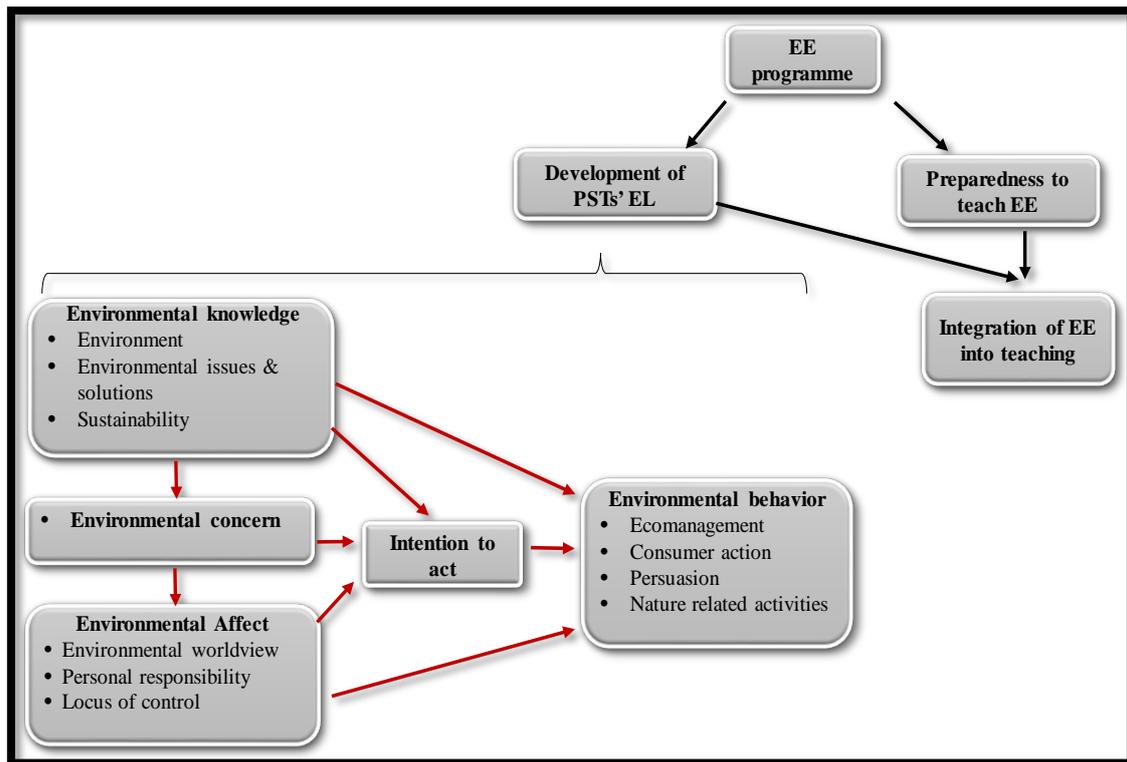


Figure 2-4 Representation of the conceptual framework of this study

The aim of this study – assessing the impact of EE teacher education programmes on PSTs' EL, and on their preparedness to teach EE – may inform curriculum developers and teacher education programmes as a whole on effective ways of preparing PSTs to be agents of social change themselves, so that they can help their future students to do the same. Within the context of this research, the conceptual framework helps the researcher to clearly see the main variables and concepts in the study; provides the approach needed for methodology – research design, target population and research sample, data collection and analysis; and guides the researcher in data collection, interpretation and explanation (Sitwala, 2014). In essence, the conceptual framework guides the scope of the research. The next chapter presents the methodology and methods employed in this study.

Chapter Three: Methodology

3.1 Chapter Overview

This chapter discusses the methodology used in this study. The chapter begins by restating the aims and research questions guiding this study. Given that researchers in the field of education have previously used a variety of philosophical positions or paradigms, this chapter reviews some common philosophies (paradigms) underpinning educational research and thereafter identifies the most suitable paradigm for this study. Next, the research approach used in this study, as well as research methods is discussed. A subsequent section of this chapter outlines the research design employed in this study. Topics covered include context of the study, population and sampling method, sample size, as well as the tools used for data collection. The next section then discusses the data analysis methods employed for the quantitative and qualitative data collected. Validity and reliability, and ethical considerations of the study are also discussed. The chapter concludes with a summary that clarifies the methodology used.

3.2 Restating the aims of the study

The purpose of this research is to evaluate the impact of environmental education (EE) on the environmental literacy (EL) of New Zealand pre-service teachers (PSTs). This study examined the EL of PSTs before and after their exposure to EE during their teacher education programme, the relationships between their EL components, and further explored whether the EL of PSTs was developed, retained, and later applied in their early years of teaching. This goal was achieved by examining two cohorts of PSTs (Year 1 and Year 3) during their teacher education programme and also examining beginning teachers, at least, six months into their first teaching job after graduation, to evaluate how they have been able to implement EE in their teaching.

3.3 Research Questions

Research questions “state the main focus of the research in question form, incorporating key ideas that the research seeks to investigate and /or explain and the key concepts of the research” (Walter, 2013, p. 26). The research questions are

viewed as crucial as they provide direction and orientation for the issue under investigation. The research questions link the researcher's literature review to the type of data that would be collected. This is helpful as it makes data collection and analysis more methodical (Bryman, 2007). The research questions guiding this study are highlighted below:

Main Question:

What is the impact of completing an environmental education paper on environmental literacy levels of New Zealand pre-service teachers?

Sub Questions:

1. What is the immediate impact of completing a first-year core paper in environmental education on environmental literacy levels of pre-service teachers?
2. What are the environmental literacy levels of ready-to-graduate pre-service teachers and how prepared do they feel to teach environmental education based on their exposure to environmental education during their pre-service teacher education?
3. What relationships exist between components of environmental literacy (knowledge, concern, affect, and behaviour) among pre-service teachers?
4. Upon exit from university and integration into the teaching workforce, what are the experiences of graduate teachers in applying their environmental literacy?

3.4 Paradigms in Educational Research

All research is established on some underlying philosophical assumptions or paradigms about what makes up 'valid' research and which research method(s) is/are appropriate for the development of knowledge in a given study (Antwi & Hamza, 2015, p. 217). To conduct any research, it is then essential to know what these assumptions are, as they orientate the researcher's point of view about reality

(Creswell, 2002), and inform about suitable research methods for gathering and analysing data (Cohen, Manion, & Morrison, 2013; Costley, Elliott, & Gibbs, 2010). A research paradigm is a “set of fundamental assumptions and beliefs as to how the world is perceived which then serves as a thinking framework that guides the behaviour of the researcher” (Wahyuni, 2012 p. 69). These paradigms describe the nature of knowledge and reality as well as the roles of the research and researcher (Walter, 2013). Components or dimensions that make up a research paradigm are ontology, epistemology, methodology, and axiology (Creswell, 2002; Creswell & Poth, 2017; Lincoln & Guba, 1985; Wahyuni, 2012).

Ontology is the view of how reality is perceived. It seeks to know what knowledge is, and whether it exists inside or outside people? (Wahyuni, 2012). Ontology is described in the literature as filters or lenses through which the world or reality is experienced (Allison & Pomeroy, 2000). It relates to ‘the what’?, the nature of reality that is being ‘researched,’ for example, in the context of this research, what is the nature of reality in respect to PSTs’ knowledge, affect and behaviour.

Epistemology refers to how we make knowledge and beliefs, as well as the means to generate, understand and use the knowledge that is believed to be suitable and valid (Wahyuni, 2012). It relates to ‘the how’?, the possible ways of knowing, the nature and forms of knowledge (Cohen, Manion, & Marrison, 2007, p. 7). For example, how do I seek for patterns and themes in PSTs responses to the questions asked? Do I attempt to understand ‘the how’ by assessing PSTs through surveys, or observe PSTs and deduce their thoughts from their actions?

Methodology relates to how knowledge is studied. Guba and Lincoln (1994, p. 108) expound that methodology asks the question: “how can the inquirer go about finding out whatever they believe can be known?” Methodology involves all data collection and analysis processes: why, what, when, from where and how data is collected and analyzed (Scotland, 2012). The aim of methodology (Cohen et al., 2007, p. 47) is “to describe approaches to kinds and paradigms, of research” and “to help us understand, in the widest possible terms, not the products of scientific enquiry but the process itself”. Walter (2013, p. 10) describes methodology as “the

worldview lens through which the research question and core concepts are viewed and translated into research approaches In the context of this study, do I seek to use a case study strategy to explore the EL of PSTs? Also what approaches would be more suitable, quantitative, qualitative or mixed?

Axiology refers to what values go into the knowledge known (Creswell & Poth, 2017). Is it value-free or value-laden? Axiology also relates to ethical considerations and researchers' philosophical viewpoints (Wahyuni, 2012). This defines the researcher's stance, whether to take an independent position from the data, maintaining an objective stance or a participatory role which would imply a subjective position. For example, do I intend to explore PSTs' EL by observing and using the information provided by them to reach conclusions or do I intend to be actively involved in their teaching and learning process?

In educational research, individual social theories are often drawn and developed from recognized paradigms (Walter, 2013) related to and informing each other (Cohen, Manion, & Morrison, 2011; Hartas, 2010). It is important that research is consistent with the dimensions (ontology, epistemology, methodology, and axiology) of the selected paradigm (Cohen & Manion, 2011; Mertens, 2010). Thus, when a particular paradigm is selected for a study, the researcher acknowledges that beliefs and assumptions would also inform the research (Creswell & Clark, 2011). In other words, the way an individual sees the world affects the way he or she makes sense of it. Three established paradigms in educational research are positivism, interpretivism, and critical theory. They are discussed below through their ontological, epistemological, axiological, and methodological stances (summarised in Table 3-1).

3.4.1 Positivism

The positivist paradigm, also known as the normative paradigm, is a traditional approach to scientific research (Cohen et al., 2011; Cohen. L. & Manion. L. and Morrison, 2007). Ontologically, a positivist paradigm assumes the view that social reality is external and objective (Creswell, 2009; Guba & Lincoln, 1994). Therefore, positivism has a naïve realism. Epistemologically, the positivist's view is centred on understanding humans' behaviour through a scientific, hypothesised description

and its generalisation. From this standpoint, all knowledge is founded on sensory experiences and comprises of observable and verifiable data or facts (Cohen & Manion, 2011).

From the axiological perspective, positivism maintains the independence of the observer (researcher) and the instruments used. Therefore the researcher takes the outsider perspective (Costley et al., 2010). Positivist researchers also argue that social problems can be solved by tested and fruitful scientific methods (Cohen et al., 2011). This perspective posits that there is no free will and that causes always produce measurable effects (Burton & Bartlett, 2009). Methodologically, positivist researchers usually use quantitative data produced by collection techniques such as experimentation, observation, and manipulation (Cohen et al., 2011). Positivists use research methods that are built on evaluating propositional hypotheses to formulate results. Formulated results are then compared with the original hypotheses to determine consistency (Cohen & Manion, 2011).

Some critical assumptions of positivism are based on the use of scientific methods as the only way to discover truth about the world, and that when research is done well scientifically and objectively in a well-controlled context, one can discover human behaviours comprehensively (Willis & Jost, 2007). Due to criticisms of these assumptions, especially in understanding human behaviours objectively, an alternative approach regarding a more subjective paradigm has emerged, termed interpretivism.

3.4.2 Interpretivism

Ontologically, interpretivists believe that reality is subjective, interactive, and socially constructed. Interpretivism embraces reality as constructed by social actors and people's perceptions (Cohen et al., 2011; Neuman & Neuman, 2006). Context is also usually taken into account and the recognition that human perspectives and experiences are not only subjective, but that they may change and be varied in nature (Hennink, Hutter, & Bailey, 2010).

Its epistemology recognises multiple realities and the importance of understanding a situation through the viewpoints of the participants (Cohen et al., 2011).

Regarding axiology, interpretivists take the stance of an insider, acknowledging the role of the researcher in the study. Methodologically, interpretive researchers favour a more subjective approach and value the social world, preferring to have an interaction with the studied participants (Wahyuni, 2012). Typically, they prefer to work with qualitative data as it provides rich descriptions of social constructs (Cohen et al., 2011; Neuman & Neuman, 2006). As opposed to positivist researchers who employ a generalisation approach, interpretivists often use a narrative form of analysis that is highly specific, with a detailed account of the social reality being studied (Newman, 2011).

Both the positivist and interpretive paradigms are essentially concerned with understanding phenomena, although through different perspectives. These two paradigms have both been critiqued as excluding the political, ideological, and value-determined contexts of educational research (Cohen et al., 2011; Guba & Lincoln, 1994). As such, a third paradigm, critical theory, addressing this gap is discussed next.

3.4.3 Critical theory

Critical theory shares many features of the interpretive paradigm, as it is concerned with the social reality of research participants. However, it goes much further and seeks to change this reality, for the better, through intervention. The purpose of the critical theory paradigm is “not merely to give an account of society and behaviour but to realize a society that is based on equality and democracy for all its members” and “not merely to understand situations and phenomena but to change them.” (Cohen & Manion, 2011, p. 31). Ontologically, it emphasises that reality is apprehendable, created and shaped by social, political, cultural, economic, ethnic and gender-based forces. These forces have been formed over time into social structures and are now taken to be natural or real. Epistemologically, the critical theory paradigm is “transactional or subjectivist” and has “value-mediated findings” (Lincoln & Guba, 2000, p. 168). Therefore, the goal of using critical theory in research is to change situations, not merely to understand them. Critical theory is mainly transformative, and as such, it is an area of research that is hugely practical, with the aim of bringing about change towards an egalitarian society (Mackenzie & Knipe, 2006).

Table 3-1 Research Paradigms in educational research (Cohen et al., 2011; Wahyuni, 2012b)

Fundamental Beliefs	Positivism (Normative)	Interpretivism	Critical Theory
Ontology: the position on the nature of reality	External, objective and independent of the social actor.	Socially constructed, subjective and may change	Historical realism – virtual reality shaped by social, political, cultural, economic forces? formed over time
Epistemology: the view on what constitutes acceptable knowledge	Only observable phenomena can provide credible data, facts. Focus on causality and law-like generalisations, reducing phenomena to simplest elements	Subjective meanings and social phenomena. Focus on the details of a situation, the reality behind these details, subjective meanings and motivating action	Transactional/subjectivist; based on real-world phenomena and linked to societal ideology.
Axiology: the role of values in research and the researcher's stance	Value-free and etic. Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Value-bound and emic. Research is valued bound; the researcher is part of what is being researched, cannot be separated and so will be subjective	Value-mediated findings with a preconceived starting point
Research	Quantitative	Qualitative and/or Quantitative	Dialogical/dialectical

The critical theory paradigm stresses liberty for the disempowered and democratic society that promotes equality (Cohen & Manion, 2011; Mackenzie & Knipe, 2006).

In critical theory, the researcher and subject of research are linked, and the process is influenced by the researcher's values and perceptions. Methodologically, critical theorists tend to rely on methods that involve dialogues, for example, observation and interviewing with a view to inform conversations and reflections. This approach gives room for questioning of the 'natural' state between the researcher and the participants, with the goal of bringing about change.

3.4.4 The Research Paradigm for This Study

It is imperative in educational research to align one's research to a suitable paradigm (Guba & Lincoln, 1994). In other words, a researcher must justify the selection of a paradigm on the basis of beliefs, assumptions, values and ethical constraints (Conrad & Serlin, 2011). Upon careful consideration of the underlying assumptions in educational paradigms with respect to the overall aim of this study, the interpretive paradigm was selected as the most suitable approach for this study. This is because the ontological and epistemological viewpoints of interpretivism discussed earlier align with the purposes of this study. This study is interested in understanding PSTs' perspectives about their EL and preparedness to teach EE. It also attempts to seek meanings, rather than looking for objectivity. Interpretivism provides a basis for exploring the participants' perspectives (and inner realities) of their EL, rather than assuming one single external reality. In particular, the interpretive paradigm upholds the innate qualities of PSTs that could contribute to their exhibition of ERB.

This study does not therefore fully accept the positivism ideologies, as it aims to understand the realities of humans' (PSTs') lives and this cannot be unswervingly understood simply through an objective approach alone. In particular, PSTs' perceptions, affects, behaviours, experiences, or reasons for carrying out or not carrying out some specific actions cannot be understood merely through a positivistic lens (Neuman & Neuman, 2006). In other words, this study is based on the understanding that reality is inside people rather than exterior to them. Also, people create knowledge and meanings about the world around them on the basis of their past and present knowledge and experiences (Cohen et al., 2011; Creswell, 2002; Lincoln & Denzin, 2003).

Furthermore, having the understanding that people's behaviours towards the environment and sustainability are based on their values and beliefs about themselves, their environment and their actions (Tilbury, 1995) situates this study under the interpretivism paradigm. Although questionnaires formed a major method through which data was collected in this study (see Section 3.7.5), most of the questions (78 out of 83 questions) sought to assess the perceptions of PSTs on their EL: knowledge, affective disposition, and behaviour. Hence, the questions were more subjective than knowledge-based. While some analysis conducted (as would be discussed later) to assess the relationships between the EL components in this study appears to be underlined by positivism principles, the adopted scale consisted of questions which reflected the perceptions of the PSTs. This study does not also employ a critical perspective aimed at "the emancipation of individuals and groups in an egalitarian society" (Cohen et al, 2007, p. 26). This is because in employing a critical perspective, the researcher's goal exceeds understanding or giving an account of behaviors, rather, it aims to change these behaviors. Such standpoint however transcends the focus of this study, which used an interpretivist lens to understand the underlying ideas of the development of PSTs' EL during their teacher education programme in EE.

3.5 Research approach

Given the ontology, epistemology, and axiology guiding this study, as depicted by the research questions, a pragmatic approach to research was employed to understand the social phenomenon of PSTs' EL, preparedness to teach EE and experiences of beginning teachers in teaching EE. This approach advocates the use of mixed methods. Mixed methods is a process of gathering, analysing, and "mixing" both quantitative and qualitative data in a single study to enhance the understanding of a research problem (Teddlie & Tashakkori, 2009). Mixed methods research is gradually gaining acceptance among social science researchers (Creswell, 2009; Johnson, Onwuegbuzie, & Turner, 2007; Leech & Onwuegbuzie, 2009; Tashakkori & Creswell, 2007) as it tends to "sidestep the contentious issues of truth and reality" (Yvonne Feilzer, 2010, p. 8). It can combine several ways of understanding the research questions. Mixed methods approach rests on the assumptions that there are different ways of knowing and each of these ways offers significant and genuine

views towards the issue under investigation. Therefore, incorporating multiple ways of knowing promotes a better way of understanding the issue under investigation (Greene, 2007). Mixed methods have been suggested to increase the validity of data and provide a complete picture of the phenomenon under study (Denscombe, 2008). Leech and Onwuegbuzie (2009) argued that since the world is mixed, it is not exclusively quantitative nor qualitative, it is, therefore necessary for researchers to use both methods, despite the obvious inclination a research under study might seem to tilt towards. The ability to mix different approaches has the advantages of enabling triangulation. Triangulation is a way of seeking convergence across quantitative and qualitative methods (Cohen & Manion, 2011). Limitations and biases inherent in a single method can be neutralized or canceled by the biases of the other method, to develop a rich data set. Triangulation of method is used to improve reliability and validity of the data collected (Creswell, 2009; Wiersma & Jurs, 2009). Triangulation through mixed methods used in this study involved data triangulation (the use of a variety of data sources), theory triangulation (use of various perceptions to understand the findings) and methodological triangulation (use of different methods to study the research problem).

A concurrent mixed method design (see Figure 3-1) was used (Creswell, 2009; Johnson & Onwuegbuzie, 2004, p. 53; Johnson et al., 2007) in this study, as it advocates the following conditions appropriate in answering the research questions of this study:

- (a) both the quantitative and qualitative data are collected separately at approximately the same point in time,
- (b) neither the quantitative nor qualitative data analysis builds on the other during the data analysis stage,
- (c) the results from each type of analysis are not consolidated at the data interpretation stage until both sets of data have been collected and analyzed separately, and
- (d) after collection and interpretation of data from the quantitative and qualitative components, a meta-inference is drawn which integrates the inferences made from the separate quantitative and qualitative data and findings.

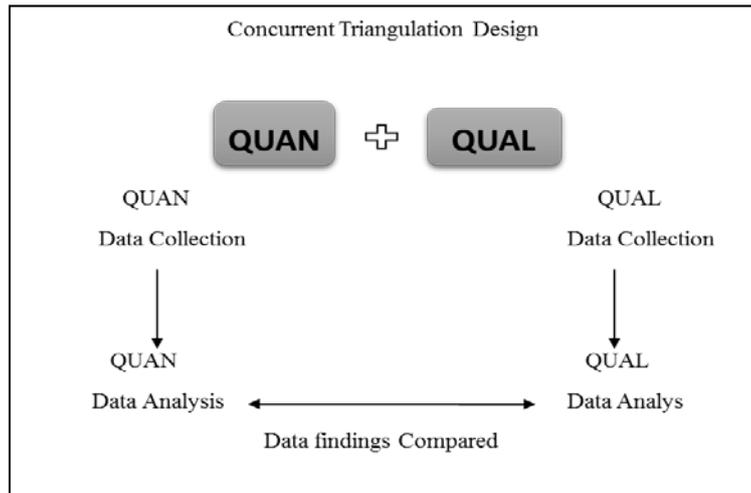


Figure 3-1 Concurrent triangulation design

Greene (2007) also describes this type of concurrent mixed method research as a coordinated mixed method design because the methods are planned and implemented as, “discrete, separable sets of activities” and, “remain distinguishable throughout the inquiry” (p. 255). Keeping the methods separate is in part possible due to the research questions of this study and how to best answer them. Dillon and Wals (2006) opined that “inquiry should be driven by questions, not by preferred methods or even methodologies” (p. 558). As shown in Table 3-2, a mixture of quantitative and qualitative approaches were employed in answering research questions (RQ) 1-3. The qualitative method provided data that were used to support, supplement and further provide insights into the quantitative data. A purely qualitative approach was used to address RQ 4.

Table 3-2 Research questions guiding this study

Research Questions	Research Approaches
1 and 2, 3	Quantitative and qualitative
4	Qualitative

3.5.1 Quantitative research approach

Quantitative research involves mainly a formal, objective, deductive approach to understanding a phenomenon and the examination of the distribution of its occurrence by asking specific, narrow questions on the basis of numerical data

(Creswell, 2008, p. 645). Causes of occurrences may be explained through objective measurement and analyses of the distribution of such occurrences using statistics (Cohen & Manion, 2011; Creswell, 2009). Quantitative research makes use of questionnaires, surveys and experiments to gather data. Variables are measured on a sample of subjects and the relationships between the variables are expressed using effect statistics such as relative frequencies, correlations, or differences between means; with a focus to a significant degree on testing of theory.

Reliability and validity of results are derived from the careful design of data collection instruments used to collect information in an unbiased, objective manner from selected representatives of a population (Burton & Bartlett, 2009). The quantitative research approach aims to isolate causes and effects, operationalize theoretical relations, measure, quantify phenomena, and develop the generalisation of findings of human behaviour to allow for greater levels of prediction and control (Cohen & Manion, 2011; Lincoln & Denzin, 2003).

3.5.2 Qualitative research approach

Qualitative research is an informal, subjective, inductive approach to understanding a phenomenon (Creswell, 2012). Information about the phenomenon is typically collected from the participants by inquirers asking broad and general questions and collecting detailed views of the participants in the form of words or text-based data which are thematically organised, analyzed and described (Cohen & Manion, 2011).

Traditionally, qualitative research is more closely associated with an interpretive paradigm than with a positivist paradigm. In a qualitative approach, reality is never fully apprehended, only approximated (Guba & Lincoln, 1994) and thus often relies on multiple methods to capture the socially-constructed nature of reality. The relationship between the researcher and individuals is constrained to the settings of the research (Cohen & Manion, 2011), thus emphasizing its value-laden nature.

Like quantitative researchers, qualitative researchers emphasize the generation and verification of hypotheses and theories; however, in contrast to the sequence of the quantitative approach, the theories and hypotheses of qualitative research are derived from the data when it is analysed (Cohen & Manion, 2011). Qualitative

researchers attempt to make sense of or to interpret phenomena regarding the meaning people bring to them (Mertens, 2014). Qualitative data sources include observations, interviews and questionnaires, documents and texts, as well as the researcher's impressions and reactions (Myers, 2009).

Largely, the major differences between quantitative and qualitative approaches are in their purpose of inquiry, that is, for quantitative methods, the purpose is 'explanation' while in the case of qualitative it is understanding. Additionally, these two methods differ in the nature of knowledge generated: in a quantitative approach, knowledge is being discovered while it is being constructed in a qualitative approach. The role of the researcher is personal in the case of a qualitative approach while it is impersonal in the case of a quantitative approach. Also, a deductive approach is employed in a quantitative research as against the inductive approach used in qualitative studies (Lincoln & Guba, 1985). The research strategy used in this study, a case study strategy is described next.

3.6 Case Study Strategy

Case studies are an appropriate methodology for in-depth empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly defined (Yin, 2013). The case study approach is particularly valuable in circumstances where contextual conditions of the event being studied are critical and where the researcher has no control over the events as they unfold. The case may be a programme, an event, or an activity bounded in time and place. According to McMillan and Schumacher (2001), a case study examines a bounded system or a case over time in sources of data found in the setting, which strengthens data credibility (Yin, 2003). Findings from the case study might assist researchers to gain a better understanding of why the occurrence happened as it did, and what might become vital to look at more broadly in future research (Collis & Hussey, 2003). Case study is useful in providing a range of different pieces of evidence to answer specific research questions (Gillham, 2000a)

Given the interpretive position adopted in this research and the nature of the research questions, the case study strategy was considered the most appropriate strategy. Also, given that this study sought to assess the impact of an EE paper on PSTs' EL and their preparedness to teach EE, carrying out this kind of assessment would not be possible without a context, in this case, it is in a teacher education programme at a New Zealand University and more specifically, the EE paper being offered. Corcoran and Wals (2004), supporting this position, affirm that case-study methodology is the ideal research tool to investigate sustainability in higher education as it allows the researcher to 'go deep,' to learn what works and what does not. Correspondingly, regardless of the researcher's epistemological stance, the case study is a suitable approach for answering questions about how or why (Corcoran & Wals, 2004)

A major drawback related with case study is the possibility of researchers attempting to answer a question that is too extensive or an issue that has several objectives just in one study. To circumvent this problem, authors Stake (1995); Yin (2013) have proposed that when boundaries are placed on a case, it makes the study more concise and focused. Ideas on how to set boundaries on a case include: (a) a definition and context (Miles & Huberman, 1994); (b) time and activity (Stake, 1995); and (c) by time and place (Creswell, 2003). These boundaries specify what will and will not be studied in the scope of the research (Baxter & Jack, 2008). Based on these suggestions, evaluation of PSTs' EL and preparedness to teach EE is guided partly by the learning outcomes/objectives of the EE paper used as a case study (see Appendix J). Table 3-3 gives the overview of topics covered in the EE paper.

The EE paper used as a case study in this research covered an 11-week period that included one-hour weekly lectures and two-hour weekly tutorials. The participants were made up of first-year on-campus and online PSTs, and as such, the paper was taught through a mix of modes. For the first lecture, the online PSTs joined their campus counterparts on campus, while for the online students, subsequent lectures were recorded and made available through an online platform (Moodle). As shown in Table 3-3, the first five weeks of the EE paper focused on teaching PSTs about environmental and sustainability issues.

Table 3-3 Overview of topics covered in EE paper taken by PSTs

Weeks	Principal Lecture	Tutorial Theme
Week 1	What is Sustainability?	What is the environment and what is sustainability? A sustainability inquiry
Week 2	Environmental Sustainability	Environmental systems Biodiversity, interdependence and adaptation Field trip preparation
Week 3	Socio-cultural sustainability	Social justice and intergenerational equity Values and attitudes Field trip preparation Assignment 2 introduction
Week 4	Economic sustainability	Economic sustainability Resources Production and consumption
Week 5	Sustainability connections and ethics	FIELD TRIP
Week 6	No lecture	No tutorial
Week 7	Teaching and learning in ESE in NZ	Key ideas in ESE ESE in the NZ Curriculum ESE in NZ schools
Week 8	ESE in schools - pedagogy and practice	ESE pedagogies Action Learning cycle Approaches and activities Useful resources
Week 9	ESE in schools – planning for learning	Planning for learning in ESE Integration in practice Evaluating teaching and learning
Week 10	ESE in schools – where to from here for me?	Revisiting a rationale for ESE Examples of good ESE Sustaining our involvement
Week 11	No lecture	Critiquing ESE teaching and learning

These included concepts such as biodiversity, interdependence, ecosystem services, values, social justice and inter-generational equity, finite resources, and supply and demand. The last five weeks focused on teaching PSTs aspects of pedagogy and practice of EE in New Zealand primary schools. PSTs were provided with readings to enhance their understanding of environmental and sustainability education, as well as pedagogical ideas and practices in the field. Woven throughout these topics was a theme of sustainable food production, which featured strongly in the focus of the two major assessments. As part of their learning experience, on-campus PSTs had a field trip to [the] Gardens to explore different ways of food gardening, and their online counterparts were tasked with experiencing a local example or issue in sustainable food production with support from staff. All students were given an assignment to assess their understandings of EE in relation to their field trip involvement or local experience, and a second assignment focused on the issue of bee decline that sought to draw on their learning throughout the paper.

3.7 Research methods

This section describes the different research methods employed in this study. Research methods refer to techniques (such as an interview, questionnaire, or documentary analysis) used to gather information (Walter, 2013). Methods are usually selected to align with the research questions of a study. As mentioned previously (Section 3.5), a mixture of these methods enhances triangulation. For this study, five different methods: questionnaires, interviews, focus group discussions, document analysis, and observation were used to collect data. By using more than one viewpoint, these methods were used “to map out or explain more fully, the richness and complexity of human behaviour” (Cohen & Manion, 2011, p. 141). The methods used in this study and how they were used are discussed next.

3.7.1 Questionnaires

Questionnaires, also known as surveys, are widely used as data collection tools in social and educational research (Cohen et al., 2011; Creswell, 2009; Neuman & Neuman, 2006). The widespread “use of surveys is a testament to their value as a research method” (Walter, 2013, p. 122). The layout and content of a questionnaire are shaped by the nature of the research questions or hypothesis, the theoretical and

conceptual frameworks used and the paradigm selected for the study (Gall et al., 2007). The main function of a questionnaire is to translate research aims, objectives, or questions into specific questions (Creswell, 2005; Neuman, 2006). Administration of questionnaires can be to the entire population or to a sample. Administering questionnaires has an advantage of being inexpensive and often easy to analyze (Cohen, 2011). It is easy to ensure anonymity, and they can be quickly and effectively administered to a relatively large population, thus providing many data (Burton & Bartlett, 2009; Cohen et al., 2000). Questionnaires can collect both quantitative and qualitative data through structured questions (closed-ended) and unstructured (open-ended) questions respectively. Closed-ended questions are questions to which the respondents choose from a fixed set of answers, while open-ended questions are questions to which participants are free to provide any response (Burton & Bartlett, 2009; Neuman, 2006). Closed questions can be useful because they are quicker and easier for both respondents to answer and researchers to analyse (Burton & Bartlett, 2009; Newman, 2011). However, because responses are limited to a set of alternatives, closed questions have the potential to be biased or limited; also, respondents may wish to provide further details about their answers but be unable to do so because of the restrictive nature of the question type (Burton & Bartlett, 2009)

Open-ended or unstructured questions are qualitative in nature and allow the exploration of many themes because respondents can write about anything they consider relevant in response to the question asked (Burton & Bartlett, 2009; Cohen et al., 2007). They may raise issues that had not been anticipated or even thought of by the researcher (Burton & Bartlett, 2009). The biggest problem with collecting data using open-ended questions is that they are more time-consuming than a closed question format for respondents to complete, and for researchers to collate or analyze the data (Burton & Bartlett, 2009).

The advantages of conducting surveys with questionnaires (Walter, 2013, pp. 122-123) are as follows:

- a) **Versatility:** Surveys can be used to investigate a wide range of issues and collect information on people's demographic background, attitudes, values, beliefs, perceptions, and opinions.
- b) **Efficiency:** Surveys can gather data and information from a large sample in a short period.
- c) **For a large population:** A survey could also provide reliable and valid information about a large group of people from a relatively small sample.
- d) **Suitability for statistical analysis:** Relationships between variables in the data could be identified using various statistical analysis techniques.
- e) **Facilitation of secondary data analysis:** Data generated by a survey could also be analysed by researchers' other than the original person who carried out the survey, referred to as secondary data analysis.

However, according to Walter (2013), surveys also have drawbacks. For instance, survey data are snapshots and self-reported, relationships do not necessarily equate to causality, they cannot provide all the answers, and some surveys are expensive. Another disadvantage in administering questionnaires can be the low return rate. Participants do not always complete and return them (Cohen & Manion, 2011).

3.7.2 Interviews

Interviews are a common form of data gathering method used in social and educational research (Burton & Bartlett, 2009; Cohen et al., 2011). Through interviews, the researcher could "explore and probe participants' responses to gather in-depth data about their experiences and feelings" (Gay et al., 2012, p. 386). Interviews are an appropriate way to access people's perceptions, meanings, or definitions of situations (Punch, 2005, p. 168). In an interview, the interviewer asks questions, and the participants respond. Interviews are usually conducted with individuals, face to face or over the phone, using open or closed questions, although open-ended questions are most commonly employed (Creswell, 2002). Interviews are particularly useful for obtaining the story behind a participant's experiences (Cohen et al., 2011). Interviews may be helpful to follow-up on responses provided in questionnaires (Burton & Bartlett, 2009) thus enhancing triangulation. Interviews can be structured, unstructured, and semi-structured. In a structured interview, the precise set of questions to be covered is decided in advance (Burton & Bartlett,

2009; Cohen et al., 2011). Unstructured interviews have “questions prompted by the flow of the interview” and the semi-structured interviews “combine both structured and unstructured approaches” (Gay et al., 2012, p. 386). Regardless of the type used, the researcher must ensure that the objectives of the interview are met (Cohen et al., 2011). In this research, semi-structured interviews with probing questions to gain deeper insights into the perceptions of PSTs’ on their learning in the EE paper as well as on beginning teachers’ experiences in teaching EE were employed. Deliberately, some interview questions that sought to triangulate data previously collected from PSTs’ questionnaires were included.

Advantages of interviews are that respondents are free to express themselves in their own words, and the researcher can obtain higher response rates. The interview allows researchers to develop a relationship with the participant and potentially get a full range and depth of information. In an interview, the researcher can be flexible with the questions to seek clarity of responses. The interviewer controls the situation and can probe ambiguous or evasive answers. It is common for interviews to be recorded on either audio or videotape. Interviews can provide useful open-ended comments, often with rich detail and new insights, and are best used if extensive information is required (Cohen et al., 2011). The disadvantages of the interview method are that the wording of questions might bias responses, interviews can be very time-consuming if only one person conducts them, and operational cost can be high if several interviewers are employed (Cohen et al., 2011). This method may not be so suitable for younger children, older people, people who do not know the language used, and for examining complex topics or sensitive issues (Creswell, 2005; Neuman, 2006). In this study, the interview questions were carefully developed and reviewed by the researcher and supervisory team to reduce bias in questioning, and so that the target population, PSTs, were able to understand and relate to the issues raised (Cohen et al., 2011; Creswell & Creswell, 2005).

3.7.3 Focus group discussions

A focus group discussion is a kind of interview carried out with a group of people, usually two to five individuals (Basit, 2010). Focus group discussion does not just involve doing many interviews at the same time, rather it “harnesses group dynamics and group processes into the process” (Walter, 2013, p. 247). A focus

group provides an avenue for the collection of shared understanding on a particular issue or concept from different individuals (Creswell, 2009). Since it helps to provide varying views about the issues or concepts being considered as a result of the different individuals involved, a certain amount of direction and structure is necessary for moving the discussion along. The ideal moderator for the focus group discussion is one who is comfortable using diverse styles of interviewing, which could range from non-directive to directive approaches (Stewart & Shamdasani, 2014). The directive approach usually allows for greater coverage of topics or more detailed coverage of specific items of interest in the time available. Non-directive approaches provide more opportunity for group interaction and greater opportunity for the individual participants' views to emerge, rather than the researcher framing of the issues imposed on them (Stewart & Shamdasani, 2014). In this study, a combination of directive and nondirective approaches were used. It is common for focus groups sessions to be recorded on either audio or video tape. It is also customary to inform group members at the outset of the session that audio or video recording is taking place (Creswell, 2009). Some of the weaknesses of focus group discussion could be that of the interviewer lacking control over the interview discussion. In addition, differentiating between the voices of individuals at the point of transcribing an audiotaped interview might be difficult. Another problem with conducting focus group interviews is that the researcher often has difficulty taking notes because so much is occurring (Creswell, 2009). In hindsight, it was somewhat challenging for the researcher to assume the role of the moderator and take notes at the same time. This experience indicates that wherever possible, it would be advisable to have another person available to assist with note taking during the focus group discussion.

3.7.4 Document analysis

Document analysis involves gathering data from written or printed material which includes policy papers, textbooks, teaching programmes, examination results, maps, computer printouts of school data, teacher guides, student guides, reading books and student journals (Basit, 2010; Wolf & Ramakrishnan, 2005). The documents can be small and short or large and lengthy (Burton & Bartlett, 2009; Wolff, 2005). On the other hand, because the documents were not written specifically to provide data for the study concerned, the data needed for the research may not be available

(Basit, 2010). The advantages and limitations of documents as sources of data must be kept in mind while planning. In this study, the documents gathered were well targeted towards the goal of the study, including the paper outline indicating the context of the paper, and the online PSTs' discussions, and these documents were carefully examined to ensure that appropriate inferences relevant to the research questions were made.

3.7.5 Observations

Observational techniques are used widely to gather data in real-life settings (Cohen et al., 2011). Observation as a research method helps the researcher to have a better understanding of the situation, capturing the context within which people interact. It also creates an avenue to explore some aspects participants might be unwilling to, or simply don't discuss in an interview (Creswell, 2007). There are two main types of observation – participant observation and non-participant observation. In participant observation, the researcher (observer) engages in the same activities they set out to observe in such a manner that participants would assume they are part of the group. For non-participant observation, on the other hand, the researcher stands aloof from the group activities they are examining and avoids group involvement (Gay et al., 2012). In this study, a non-participant observation method was employed to investigate ongoing learning and behaviour of PSTs during the on-campus tutorials for the EE paper used as a case study. The next section outlines the research design employed in this study in details.

3.8 Research Design

Research design sheds light on how the study was conducted, showing how all of the major parts of the research study: the samples or groups, measures, treatments or programmes, etc. synergistically address the research questions (Walter, 2013). It is the master plan of the study that classifies the research methods, procedures as well as collection and analysis of data used. Yin (2003) argues that “colloquially a research design is an action plan for getting from *here* to *there*, where ‘here’ may be defined as the initial set of questions to be answered and ‘there’ is some set of (conclusions) answers” (p. 19). In addition to the research design scope above, it also addresses trustworthiness and ethical issues in the investigation (Cohen &

Manion, 2011). This section (summarised in Figure 3-2) describes how this study was conducted, guided by its aims, research questions, ontological and epistemological dimensions underpinning the study.

3.8.1 Context of the study

This study was conducted at a New Zealand University where all primary/elementary PSTs complete a compulsory first year paper in EE as part of the requirement for a Bachelor's degree programme in Teaching. The paper was a half-paper taken as part of a 3-year, 20-paper degree. The paper version studied here was taught in the second semester (July to October) of 2015 (some students also studied the paper in the first semester, so the cohort involved was only a sample of all students enrolled in the paper in that year). The paper is the only formal opportunity to study EE in the degree, although other papers may include environmental and sustainability contexts as part of their curriculum, in particular in science and social science in the first year and second years of the degree.

3.8.2 Population and sampling method

The population is the collection of all units involved in a study (Walter, 2013). It is essential to define who and what makes up the population of a study before selecting the study's sample. Data can then be gathered from the population and conclusions drawn (Cohen & Manion, 2011; Mertens, 2014). Two cohorts of population were involved in this study. They are the Year 1 PSTs and the Year 3 PSTs. The Year 1 PSTs included PSTs enrolled in an EE paper, at the University for Semester 2 (July to October), 2015. The Year 3 PST cohort comprised final year PSTs who had taken the EE paper in their first year. The beginning teachers are a subset of the Year 3 cohort, comprising of PSTs who had completed their degree at the University in 2015 and had secured teaching positions in New Zealand primary schools. These practicing beginning teachers had indicated their willingness to be followed up after securing employment. Apart from the PSTs, the tutors of the Year 1 PSTs were also involved in the study.

Since a mixed method approach was employed in this study, the sampling methods for the quantitative data and qualitative data are discussed separately. For the quantitative analysis in this study, two statistical populations, having similar

characteristics that make them unique from other populations were: Year 1 and Year 3 PSTs. Both cohorts were predominantly made up of females (90% of the population). About 85% of Year 1 PSTs were between 18 and 26 years old while about 83% of Year 3 PSTs were between 20 and 26 years old. For the quantitative data, although a purposive sampling approach was employed by selecting Year 1 and Year 3 PSTs cohorts, each PSTs had the choice to either participate or not. For qualitative analysis, a convenient and purposive sampling approach was utilized in recruiting PSTs and beginning teachers for the interviews and focus group discussions. PSTs involved were selected based on their willingness and availability to take part in the study. All three tutors for the Year 1 PSTs were also interviewed.

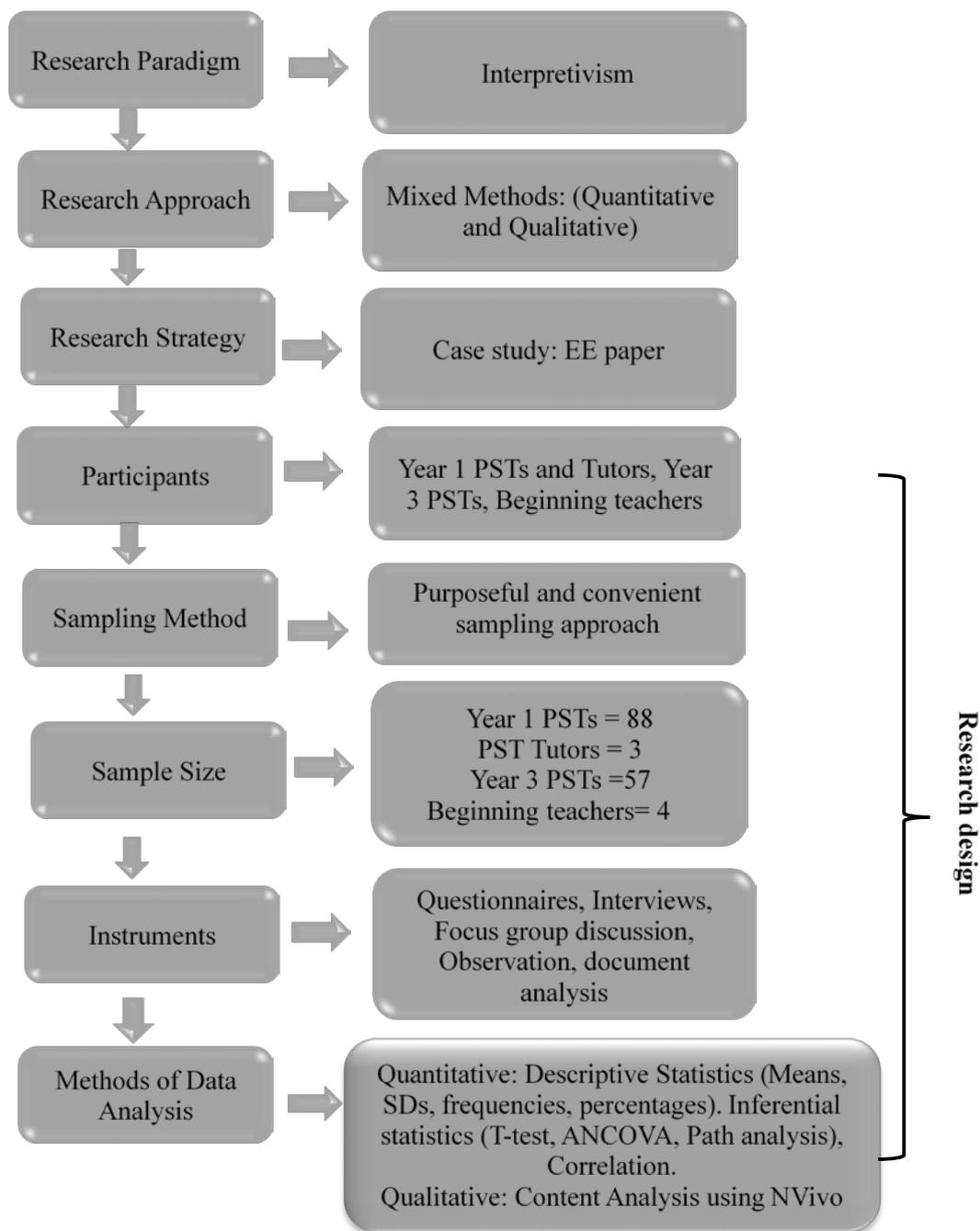


Figure 3-2 Overview of research methodology and design for the study.

3.8.3 Sample size

A sample is a set of cases or elements selected from a population (Walter, 2013). For quantitative data, the larger the sample, the greater the chances of obtaining findings that reflect the population and the lower the sampling error (Kenny, 2014). In line with Parizanganeh, Lakhan, Yazdani, and Ahmad (2011), the appropriate

sample size for the two cohorts (Year 1 and Year 3) was calculated using the standard sample size formula (see below).

To obtain a representative sample at the 95% confidence level, it was necessary to use the formula:

$$n = \frac{Z^2 pq}{e^2}$$

Where n=sample size,

Z^2 = desired confidence level at 95%,

p = estimated proportion of the sample,

q = 1- p, and

e =desired level of precision at 1%.

Based on this calculation, a representative sample at the 95% confidence level was calculated as 83 for the year 1 PSTs and 54 for the Year 3 PSTs. In this study, however, 87 Year 1 PSTs and 57 Year 3 PSTs were involved.

As opposed to a quantitative approach where sample size is normally calculated and guided by clear mathematical rules, guidelines for determining qualitative (non-probabilistic) sample sizes are practically nonexistent (Guest, Bunce, & Johnson, 2006). In qualitative approaches, there are no absolutes when it comes to sample size specification. The rule of thumb for a satisfactory sample size is that the sample size should be adequate to ensure saturation (Galvin, 2015; Guest et al., 2006), the point at which no new relevant information is imminent, even if more people are interviewed. It is, however, tricky to estimate this saturation point before recruiting participants for a qualitative study. The sample size for a mixed methods approach could even be smaller, as proposed by Galvin (2015):

For studies that combine qualitative interviews with one or more sets of quantitative data ... it might be argued that this reduces the need for rigor in qualitative interviews, as these are merely a deeper investigation of features that are already known by more rigorous means. However, substantive conclusions are drawn from these qualitative studies, often as a

way of explaining why the quantitative results turned out the way they did (Galvin, 2015, p. 4)

In this study, one Year 3 PST was interviewed, 10 Year 1 PSTs were involved in focus group discussions, and four beginning teachers were interviewed to collate qualitative data.

3.8.4 Data Collection

The data collection process in this study was carried out on a cohort basis as guided by the research questions (see Figure 3-2 and Table 3-4). This section describes the processes involved based on the instruments (questionnaires, interviews, focus group discussion, observation, document analysis) used.

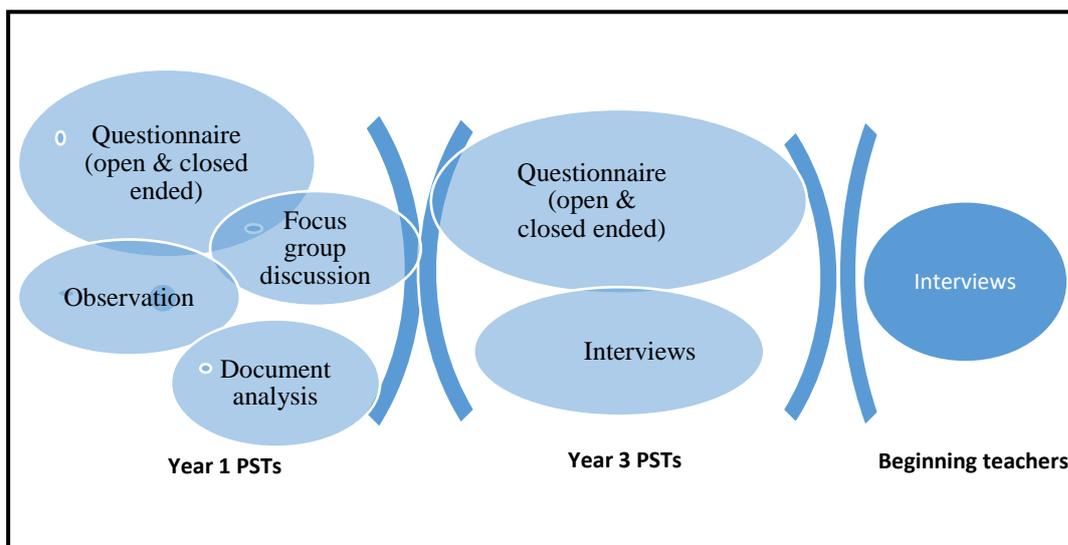


Figure 3-3 Overview of data collection instruments for participants

Table 3-4 Data collection process and research questions

Research questions	Groups	Research methods
What is the immediate impact of completing a first-year core paper in environmental education on environmental literacy levels of pre-service teachers?	Year 1 PSTs	Questionnaire Focus group discussion Observation
What are the environmental literacy levels of ready-to-graduate pre-service teachers (Year 3) and how do they feel prepared to teach environmental education based on their exposure to environmental education during their Pre-service teacher education?	Year 3 PSTs	Questionnaire Interview
What relationships exist between components of environmental literacy (knowledge, concern, affect, and behaviour) among pre-service teachers?	Year 1 PSTs Year 3 PSTs	Questionnaire
Upon exit from university and integration into the teaching workforce, what are the experiences of graduate teachers in applying their environmental literacy?	Beginning Teachers	Interviews

3.8.4.1 Questionnaire

To explore PSTs' EL and preparedness to teach EE before exposure to educational content related to EE in their teacher education programme, a quasi-experimental research design was done. This involved one-group pre-and post-test design employed to administer questionnaires to the Year 1 PSTs. Pre-and post-test design is common in educational research and is suitable for investigating effects of educational initiatives where changes in educational outcomes resulting from modifications to the learning process are often a focus of research (Schilling & Applegate, 2012). In a pre-and post-test design, two identical or parallel measuring instruments are administered at two points in time and the differences between the scores obtained from the two are computed and compared.

The one group pre-test-post-test design used in this study can be represented as:

Experimental O_1 X O_2

Where O_1 = group measured on a dependent variable(s)

X = experimental treatment

O_2 = group measured again on same dependent variable(s)

The obtained difference score is treated as an index of change, which could be attributed to programme impact. In the context of this study, the pre-test aimed to determine pre-intervention status in PSTs' EL: knowledge, affect, behaviour and preparedness to teach EE, while the post-test sought to measure post-intervention status. Significant differences between pre- and post-intervention scores are often construed as indicators of intervention-related changes (Dimitrov & Rumrill Jr, 2003).

A major drawback, however, to using quasi-experimental designs is that it typically has less internal validity than true experimental designs. This is because the difference between O_1 (group measured on dependent variables) and O_2 (group measured again on same dependent variables) cannot be fully ascribed to X (the experimental treatment). There could have been some extraneous variables, possible influences, which might account for the O_1 - O_2 differences. These kinds of extraneous variables that are beyond the experimenter's control in one-group pre-test-post-test designs threaten to invalidate their research efforts (Cohen & Manion, 2011). As discussed in Section 3.5, data triangulation was used in this study to lessen this limitation, as data from other sources (interviews, focus group discussions) were used to provide further insights obtained into results obtained from the quantitative analysis.

The pre-test questionnaire was administered in hard copy during the first workshop attended by the Year 1 PSTs in July 2015. It was necessary to design a suitable questionnaire that addressed the research aims and objectives since no similar research had been done in New Zealand. The overview of questionnaire design and administration stages are shown in Figure 3-4.

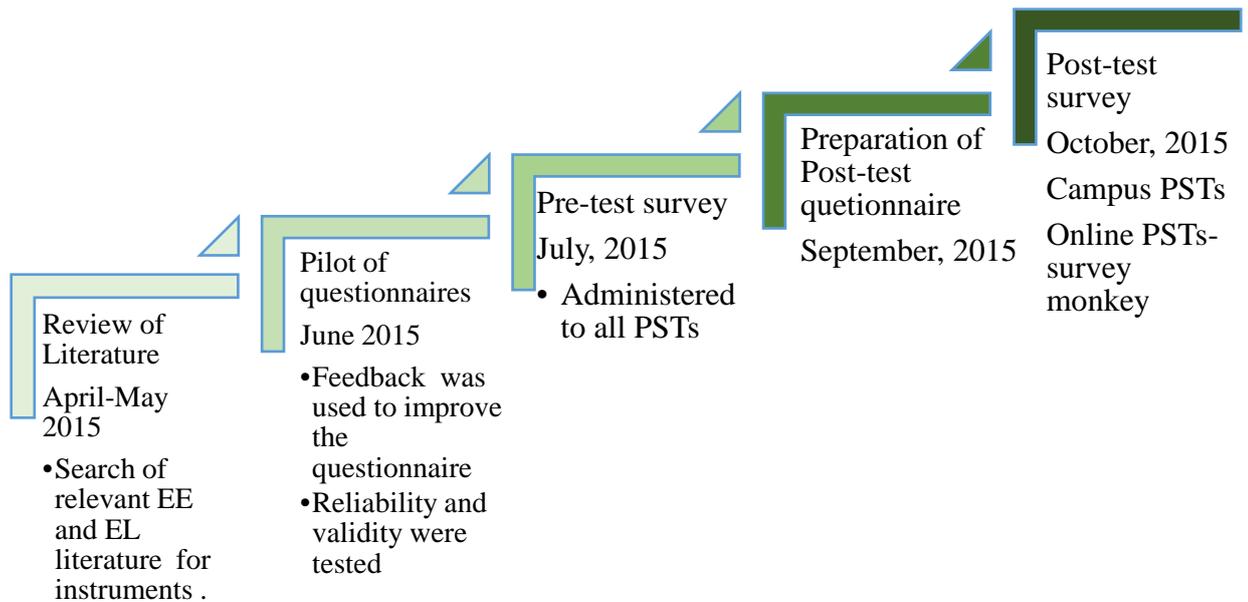


Figure 3-4 Overview of questionnaire design and administration stages

In May 2015, the process of designing the questionnaire started with literature searches in the field of EE and EL to get a better understanding of published questionnaires and their content validity and to learn what kind of instrument(s) were being used for similar studies. Based on the searches made, the first draft was developed partly on previous research in EL (Yavetz et al., 2009; Yavetz & Pe'er, 2002) as well as other EE research (Bradley, Waliczek, & Zajicek, 1999; Morrone, Mancl, & Carr, 2001; Schindler, 1999). Four environmental education experts evaluated the drafted questionnaire for content validity and a revision was made to the draft questionnaire based on their recommendations. In June 2015, the content-validated questionnaires were administered as a pilot study to 30 first-year PSTs, who were being prepared to teach in secondary schools, to further test the practicality, coherence and clarity of the questions (Oppenheim, 1992). Data from the pilot study was used to evaluate the reliability and internal consistency of the different scales that made up the questionnaire. Cronbach alpha scores (Kline, 1993) obtained from the scales attest to the reliability of the questionnaire administered. In this study, the Cronbach alpha for the scales ranged from .693 to .93. These Cronbach alpha scores could be regarded as reliable as they were equal to or larger than 0.7 (Cohen et al., 2011). Additionally, feedback from the pilot study was helpful in improving the overall quality of the final questionnaire. For

example, based on a feedback from the pilot study, the instruction leading to the objective knowledge section of the questionnaire was reworded for more clarity.

Permission was gained from the convenor of the paper and workshop tutors to gain access to participants. Before administration of the questionnaire by the researcher, PSTs were given oral instructions on how to complete the survey. On average, completing the questionnaires took 20 minutes. All questionnaires were returned by the PSTs to the researcher, and those that were not fully completed were not considered for further analysis. The questionnaires had eight major sections, made up of closed and open-ended questions (see Appendix A). The first section relates to questions about PSTs' background information (gender, age, and previous environmental affiliations), while the subsequent sections revolved around PSTs' EL and preparedness to teach EE. These are discussed next.

Environmental knowledge

This section of the questionnaire (Questions 47-51) was used to gather data on PSTs' actual knowledge of the environment and sustainability. The environmental knowledge section comprised multiple choice questions with five possible options. For each question, three options were ones that sustainability experts would consider to not represent sustainability, one option that would be considered to represent sustainability and a 'don't know' option. These questions examined knowledge of issues covered in the EE paper, including ecosystems, sustainable approaches, bee decline, consumption and waste, and a question on water pollution, which was not directly covered in the EE paper. The inclusion of this latter question was perceived to be very relevant to the regional context given the current prevalence of water pollution issues (Ballantine & Davies-Colley, 2014). Additionally, PSTs' self-assessment of how informed they felt on environmental issues i.e. their perceived knowledge (Question 40-46) was conducted using a 5-point Likert-type scale (1= very uninformed to 5= very informed).

Environmental affect

As influencers of EL in schools, the beliefs that PSTs have towards the environmental issues and how they can affect them is important in how they might nurture these in their future students. Consequently, the environmental affect

section of the questionnaire (Questions 6-17) included three parts. The first two parts comprised statements that focused on PSTs' locus of control (2 items) and personal responsibility (3 items), while the third had statements exploring the PSTs' environmental worldviews (6 items). These statements were adapted from the NEP scale (Dunlap et al., 2000). In all, the environmental affect section of the questionnaire comprised 11 statements to which PSTs could state their extent of agreement, based on a 5-point Likert-type scale (1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree). The scores of the negatively worded items were reversed during analysis.

Environmental concern

PSTs' environmental concern on seven environmental and sustainability issues (Questions 18-24) was assessed using a 5-point Likert-type scale (1= very unconcerned to 5= very concerned). These environmental and sustainability issues included water pollution, climate change, consumption and waste, endangered species, child poverty, racial discrimination and bee decline. Factors that influenced the choice of these environmental and sustainability issues were topics taught in the EE paper, local and publicized issues, and relevance to potential teachers.

Environmental behaviour

This section of the questionnaire sought to assess (a) PSTs' intention to act (Question 25-29) by indicating their level of agreement with 5 statements assessing their willingness to participate in pro-environmental actions (using a 5-point Likert scale from 1= strongly disagree to 5=strongly agree), and (b) PSTs' environmental behaviour (Question 29-39) through self-reported data signifying how often they carried out some environmental actions. The environmental actions of PSTs assessed in this study align with theoretically-defined scales for measuring environmental behaviour (Hines, Hungerford, & Tomera, 1987; McBeth & Volk, 2009; Simmons, 1995; 1999 NEETF/Roper Report Card). In support of the scale for measuring environmental behaviour, Roth (1992) also argued that an individual operating at the functional level of environmental literacy should exhibit these behaviours. These actions encompass consumer action (3 items), eco-management (2 items), persuasion (2 items), nature-related leisure (1 item), community giving (1 item) and environmental activism (1 item).

In addition to PSTs' EL, since this study also sought to assess PSTs' preparedness to teach EE, two sections of the questionnaire addressed this aspect. They are:

Level of understanding of learning outcomes

This section assessed PSTs' level of self-reported understanding of the teaching and learning outcomes of the EE paper (Questions 52-55). The areas included PSTs' understandings on the significance of the environment and its associated issues and people's demonstration of attitudes that influence ERB. PSTs were required to indicate this on a scale ranging from very poor understanding to very good understanding.

Confidence to teach EE in primary schools

This section examining PSTs' confidence to teach EE (Questions 56-61) asked them to rate how confident they felt about teaching to achieve EE-related objectives in primary schools on a scale ranging from 1 (not confident at all) to 5 (very confident).

The pre-test questionnaire ended with two sections, made up of four questions that could be divided into two broad themes; environment and sustainability. The first two questions asked PSTs to rate their understanding of the natural environment and explain what the natural environment meant to them (Questions 62-63). The last two questions asked PSTs to rate their understanding of sustainability and define what sustainability meant to them (Questions 62-63).

Following the pre-test survey, preparation for the post-test questionnaire began in September 2015, and by October 2015, the post-test survey was administered in hard copy to the Year 1 cohort during the last workshop of the campus PSTs. For the online PSTs, Survey Monkey was used to administer the post-test survey. The post-test questionnaire retained all the content from the pre-test questionnaire described above. It, however, had additional sections that sought to understand PSTs' perspectives of the impact of the just completed EE paper on their EL and preparedness to teach EE. The supplementary questions were divided into three sections: (a) PSTs' reflection on their learning in the EE paper; (b) PSTs' beliefs about the influence of the EE paper; and (c) PSTs' confidence to teach EE.

Reflecting on their learning in the EE paper, PSTs were asked to indicate whether they would have liked to have had more, less or about the same learning opportunities on six key areas of the EE paper taken (Questions 66-71, see Appendix A). PSTs were also asked about the extent to which they felt the just completed EE paper had influenced their EL (environmental knowledge, affect, intention to act and behaviour) and had encouraged them to teach environmental and sustainability issues (Questions 72-76, see Appendix A) on a 5-point Likert scale ranging from 1 (Not at all) to 5 (A great deal). Considering the possibility of other influences on PSTs' EL, PSTs were asked to indicate the level of contribution a variety of factors had on their EL (Questions 77-83, see Appendix A). These factors included completion of the EE paper, completion of other University papers, participation in the field trip, media, experiences with family and friends or any other experience. A 5-point Likert scale ranging from 1 (no contribution) to 5 (very strong contribution) was employed.

The same post-test questionnaire was used to gather data from the Year 3 PSTs in November 2015. Permission was gained from the convenors of Year 3 PSTs, and after receiving consents, the questionnaire was administered physically by the researcher. It took on average 20 minutes to complete the questionnaire. A consent form requesting permission to follow up Year 3 PSTs six months into their beginning teaching career was also administered.

3.8.4.2 Interviews

A set of interview questions were designed for Year 1 PSTs' tutors (see Appendix B). The aims of the research, which were to examine PSTs' EL and preparedness to teach EE upon graduation, guided the development of the interview questions. The interview questions were reviewed for structure and content by the researcher and her supervisors to ensure that the coverage of the questions aligned with the aim of the study. Interviews were used for Year 3 PST and beginning teachers to gather data about the preparedness of ready-to-graduate teachers to teach EE and their experiences in teaching EE respectively (see Appendices C-D). For the Year 3 PSTs, an in-depth interview was conducted to gain further insights into some responses from the questionnaire already completed. Semi-structured questions were asked which revolved around PSTs' EL and how much they felt they had

retained whatever EL they had gained two years previously, as well as how ready they felt for teaching their future students for a sustainable future. Probes were used in the interview sessions to explore further PSTs' perspectives on the issues being raised. The interview with the Year 3 PSTs was conducted in a booked office on campus while telephone interviews were used for the beginning teachers except for one, in which the researcher went to her home for the interview.

3.8.4.3 Focus group discussions

A focus group discussion, according to Walter (2013), provides a platform that generates a wide range of opinions and insights formed by the interaction of the group. Upon completing the EE paper, in October 2015, focus group discussions were conducted by the researcher with 10 Year 1 PSTs from the on-campus cohort. These PSTs expressed their willingness to be involved in the study and they were informed of the confidentiality through the consent form distributed before the focus group discussion. The PSTs were also informed that discussions during the focus group should remain within the group, as information shared should not in any way be used against any participant after the focus group discussion. They were encouraged to respect each other's views. The aim of the focus group discussion was to give the PSTs an opportunity to reflect on their learning in the EE paper they had just concluded and how it had impacted their EL and confidence to teach EE. Semi-structured questions were designed in accordance with this aim (see Appendix E). Also, the questionnaire responses provided some basis for probing questions raised in the focus group discussion. For example, as a result of PSTs' reported understanding of sustainability in the questionnaire, one of the discussions in the focus group revolved around what sustainability meant to the PSTs. This question was posed to elucidate PSTs' understanding of sustainability as the questionnaire responses to what sustainability meant to them seemed skewed towards the environmental aspect of sustainability and it was important to delve more deeply into this. The focus group discussion, which lasted about 60 minutes, was audio taped. Overall, the focus group discussion in this study aimed at understanding PSTs' responses to the issues raised and the interactions between them.

3.8.4.4 Observations

Observations in this study were guided by the research questions. Ten tutorial sessions of the on-campus PST cohort were observed, each lasting between 90-120 minutes, as well as all 9 one-hour lectures were observed. The aim of the observations was to capture participants' activities and interest while they were engaging in their usual teaching and learning processes. Observations were unobtrusive, focused on the teacher and learners, and an unstructured approach was used to taking the observation notes (Patton, 2002) was employed. The observation notes captured PSTs' learning in the EE paper, in line with the research's aims.

3.8.4.5 Document Analysis

In this study, the paper outline for the EE paper used as case study, stating the objectives and goals of the EE paper was analysed. Also, tutors' presentations, mostly PowerPoint slides were analysed for the contents covered in the EE paper. These documents were carefully examined to ensure that appropriate interpretations relevant to the research questions were made. The following section describes the data analysis procedures used for the data collected in this study.

3.9 Data analysis

Data analysis is the “process of transforming raw data into usable information. This process involves many important steps, including identifying an issue, asking meaningful questions, developing answers to these questions through examination and interpretation of data and, finally, communicating the results” (Binder & Roberts, 2006, p. 2771). This implies that there is the need for choosing the most appropriate analysis technique that aligns with the research aims and questions. As discussed in Section 3.5, this study used a mixed methods approach; hence, quantitative and qualitative data were collected. The two types of data collected were treated differently, as is discussed below

3.9.1 Quantitative data analysis

Statistical analysis, a means of revealing patterns and regularities within a quantitative data set, was employed to analyse the closed-ended questions in the

questionnaire, using Statistical Package for Social Sciences (SPSS 22). Figure 3-5 shows the summary of the quantitative procedures employed in this study.

For statistical data analysis, both campus and online PSTs were treated as one sample based on a preliminary one-way ANOVA test done. PSTs' responses to the questionnaire indicated that campus PSTs did not differ significantly from online PSTs on all the questions evaluating their EL and preparedness to teach, except for their responses related to environmental concern, so the two groups were considered to be sufficiently the same to be treated as such.

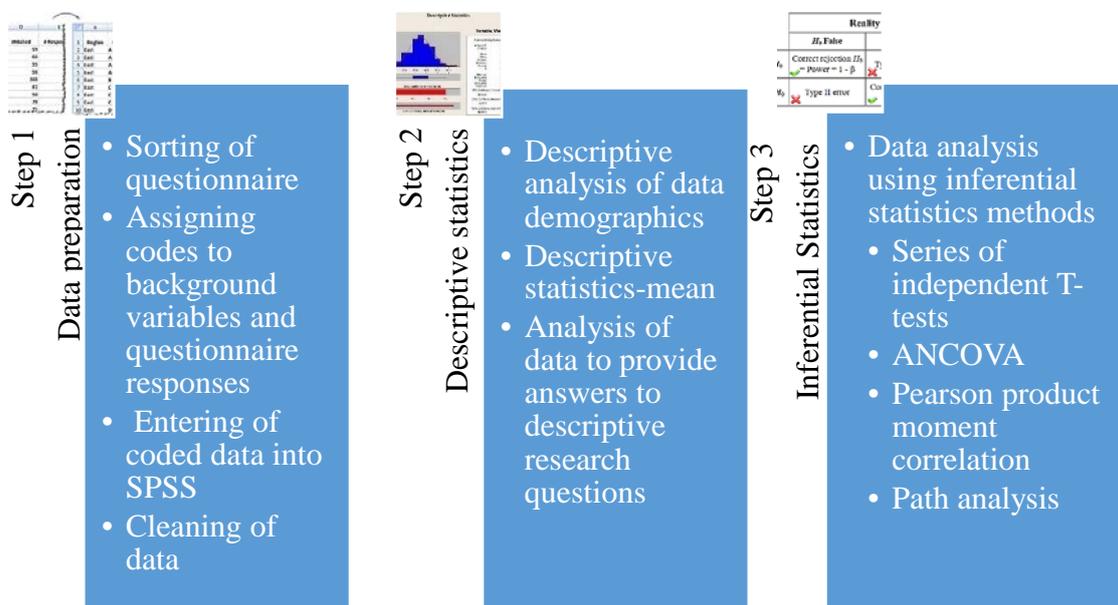


Figure 3-5 Quantitative data analysis process

Data analysis started with data screening and cleaning after assigning codes to the variables used in the questionnaire. The data screening and cleaning stage involved checking for errors that might have occurred during the data entering stage, as well as checking for variable scores that were out of possible range score. For example, a five-point Likert scale was used, so any value above five must have been due to error.

The next step was to manipulate the data. This was necessary because to perform statistical analysis on the whole data set, there is the need to calculate total scale

scores for the scales (Pallant, 2013). To achieve this goal, a reversal of the negatively worded items on the NEP scale used in this study was done using SPSS. After which the total scores for the scales were calculated.

As guided by the research questions, descriptive and inferential statistical analyses were performed. The descriptive analysis was done to assist in describing and summarizing the data in a meaningful way as well as showing patterns that emerged from the data. However, conclusions cannot be made beyond the data analyzed as they are simply a way to describe the data (Pallant, 2013). In this study, the descriptive statistics used were frequencies, percentages, means, and standard deviations (Gay et al., 2012). This was appropriate for summarizing the data from EL (affect, concern, intention to act, and behaviour) scales used in this study. While descriptive statistics presents data summary from the immediate group of data, with the inferential analysis conclusions that extends beyond the immediate data alone are induced. With descriptive statistics, judgments of the probability that an observed difference between groups is a dependable one or one that might have happened by chance in this study can be made. Inferences from one's data to more general conditions are made with inferential statistics. Inferential statistical tests include t-test, Pearson product moment correlation, Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA).

Informed by the first research question of this study, to explore the immediate impact of taking an EE paper on PSTs' EL and preparedness to teach EE, a series of independent sample t-tests were conducted. Since a pre-test and post-test design was employed, a t-test was used to examine the significant differences in mean scores of the dependent variables (between the pre-test and post-test scores of Year 1 PSTs). The use of the independent sample t-test instead of a paired sample t-test was required because of the anonymous nature of the questionnaire, which made it impossible to match pre-test and post-test responses of PSTs. Although the paired sample test can give a more valid result, the independent sample test used examines that same general relationships and loses little in validity.

Furthermore, this study was interested in the relationships between the EL components and as such, Pearson product moment correlation was used. The

relationships between the EL components for Year 1 PSTs (pre-test and post-test) and Year 3 PSTs were explored. Pearson product moment correlation is a measure of the strength of a linear association between two variables and is denoted by r . For each PST respondent, an overall total of each EL component (environmental knowledge, affect, concern, intention to act and behaviour) was calculated. These total scores for each EL component were correlated with each other to investigate the measure of linear dependence between any two components, at any time. Using this approach, correlation values generally range between +1 and -1 inclusive, where +1 is a total positive linear correlation, 0 is no linear correlation, and -1 is a total negative linear correlation (Sedgwick, 2012).

To explore more opportunities for modeling interactions between the EL variables, path analysis was used. Path analysis, an advanced and comprehensive statistical procedure uses both bivariate and multiple linear regression techniques to test the causal relationship among the variables in a proposed model (Olobatuyi, 2006). In a path analysis model from the correlation matrix, two or more causal models are compared. The path of the model is shown by a square and an arrow, which shows the causation (Garson, 2013). Regression weight (β) is predicted by the model. Then to see the fitting of the model, the goodness of fit statistics is calculated. Garson (2013) suggested that the expected fit indices for good (fitted) models are above .90 for GFI, AGFI and below .05 for RMSEA. For the sake of clarity GFI, AGFI, and RMSEA are explained below:

Goodness of Fit Index (GFI): The ratio of the sum of the squared differences between the observed and reproduced matrices to the observed variances is the base of the GFI (Schumacker & Lomax, 1996). The range of the GFI is from 0 to 1. The values exceeding 0.9 indicates a good fit to the data (Kelloway, 1998)

Adjusted Goodness of Fit Index (AGFI): The AGFI index is the adjusted GFI for the degrees of freedom of a model relative to the number of variables (Schumacker & Lomax, 1996). As with GFI, the AGFI has a range

from 0 to 1, with values 0.9 indicating a good fit to the data (Kelloway, 1998).

Root Mean Squared Error of Approximation (RMSEA): This is computed on the basis of the analysis of residuals. Values below 0.10 indicate a good fit, values below 0.05 indicate a very good fit, and the rarely obtained values below 0.01 indicate an outstanding fit to the data (Garson, 2013).

Standardized path coefficients with absolute values less than 0.10 may indicate a small effect; values around 0.30 indicate medium effect, and values above 0.50 indicate large effect (Henseler & Fassott, 2010). Hence, in this study, in line with the conceptual framework, path analysis was used to examine interactions between the EL components (environmental knowledge, concern, affect) and how these relate to intention to act (ITA) as well as environmental behaviour (EB).

3.9.2 Qualitative data analysis

Qualitative data analysis is “a dynamic, intuitive and creative process of inductive reasoning, thinking and theorizing” (Basit, 2003, p. 143). Throughout the analysis period, researchers attempt to gain a deeper understanding of the issue under investigation and continually refine their interpretations. As Miles, Huberman, and Saldana (2014, p. 14) put it, qualitative data analysis is a “continuous and iterative enterprise...which needs to be well documented”. The object of analysing qualitative data is to determine the categories, relationships and assumptions that inform the respondents’ view of the world in general, and of the topic in particular.

The approach used for qualitative data analysis (interviews, focus group discussion, observation data) in this study is content analysis. Content analysis “produces a relatively systemic and comprehensive summary or overview of a data set as a whole, sometimes incorporating a quantitative element” (Silverman, 2016, p. 84). This technique was preferred in this study because it is an interpretive approach in which social actions and human activities can be handled as transcripts (Berg, 2001). Content analysis involves data coding, categorizing and classification with the main purpose of making sense of the information collected and highlighting the

main themes and/or findings of the collected documents (Krippendorff, 2012). Specifically, for this research, content analysis served as a technique for analyzing PSTs' responses to questionnaire open-ended questions, interviews, focus group discussions and the observation sheet. Content analysis is a descriptive method.

As shown in Figure 3-6, NVivo 11 pro was used for qualitative data analysis in this study. NVivo, a qualitative data analysis (QDA) computer software package produced by QSR International, aids researchers in the search for an accurate and transparent picture of the data, while also providing an audit of the data analysis process as a whole (Bazeley & Jackson, 2013). The benefits include enhanced management of data from various sources (e.g., interview transcripts, surveys, observation notes and published documents), improved management of ideas, and use of the software (query feature) in answering several questions about the data. Using NVivo, results of queries can be “saved to allow further interrogation and so querying or searching becomes part of an ongoing enquiry process” (Bazeley & Jackson, 2013, p. 3). Relationships between analysed data can also be modelled visually through graphs, maps, etc. for reporting.

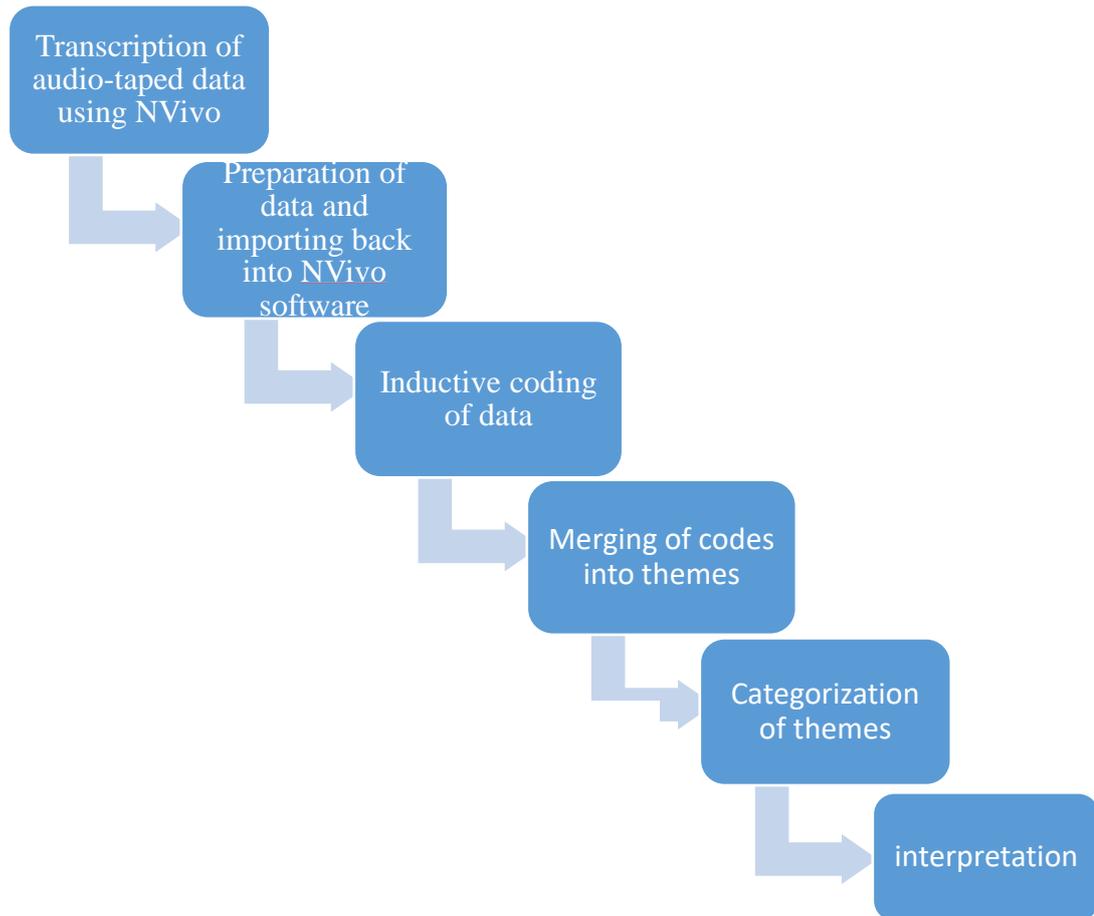


Figure 3-6 Qualitative data analysis process using NVivo 11 pro

The sequence of the content analysis employed in this research using NVivo was as follows:

- i. Interview transcriptions using NVivo, cleaning of data on word document and importation of data back into NVivo for analysis
- ii. Reading through the transcript multiple times to get familiar with the content. A query feature on NVivo that gives the overview of PSTs' responses to each of the questions was used at this stage for a quick appraisal of emerging themes.
- iii. Coding of transcripts inductively to adequately capture themes emerging from PSTs' responses, as guided by research questions.
- iv. A series of coding and recoding of responses, checking thoroughly for consistency and adequateness of coverage (Cohen et al., 2011).
- v. Grouping themes into main and minor themes and removing redundant themes.

- vi. Transformation of themes into categorical labels. This involved categorization of themes by identifying similar phrases, patterns, relationships, and commonalities or disparities.
- vii. A check for validity of the themes and categories through a careful review of the codes by the researcher and supervisor, an EE expert.
- viii. Counting frequencies of occurrence of the themes and categories
- ix. A careful assessment of themes and categories to derive meanings through the observed patterns.
- x. Interpretations were made by considering identified patterns in the light of existing literature.

3.10 Validity and reliability

Validity and reliability are essential for research (Cohen, 2011). Validity refers to “appropriateness, correctness, meaningfulness and usefulness” (Fraenkel & Wallen, 2003, p. 158) of inferences based on the data. Reliability, on the other hand, refers to the degree of consistency of data measurements (Patton, 2002). It is important to note that “threats to validity and reliability can never be erased completely; rather the effects of these threats can be attenuated by attention to validity and reliability throughout a piece of research” (Cohen, 2011 p. 133).

Validity and reliability both have internal and external aspects (Lodico, Spaulding, & Voegtle, 2010; Wiersma & Jurs, 2009). Wiersma and Jurs (2009) explain that “internal reliability is the extent to which results can be interpreted accurately, and external validity is the extent to which the results can be generalized to populations, situations, and conditions” (p. 5). External validity refers to the consistency of data collection, analysis and explanation if given the same conditions over time, over instruments and groups of respondents. External reliability, on the other hand, refers to whether a study can be replicated by other researchers under the same or similar settings.

In quantitative research, validity and reliability have to do with measurement (Muijs, 2010). It is related to asking questions about the instrument measuring what it intends to measure. Hence, an instrument is considered valid when it measures what

it is designed to measure, as exemplified by the relationship between the data collected and concepts detailed in the study's theoretical framework. Validity might be enhanced through careful sampling, suitable instrumentation and suitable statistical treatments of the data (Cohen & Manion, 2011). These aspects were taken into consideration in this study. To ensure validity in this study, before administering the questionnaires, content validity was checked by review from experts on my supervisory team and other experts from the Faculty of Education at the University. A pilot test was also carried out. Since in quantitative research, there is always some element of error called measurement error, reliability then refers to the extent to which test scores are free from measurement error (Muijs, 2010). It has two main types; repeated measurement and internal consistency. In this study, however, to evaluate the reliability of the instrument used, internal consistency was assessed by calculating Cronbach alpha scores for the EL scales presented in the questionnaire.

Validity and reliability are also applicable to qualitative data, but the suitability of the terms have been contested by qualitative researchers (Winter, 2000). Parallel terminologies for validity and reliability in qualitative research (Shenton, 2004) have been suggested as:

- a) credibility (in preference to internal validity);
- b) transferability (in preference to external validity/generalisability);
- c) dependability (in preference to reliability);
- d) confirmability (in preference to objectivity).

As opposed to quantitative research, where internal validity seeks to ensure that the study measures what is actually intended, credibility answers the question, "How congruent are the findings with reality?" This is vital to establishing the trustworthiness of any study. As proposed by Shenton (2004), the credibility of the qualitative data was ensured through the use of a mixed methods approach, and multiple sources of data to enhance triangulation. In this study, to ensure credibility, the following approaches were adopted:

- a) The use of multiple data sources and methods that lend themselves to form meanings and patterns, that is, ‘mixed’ method research according to Creswell (2009).
- b) Enhancing honesty in PSTs by giving them the opportunity to refuse to participate in the study. Also, the researcher made it clear to the PSTs, through an information sheet and consent forms (Appendices F - H) before participating in the research that they had the right to withdraw from the study at any time and that there were no right or wrong answers as the study was interested in assessing their perspectives on the questions asked.
- c) The interview and focus group questions contained probes to elicit thorough data and understand the perspectives of the PSTs to the questions asked.
- d) Member checks, considered as vital in strengthening a study’s credibility (Guba, 1981), were also done by sending the interview transcripts to the PSTs and their tutors. All participants agreed with the transcripts.
- e) The analysis process also involved thoughtful reflections in line with the research aims and questions.

Transferability is related to the degree to which the findings of a study can be useful to other conditions (Merriam, 1988). In quantitative research, transferability, as it relates to generalisation, is tricky because the findings of a qualitative project are specific to a small number of particular environments and individuals. It is often impossible to demonstrate that the findings and conclusions are applicable to other situations and populations. Lincoln and Guba (1985), however, argue that generalisation should be reader-made, i.e. readers should decide for themselves the extent to which the study is similar and instructive to theirs. Researchers should, however, ensure that they provide a clear and in-depth description of their study so that readers can then determine the possibility of transferability or not. In this study, this approach has been followed. Where at all possible, PSTs’ voices have been retained and presented in the data.

Dependability, equivalent to reliability in quantitative research, seeks to demonstrate that similar findings will be obtained if a repeat of the study is done with the same people in the same context, using the same method. Research that

deals with humans cannot, however, fulfil this condition because of the changing nature of the phenomena scrutinised by qualitative researchers. Reliability can be regarded as a fit between participants' perceptions of what actually occurred in the natural setting and the researcher's record as data. In other words, it could be regarded as the degree of accuracy and comprehensiveness of coverage (Guba & Lincoln, 1989). According to Guba and Lincoln (1994), dependability is closely linked to credibility. Therefore, it is most likely that a study that enhances credibility would as well be dependable. Triangulation of approach, as well as reporting detailed processes involved in a particular study, would enhance dependability. Similar to transferability, readers can then assess the extent to which proper research practices have been followed based on the in-depth coverage provided.

The concept of confirmability is the qualitative investigator's comparable concern to objectivity. It is "assuring data, interpretations, and outcomes of inquiries are rooted in context and persons" (Guba & Lincoln, 1989, p. 242). To enhance confirmability in qualitative data, steps must be taken to assist in ensuring as far as possible, that the work's findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher. As such, detailed reports of decisions made in respect to beliefs underpinning the research methods should be acknowledged within the research report. This should include the reasons for favouring one approach when others could have been used, and weaknesses in the techniques. The role of triangulation in promoting such confirmability must again be emphasised, in this context, to reduce the effect of investigator bias. Critical to this process is the audit trajectory, which allows any observer to trace the course of the research step-by-step via the decisions made and procedures described. The audit trajectory may be represented diagrammatically as has been done here.

3.11 Ethical Considerations

In all the other aspects of research, as discussed in this chapter, the principal focus is on the project and the requirements flowing from the research questions. However, "when it comes to ethical issues, the focus shifts from the needs of the

project to those of the key stakeholders: the participants, the researcher, the research organization and the scientific community, as well as the broader public” (Walter, 2013, p. 73). Ethical research ensures that in research involving humans, ethical principles and values are always upheld (Walter, 2013). Ethics is concerned with protecting the rights of participants by instituting safeguards (Lodico et al., 2010). This could sometimes get in the way of successful projects that deliver results promptly. This can be illustrated in the researchers’ and the researched rights. For instance, as much as the researcher needs high response rates, the researched has a right to refuse participation. Equally, a researcher needs low attrition rate, but then, the researched has the right to withdraw participation at any time. There is, therefore, the need for a “balance between the demands placed on researchers ... in pursuit of truth, and their subjects’ rights and values potentially threatened by the research” (Cohen et al., 2011, p. 51). “The traditional and often dominant issues that emerge when considering research ethics involve obtaining informed consent from participants, protecting them from harm and ensuring confidentiality” (Lodico et al., 2010, p. 18).

These issues were addressed in this study appropriately. Before commencing the study, ethical approval was sought and received from the University’s Human Research Ethics Committee (see Appendix I for confirmation of enrolment letter which is granted alongside ethical approval). To gain access to the participants and PSTs, official permission before conducting the study was sought by the researcher (Cohen et al. 2007) from the Dean of the Faculty within which participants were studying, as participants of the study were from across the Faculty. Also, permission was sought from convenors of Year 1 and Year 3 PSTs to gain access to PSTs and staff in their papers.

Concerning informed consent, the guiding principle for researchers is that a person’s decision to participate in research is voluntary, and based on sufficient information, an adequate understanding of the purpose, methods, risks and potential benefits of the research. In this study, before data collection, this information was communicated verbally and through information letters. The information letter containing information about the study and the possible ways PSTs would be required to engage was distributed alongside a consent form, which they were asked

to sign if they wished to participate. The Dean of the Faculty and the convenor of Year 1 and Year 3 PSTs were also asked to sign consent forms before relevant data collection began. Having read this information, their subsequent completion and submission of the questionnaire were taken as consent to use the data provided.

Cohen et al. (2007) advised that researchers uphold an ethical and moral responsibility to protect participants from possible harm. Partaking in social science research might potentially affect or cause humiliation, embarrassment, loss of respect and self-respect and other emotional discomfort (Stake, 2010). Therefore, harm is an important potential effect to avoid where possible. In this study, while this was not anticipated, measures were already put in place when there was a chance that a teacher and PSTs (in classroom observations, interviews or focus groups) may experience anxiety as a result of knowing that their actions and or responses are being closely observed. PSTs were advised that any data they provided would not be shown to their lecturers/tutor and that anything they provided would not impact on their academic progress. Neither the researcher nor the supervisor were involved in teaching PSTs in the paper used as the case study. All data gathered from the PSTs were treated with utmost sensitivity and will not be used in any way except for the study and attendant presentations and publications. Participants had the opportunity to view and amend transcripts of their interviews and were advised of their right to withdraw unprocessed re-identifiable and individually identifiable data at any point during the project. This study also recognized that any harm is an impact on teacher's time and PSTs giving freely of their own time to participate. They were advised of that time commitment and the hope that potential individual and societal gains from being involved would offset this.

Confidentiality involves keeping the shared experiences and information between the researcher and the participant, while anonymity refers to the actions that researchers use to protect the identity of participants when their data is quoted in any research outputs such as presentations, articles, or in a thesis. To ensure confidentiality in this study, the questionnaires were completed anonymously. The researcher explained in the content of the information sheets and the consent forms that any information provided by participants in the study would be kept

confidential. They were also reminded to respect the protocols around interviews, focus group discussions and that what is said of the group, remains in the group. Lecturers, student teachers, schools, and school teachers were anonymous in all publication of findings. Pseudonyms were used when referring to quotes from interview and focus groups transcripts and in descriptions from lesson observations in all presentations and publications of findings of the study. The researcher informed the participants of the use of pseudonyms to ensure confidentiality.

3.12 Chapter Summary

This chapter presented the methodology used in this study. It began with re-stating the aim of the study, which was to evaluate the impact of completing an EE paper on PSTs' EL and preparedness to teach EE in NZ primary schools. It then described the different paradigms in educational research: positivism, interpretivism and critical theory through the lens of the assumptions or dimensions of research processes in educational research: ontology, epistemology, methodology, and axiology. The ontological and epistemological assumptions of interpretivism were perceived to align the most with the aims of this study. This is because the focus of this study is to understand PSTs' perspectives and seek meanings about their EL and preparedness to teach EE, as against taking an entirely objective approach (positivism) or trying to change them (critical theory). As such, in this study, reality was seen subjectively from different lenses, understood, and interpreted through various viewpoints of PSTs about their experiences. A mixed method (qualitative and quantitative) approach was found to be most appropriate to answer the research questions. Using this pragmatic approach also enhanced triangulation of PSTs' data, harnessing the strength from each of the approaches to capture a better understanding of their EL and preparedness to teach EE upon graduation. Next, the chapter discussed the adopted case study strategy, describing the EE paper used as a case study in the research. Also, the research design which encompasses the context of the research, the population and sampling method, sample size, and data collection procedures were presented. Data analysis procedures used for qualitative and quantitative analysis were discussed. This included statistical analysis using SPSS 23 and content analysis using NVivo 11 pro. The last two sections in this chapter described measures put in place to enhance validity and reliability of the

data, as well as ethical considerations applied in the study. The next chapter presents the first findings chapter of this study which answers the first research question on the immediate impact of completing an EE paper on PSTs' EL.

Chapter Four: Findings - Year 1 PSTs

4.1 Overview of Chapter

This is the first of three findings chapters. This chapter presents the findings of the research into the immediate impact of completing an environmental education (EE) paper on the environmental literacy (EL) of pre-service teachers (PSTs) in New Zealand. Precisely, it seeks to answer the first research question in this doctoral thesis: *What is the immediate impact of completing a first-year core paper in environmental education on environmental literacy levels of pre-service teachers (PSTs)?*

The following sections present findings drawn from the environmental literacy components described in Chapter 2. The first sections encompass findings on PSTs' environmental knowledge (Section 4.2), followed by PSTs' environmental affect (Section 4.3), and PSTs' environmental behaviour which takes into account PSTs' intention to act (Section 4.4). The next sections examine the relationships between these environmental literacy components (Section 4.5) and the impact of environmental factors on PSTs' environmental literacy (Section 4.6). Also presented in this chapter is a section examining PSTs' preparedness to teach EE (Section 4.7). A summary of these findings completes the chapter.

4.2 Impact on pre-service teachers' environmental knowledge

To explore indicators that could be used to assess the immediate impact of completing EE on PSTs' knowledge, this study examined PSTs' knowledge of the 'natural environment,' 'sustainability' as well as selected 'environmental and sustainability issues' in New Zealand. As was argued in Chapter 2, this knowledge is essential for PSTs' EL, and for their ability to carry out the successful implementation of EE with their future students. Data were gathered using an anonymous questionnaire administered to the campus and online PSTs before (pre-test) and after (post-test) completing the EE paper.

4.2.1 Pre-service teacher's knowledge of the natural environment.

Pre-service teachers were first asked to rate their understanding of the natural environment on a 10-point scale ranging from poor understanding (1) to excellent

understanding (10). Presented in Figure 4-1 is the graph showing pre-test and post-test ratings of all PSTs on their understanding of the natural environment.

A categorisation of their self-ratings was done with ratings from 1 to 2 as poor understanding, 3 to 4 as rudimentary understanding, 5-6 as good understanding, 7-8 as very good understanding and 9 to 10 as excellent understanding.

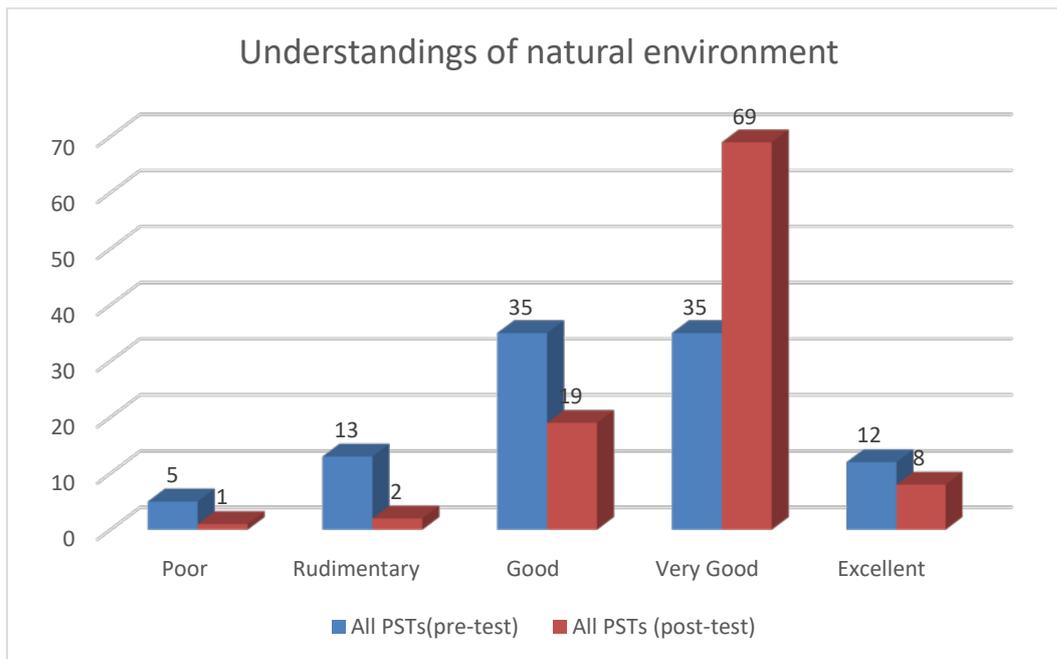


Figure 4-1 PSTs' self-ratings of their understanding of the natural environment before (pre-test) and after (post-test) completing the EE paper (n=88)

Before taking the EE paper, 18% of PSTs rated themselves as having either poor or rudimentary understanding of the natural environment while upon completing the EE paper, only 3% of PSTs remained in the category of those who rated themselves as having a poor or fair understanding of the natural environment. Also, prior to taking the EE paper, 35% of PSTs rated themselves as having a good understanding of the natural environment, and an equal proportion (35%) of PSTs, rated themselves as having very good understanding of the natural environment.

It is, however, interesting to observe that upon completing the EE paper, the proportion of those who rated their understanding as good decreased by 16% while the proportion of those who rated their understanding of the natural environment as

very good increased by 34%. This indicates a shift towards very good understanding upon completing the EE paper. A 4% reduction in the percentage of those who rated themselves as having excellent understanding was however observed upon completing the EE paper. This finding might imply that some PSTs had more self-awareness about their understanding of the natural environment upon completing the EE paper and had recognised some deficiencies therein. The two cohorts (campus and online) of PSTs showed a similar trend: an increase in the proportion of PSTs who rated themselves as having very good understanding of the natural environment upon completing the EE paper and a decrease in the proportion of those who rated themselves as having poor to rudimentary understanding.

To further determine PSTs' understanding of the natural environment, an open question asking why PSTs think the natural environment was important was asked in the questionnaire. Responses were analysed thematically, and the range of responses analysed developed the categories describing PSTs' conceptions of the environment. Some categories and themes that reflected the different ways in which PSTs perceive and understand the concept of the natural environment emerged. Some PSTs' responses were placed in more than one theme. Hence the number of themes exceeded the total number of PST respondents in this study.

From the inductive analysis, 20 codes were first identified, and these were after that grouped into 15 different themes. The 15 themes were then regrouped into five themes that reflected PSTs' understanding of the natural environment, adapting categorisation from previously published literature (Loughland, Reid & Petocz, 2002; Shepardson, Wee, Priddy & Harbor, 2007). An additional main category, 'environment and future perspectives', which has not been published in available literature related to the natural environment, emerged from the analysis of responses in this study. The themes and categories were (see also Table 4-1):

- The environment does something for people - support for life, provisioning, climate regulation, health and wellbeing, cultural, economic value. This category had the highest responses as the majority of the PSTs viewed the environment as important because of the role it plays in supporting and providing for humans and other living species.

- Environment as a place where animals/plants live - relating the importance of the environment to its use as a habitat for animals including humans reflected the PSTs' perception of the environment as an object (Loughland et al., 2002). Most of the PSTs in this category saw the environment as a place for humans and other animals, without mentioning plants.
- People are part of the environment and are responsible for it - humans are responsible for protecting the environment. PSTs in this category either indicated the importance of the environment from the perspective of what people can do for the environment or highlighted that environmental problems are largely caused by the influence of human activities.
- People and the environment are in a mutually sustaining relationship – using ideas of interdependence, biodiversity, and ecosystem. Responses in this category were observed more in the post-test analysis as the PSTs' responses in this category related to the interconnections between living species and the environment.
- Environment and future perspective – including future use, future generations. PSTs in this category related the importance of the natural environment to future use and future generations.

Table 4.1 presents the categories and themes that emerged from analysis of all PSTs responses before and after completing the EE paper. Findings from the study indicate that PSTs mainly perceive the environment regarding what it does for people, as 69% and 58% of pre-test and post-test responses respectively related to themes such as provisioning, support for life and cultural considerations.

Table 4-1 PSTs responses to the question: Why do you think the natural environment is important?

Themes	Categories	All PSTs Pre-test n=109(%)	All PSTs Post-test n=112(%)
Environment does something for people	Provisioning	16	22
	Support for life	28	26
	Cultural	14	10
	Economic value	10	0
	Health & Wellbeing	7	7
Environment as place	Place for animals	5	4
	Place for animals and plants	1	0
	Place for animals, plants, and humans	2	0
	Place for humans	3	6
People are part of the environment and are responsible for it		5(5)	8(7)
	Humans are responsible for environment	5	8
People and the environment are in mutually sustaining relationship	Ecosystems	0	6
	Biodiversity	0	3
	Interdependence	2	4
Environment and future perspective	Future generation	3	6
	Future use	4	5
Uncontextualized		9(8)	5(4)

Among these themes, support for life dominated PSTs' ideas on the importance of the natural environment, as it accounted for 37% and 40 % respectively of pre-test and post-test responses under the category 'Environment does something for people'. Some examples of responses placed in the theme *support for life* were:

The natural environment is important to help nurture the plant and animal life. Without natural environments, some plant and animal life may become extinct (Campus PST 24, pre-test)

Simply, without it, we could not survive, and a lot of other species would not survive either. It is essential to our lives (Online PST 2, post-test)

The next theme was *provisioning*, and it accounted for 22% of pre-test responses with a higher proportion (34%) observed in the post-test responses. Examples of responses classified in this theme were:

Without the natural environment, we will have no food, water, air or livelihood (Campus PST 36, post-test)

The natural environment provides us and other species/organisms with so many things (Online PST 4, post-test)

Responses associated with *economic value* were categorised as ‘environment doing something for people’. There was a notable reduction from 10 PSTs (pre-test) to none (post-test) in the number of PSTs who perceived the importance of the environment regarding its economic value upon completing the EE paper. For example, source of exports for NZ economy through natural products (Campus PST 10, pre-test)

Another theme that was prominent among the PSTs placed under the category ‘Environment does something for people’ was *cultural*. Responses in this study relating the importance of the environment to its spiritual, aesthetic and recreational advantages were placed in the theme, *cultural*. Examples are:

Because Māori see it as their Whakapapa/their relation, so as we respect our family members, so we too should respect our environment because we are connected to it (Online PST 35, pre-test)

...NZ beauty is because of its natural environment. It has stories to tell it is important to NZ culture and beliefs (Campus PST 46, pre-test)

...It is a source of pleasure in outdoor activities (Campus PST 52, pre-test)

In agreement with the study of Loughland et al. (2002), the PSTs tended to show a perception of the environment as relational, rather from an object perspective. In the latter view, only 11% (pre-test) and 9% (post-test) saw the importance of the environment as a *place where humans and animals live*. Findings thus indicate that most PSTs perceived the environment as a relationship between people and the

natural world. These findings were consistent before (pre-test) and after (post-test) completing the EE paper and among the different cohorts of PSTs.

Few responses were placed under the category, ‘people are part of the environment and are responsible for it’. Responses in this category recognised the impact of humans on the upkeep and damage of the natural environment, and a slight increase in this perception was observed after completing the EE paper (Pre-test - 4.6%; Post Test - 7 %). Examples of responses in this category were:

...It is the creation of God and humans have been entrusted with the responsibility of maintaining it so that all living beings can progress towards the ultimate goal of life (Online PST 9, pre-test)

I think it is important because if humans were to modify it, then what would happen, a major consequence would be global, affecting not just us but the whole planet (Online PST 18, post-test)

PSTs’ responses that related the importance of the environment to its *future use* and its benefit to *future generations* were categorised as ‘Environment and future perspective’. Responses that associated the importance of the environment to its *future use* were only observed among the online PSTs. An increase in the proportion of responses in this category was observed after completing the EE paper (Pre-test, 6.4%; post-test, 9.8%). Examples of responses in this category were:

We need to protect and preserve our natural environment for future generations (Campus PST 50 pre-test)

...and how we treat it can have a huge impact on our lives and for the future (Online PST 13 post-test)

Following the completion of the EE paper (post-test response analysis), themes such as *ecosystems* and *biodiversity* that were not present in the pre-test responses emerged. Although the theme *interdependence* was identified in both pre-test and post-test responses across the different cohorts of campus and online PSTs, there was a general increase in responses coded under this theme upon completing the EE paper (Table 4.1). All three themes that is, *interdependence*, *ecosystems*, and *biodiversity*, were categorised as ‘People and the environment are in mutually

sustaining relationship'. An increase from 2%, pre-test to 12% post-test was recorded. Classroom observations showed that the EE paper taken by the PSTs highlighted these concepts (Classroom observations 1, 2 and 3). On the whole, the findings indicate that PSTs showed a perception change in relation to the course content. Some responses, although reduced in proportion, 8% to 4% for pre-test and post-test, respectively were, however, grouped as *Uncontextualized* as it was difficult to fit these responses into the themes and categories that emerged upon analysis of PSTs responses.

A further thematic analysis of responses from all PSTs, when asked why they think the natural environment is important, categorised each response as expressing either mainly anthropocentric (human-centred) or ecocentric (environment-centred) conceptions (see Figure 4-2). A conception classified as theocentric (faith-centred) was also observed among some PSTs' responses, but only a small number in the pre-test and these were not present in the post-test. An anthropocentric conception was predominant among all PSTs before taking the EE paper (47%), and this further increased slightly after completing the EE paper (57%). Although an increase in PSTs' ecocentric conceptions was observed after completing the EE paper, this increase was small (4%). Not all the responses could be categorised in any of the three themes. These responses were thus grouped as *Uncontextualized*. Upon completing the EE paper, a reduction (7%) in the responses categorised as *Uncontextualized* was observed.

PST responses that were classified as anthropocentric took a human-centred view that emphasised the value of securing the resources needed for further development and that the environment should be protected because of its value in maintaining or enhancing the quality of human life. Examples of such PSTs' responses included:

...the natural environment feeds the economy because of the resources and tourism; we would be lost without it (Campus PST 20, pre-test)

The environment has been taking care of us such as food and shelter giving us the resources we need to live and survive on this earth (Online PST 32, post-test)

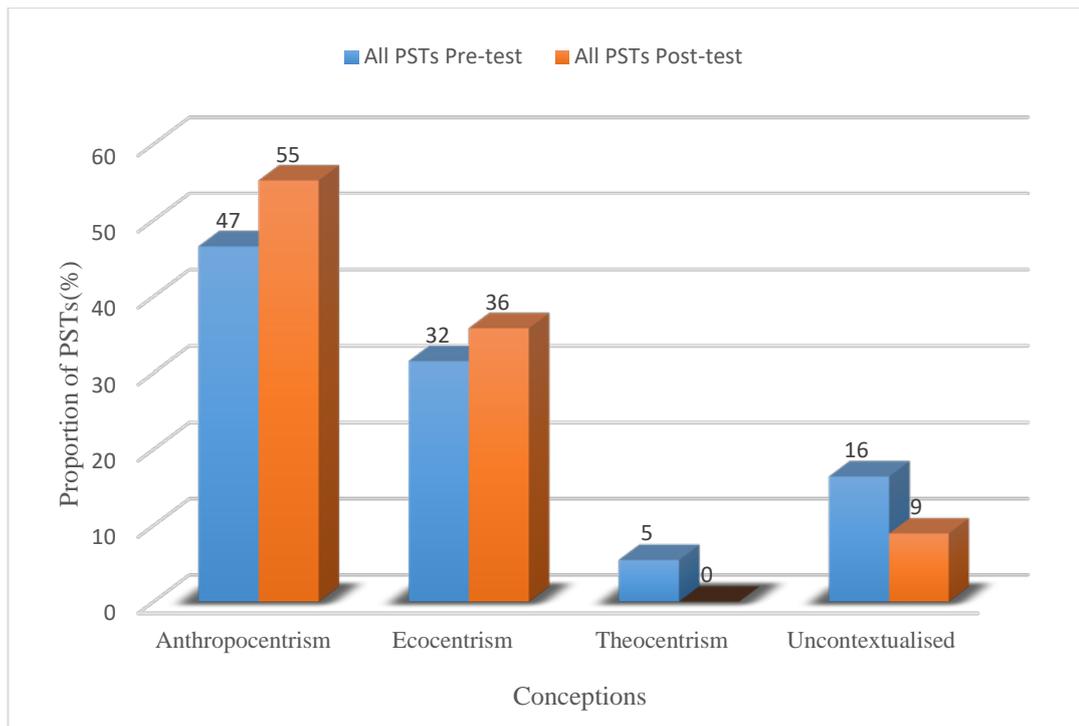


Figure 4-2 Conceptions induced from all PSTs' responses to the question: Why do you think the natural environment is important?

PSTs' responses that portrayed an ecocentered view, valuing nature for its sake and therefore, that it deserves protection because of its intrinsic value, were classified as an ecocentric view. Examples of such PSTs' responses included:

...NZ's environment is so beautiful and green (Campus PST 32, post-test)
 Not only because of its beauty but it caters to animals and insects (Campus PST 19, post-test)

The responses classified as being of a theocentric view considered the natural environment as important because it is God's creation. Examples of such PSTs' responses included:

Everything that God made has a purpose, and we need to respect that and take care of it, not take advantage of it. He (God) called us to be stewards of the land (Campus PST 8, pre-test)

It is the creation of God and humans have been entrusted with the responsibility of maintaining it so that all living beings can progress towards the ultimate goal of life (Online PST 9, pre-test).

These findings reveal that majority of the PSTs seem to hold anthropocentric conceptions of the importance of the natural environment upon completing the EE paper.

4.2.2 Pre-service teacher’s knowledge about sustainability

To assess PSTs’ knowledge about sustainability, questionnaires administered before and after completing the EE paper asked PSTs to rate their understanding of sustainability on a 10-point scale ranging from poor (1) to excellent (10) understanding. For analysis, a categorisation of these PSTs’ self-rating was done with ratings from 1 to 2 as poor understanding, 3 to 4 as rudimentary understanding, 5-6 as good understanding, 7-8 as very good understanding and 9 to 10 as excellent understanding. Analysis of PSTs’ self-rating clearly indicated an apparent increase in their understanding of sustainability upon completing the EE paper (see Figure 4-3).

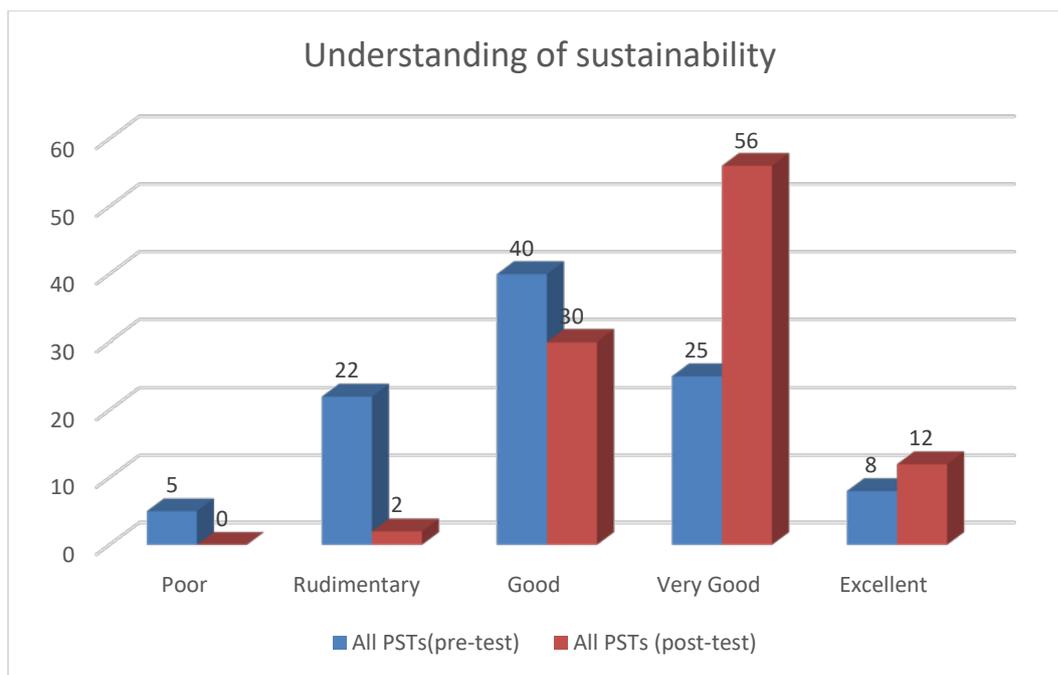


Figure 4-3 PSTs’ ratings of their understanding of sustainability (a) before and, (b) after completing the EE paper.

Prior to taking the EE paper, 27% of all PSTs rated their understanding of sustainability as either poor or rudimentary (5%-poor, 22%-fair). Upon completing the EE paper, no PST rated themselves as having a poor understanding, and only 2 % rated their understanding as rudimentary understanding. A 10% reduction in

the proportion of PSTs who rated themselves as having a good understanding and a corresponding doubled proportion of PSTs who rated themselves as having very good understanding was observed upon completing the EE paper.

A 4% increase in the proportion of PSTs who rated themselves as having excellent understanding was also observed. Considering PSTs on a separate cohort basis, each group shifted markedly between the pre- and post-tests despite the different patterns observed in the self-ratings of their understanding of sustainability. All Campus PSTs (100%) rated themselves as either having good to excellent understanding of sustainability as against 93% of the online PSTs who rated themselves as having good to an excellent understanding after completing the EE paper. At the other end of the scale, 27% of the campus PSTs rated themselves as having poor to rudimentary understanding prior to taking the EE paper and upon completing the EE paper, this proportion decreased to zero (0%). For the the online counterparts, 29% rated themselves as having poor to rudimentary understanding prior to taking the EE paper and upon completing the EE paper, 7% remained in this category. Thus, it appears that the Campus PSTs seemed to rate themselves as having more understanding of sustainability after completing the EE paper, compared to their online counterparts. On the whole, however, both cohorts through their self-ratings of their understanding of sustainability reveal substantial increases upon completing the EE paper.

To further assess PSTs' understanding of sustainability, an open-ended question, 'what does sustainability mean to you' was asked during the pre-test and post-test assessment. Their responses were thematically analysed in two different ways, first by assessing each response to identify PSTs' conceptions about sustainability and second, by exploring individual responses on the basis of the three aspects of sustainability namely; environment, social-cultural and economic. As each response often contained more than one conception, the total number of conceptions coded was consequently greater than the sample size (n=88).

At the initial stage of analysis, a general inductive approach was employed to capture adequately the categories emerging from the responses of PSTs to the questions asked. After a series of coding and recoding of the responses, sixteen

recurring categories (conceptions) were captured. Afterwards, the conceptions were placed into five themes partly informed by Summers et al. (2004). Although this study asked PSTs about their understanding of sustainability as against sustainable development in Summers et al. (2004), the themes that emerged share central elements and were found to be appropriate for use in the context of this study. Seven central elements (purpose, nature, human focus, time scale, geography scale, controversy and aesthetic) were developed when determining the understanding of sustainable development among pre-service science and geography teachers in Summers et al. (2004) study. In this study, however, PSTs responses associate well with four of the seven themes by Summers et al. (2004) namely: purpose, nature, human focus and time scale. Evidence for geography scale, controversy and aesthetic were absent in the analysis of PSTs responses. A novel conception, decision making, emerged from the responses of PSTs and was categorised as ‘process’ (the process of sustainability). Under the theme, ‘purpose of sustainability’, continuous flow and another conception termed ‘slogan’ were captured from PSTs’ responses which were not referred to in Summers et al. (2004) study (see Table 4-2).

The theme ‘nature of sustainability’ included PSTs’ responses that related their understanding of sustainability to its focus, using the three aspects of sustainability, namely, the environment, social-cultural, and economic. The next theme, ‘purpose of sustainability’ refers to PSTs’ ideas of what sustainability is for, and themes that emerged included resources, maintaining something, continuous flow, reducing negative impacts, being self-sufficient and a theme termed as ‘slogan’ was also grouped under the purpose of sustainability.

Upon completing the EE paper, there was the use of the phrase, “enough for all forever” among the Campus PSTs’ responses to the question asked. PSTs did not elaborate further on what they meant by the sentence, and so the sentence was categorised as ‘slogan’. From classroom observation of the EE paper, the phrase stemmed from the first EE lecture taken by the PSTs in which, in addition to the WCED definition of sustainability, sustainability was also defined as meaning ‘enough for all for ever’.

Table 4-2 Themes and contributing conceptions of sustainability captured from coding PSTs responses

Themes	Conceptions of sustainability from PSTs' responses	Examples of coded words from PSTs' responses
Nature	Environment	“environment” “nature” “planet”
	Social-cultural	“human health and well-being” “social” “cultural aspects”
	Economic	“comfortable existence” “economic value”
Purpose	Resources	“resources” “source” “materials”
	Maintaining something	“preserve” “look after” “maintain”
	Continuous flow	“continuous flow” “keep running”
	Reducing Negative Impact	“little ... damage” “won't harm” “not destroy”
	Self-sufficiency	“run itself”
	Benefits	“benefits”
	Sloganic	“enough for all forever”
Human Focus	Meeting people's needs	“meet our needs”
	Future generations	“future generations”
	Human population	“we” “people living here”
Timescale	Present	“now”
	Future	“tomorrow” “future”
Process	Decision making	“decisions” “choices”

The theme, ‘human focus’ was used for responses that specifically related understanding of sustainability to human population and/or their needs, for example, future generations, meeting the needs of people. ‘Timescale’ category refers to PSTs’ relating their understanding of sustainability to the present or future without attributing their understanding to humans. The last theme, ‘process of sustainability’ refers to PSTs’ conception of sustainability as involving making choices or making decisions. Under each of these themes: nature, purpose, human focus, timescale, and process, findings clearly established that environment, resources, future generations and future were mentioned more frequently than any other conception in these categories before and after completing the EE paper (see Figure 4-4).

In both pre-test and post-test, 'resources' was most frequently related to the purpose of sustainability (26 mentions during pre-test and 19 mentions during post-test) (Figure 4-4). The use of the word 'resources' as observed in the responses of PSTs was either related to environmental, social-cultural or economic aspects of sustainability. Examples of PSTs responses coded in this theme were:

...resources do not run out, sharing resources to others is key
(Online PST4, pre-test)

To continue to use resources/products for years to come
(Online PST36, pre-test)

...equation of not depleting a resource at a greater rate than...
(Campus PST7, post-test)

These findings were in concert with observations made during the focus group discussion held with a group of Campus PSTs after completing the EE paper. In the focus group discussion, PSTs were asked to define what sustainability meant to them. Six recurring themes (resources, reducing negative impact, future generation, continuous flow, sloganistic, and decision making) were captured from their responses. Out of these, 'resources' had the highest number of mentions (6 out of 9 mentions). An example of a PST's response to the question during the focus group discussion was that sustainability means 'responsible usage of resources, learning about how to make sure you leave it so that it can self-sustain, regrow and come back' (Focus group discussion, PST 8).

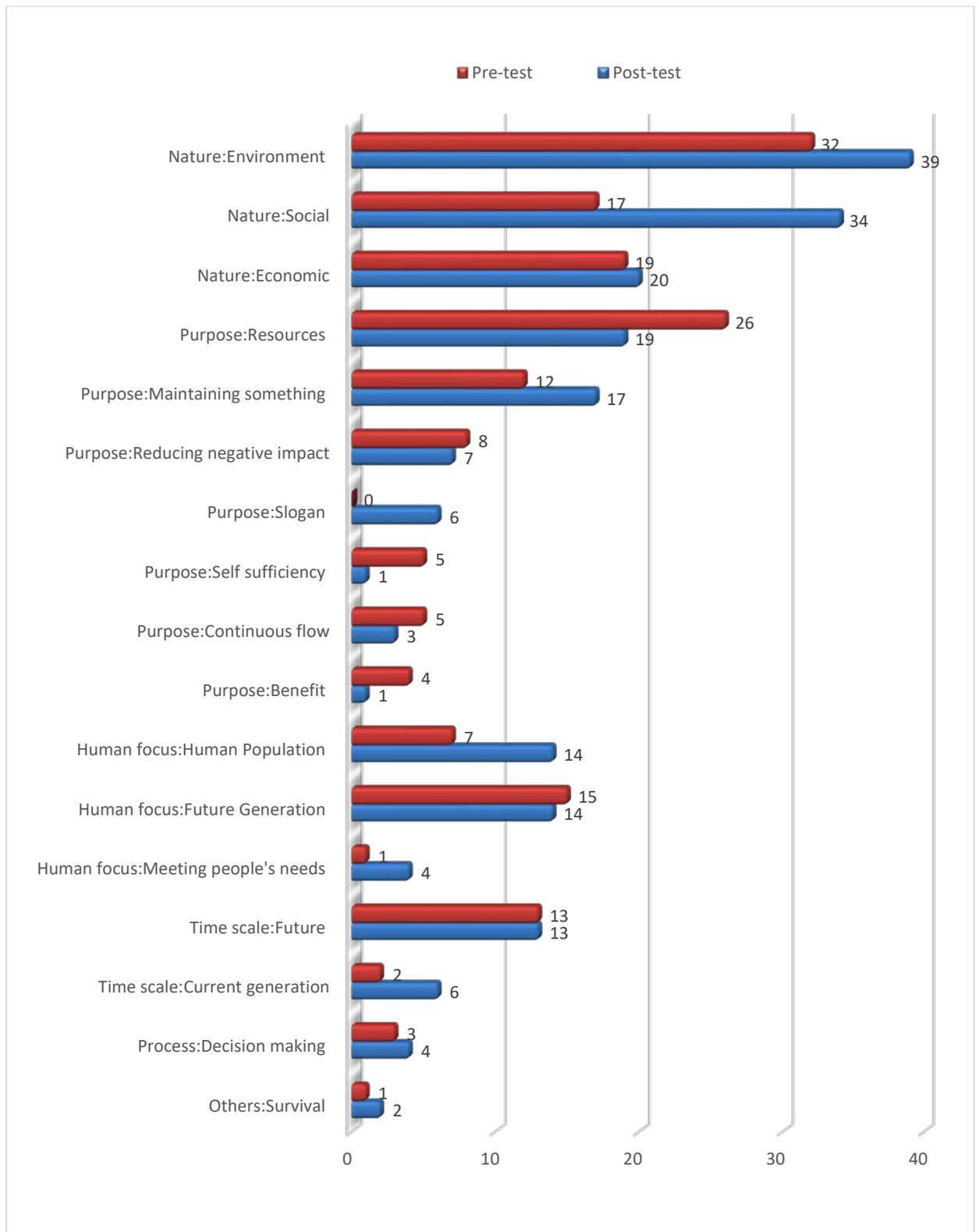


Figure 4-4 Frequency of occurrence of identified conceptions in PSTs’ pre-test and post-test responses (n=67)

The category ‘maintaining something’ had the next highest number of mentions (12 mentions during pre-test and 17 mentions during post-test) under the theme, ‘purpose’. Words coded under this theme included responses that had ‘caring for’, ‘looking after’, ‘preserving’. Some words coded under this theme just mentioned ‘maintain something’ but were not clear as to what was to be maintained. Such responses were not ignored as they depict a general dictionary definition of sustainability. Examples of responses coded under this category are:

Sustainability means looking after what we do have... (Campus PST24, pre-test)

Preserving things so they will last (Campus PST43, pre-test)

The conception, ‘future generations’ (15 mentions during pre-test and 14 mentions during post-test) was the third most frequently mentioned conception of sustainability under the theme, *Human focus*. Future generation was also the second most mentioned conception during the focus group discussion (5 out of 9 mentions). Examples of PSTs’ responses coded in this category were:

...for it to provide for future generations without harmful consequences (Online PST27, pre-test)

Having a resource for the future generation to continue using for... (Campus PST6 post-test)

...enough for others and for future generations (Online PST20, post-test)

PSTs’ understanding of sustainability solely related to the future was the most frequently mentioned conception under the theme *time scale*. Responses that had words like ‘tomorrow’ or ‘future’ were coded under this category, future. Examples of responses coded in this category were:

An environment for tomorrow... (Online PST19, post-test)

Taking care of the present so that it is there in the future ... (Campus PST32, post-test)

Overall, on PSTs’ conceptions of sustainability, a similar trend was observed in the different cohorts (campus and online) of PSTs. The only exception was the

emergence of responses termed as sloganistic among the campus PSTs upon completing the EE paper.

Workshop observation showed that the three aspects of sustainability (environment, social-cultural and economic) were emphasized in the EE lectures and workshops taken by PSTs (Workshop observations, July, 22nd, 29th 2015 & August 5th 2015). It was thus of interest to explore the extent to which these PSTs were able to relate their understanding of sustainability to any of these aspects. This was achieved by analysing their responses to the question: what does sustainability mean to you? While the initial analysis of the open-ended question (what does sustainability mean to you?) indicated the frequencies of environmental, social-cultural and economic aspects (under the theme, nature of sustainability) across the responses taken together as a whole (see Figure 4-4), it says nothing about the extent to which individual responses were recognizing all three factors or some combination of them. Each PST's response was placed in a segment of a Venn diagram to show whether environmental, economic and social-cultural aspects of sustainability were present (see Figure 4-5). Some PSTs' responses contained no mention of any of the three aspects of sustainability under consideration and so were not coded on the Venn diagram. They were grouped under a theme termed unrelated. Responses such as 'not sure', 'everything' were also grouped under this theme. It was notable, however, to observe a decrease in responses under this theme after completing the EE paper (pre-test; 11 responses, post-test-3 responses)

Responses illustrating this coding are as follows:

Conserving the environment to a steady level while balancing with economic development getting the two to work together (Environment and Economic-Online PST27, pre-test)

Living in a way that is sustainable for now and future generations. Taking care of our planet to ensure survival of its natural resources and people using them (Environment and Social- Campus PST15, post-test)

Reduce, Reuse, Recycle. Conserving water, power, gas, etc. It also means working together (Economic and social-cultural- Campus PST52, pre-test)

Sustainability is a heavily laden term to me, it means living a balanced life. Balanced in what I take and give back, environmentally, socio-culturally and economically (Environment, Economic and Social-Cultural-Campus PST52, post-test).

All the PSTs made mention of at least one of these aspects of sustainability (Figure 4-5). Analysis of the pre-test responses indicated that ‘environment’ was the most common conception (22 sole mentions) and also had the most number of mentions in the interrelated categories (10 mentions). ‘Economics’ was the second most mentioned conception (13 sole mentions), with a high proportion of mentions also in the interrelated categories (19 mentions).

Although the environment remained the most identified conception in the sole (26 mentions) and interrelated categories (13 mentions) after completing the EE paper, an increase in the number of mentions of the conception ‘social’ in the sole categories (24 mentions in post-test as against 11 mentions in pre-test) was observed among the PSTs. A salient finding from PSTs’ responses for both cohorts (campus and online PSTs) indicated that the interconnection of social-cultural and economic aspects of sustainability was poorly reflected before and after completion of the EE paper (Pre-test -1 mention, Post-test – no mention). Examining the central segment of the Venn diagram for both pre-test and post-test, a notable observation was made among PSTs’ responses. During the pre-test analysis of PSTs’ responses, no response could be placed in the central segment for both campus and online PSTs. However, upon completing the EE paper, five responses from the campus PSTs reflected interrelationships between the three aspects of sustainability and hence were placed in the central segment. This supports the view that there seemed to be a greater understanding of the complexity of sustainability, based on responses that reflect a combination of environmental, economic and social-cultural considerations, among the campus PSTs than their online counterparts.



Figure 4-5 Numbers of individual responses mentioning any or various combinations of environmental, economic or social-cultural factors (CPSTs is campus PSTs, OPSTs is online PSTs).

4.2.3 Pre-service teachers' knowledge of environmental and sustainability concepts

To assess PSTs' knowledge of some selected environmental and sustainability concepts, questionnaires administered before and after completing the EE paper had a section with five environmental knowledge (EK) questions (See Appendix A). Four of the questions used for this assessment were specifically designed to highlight some of the topics covered in the EE paper taken by PSTs. These questions were related to ecosystem services (EK question 1), an example of a sustainable approach (EK question 2), the effect of bee decline (EK question 3), and consumption and waste (EK question 5). A question on water pollution (EK question 4) that was not directly covered in the EE paper was also included. The inclusion of this latter question was perceived to be very relevant to the local context given the prevalence of water pollution issues in the region (Ballantine & Davies-Colley, 2014). The environmental knowledge section comprised multiple-choice questions with five possible options. For each question, three options that would be considered not to represent sustainability were coded as incorrect and scored as -1, one option considered to represent sustainability was coded as correct and scored as 1, while a 'don't know' option was scored as 0. The scoring was done to capture the overall extent of sustainability thinking of PSTs' choices. Thus, a shift towards more positive values indicates that more questions were answered with sustainable thinking, while a tilt towards negative values shows that more questions were answered with unsustainable thinking. The non-response rate was very low as only 4% of all the PSTs did not provide an answer to the environmental knowledge questions asked. Non-responses were therefore exempted from the analysis.

Three approaches were used to analyse PSTs' environmental knowledge of the selected concepts: (i) Calculation of the proportion of all pre-test and post-test answer choices (incorrect, don't know and correct) for each of the five EK questions used to assess the change in PSTs' answer choices prior to and upon completing the EE paper. (ii) Classification of PSTs' answer choices into groups based on the total number of EK questions answered correctly to assess PSTs' overall environmental knowledge of the selected concepts, and (iii) Calculation of mean, standard deviations and statistical significance of differences in knowledge means scores for each EK question. These three aspects are reported in turn.

Analysis of all PSTs' pre-test and post-test answer choices to each of the five EK questions indicated a general increase in the proportion of correct answer choices after completing the EE paper (see Figure 4-6 and Table 4-3). PSTs' answer choices to EK questions related to examples of sustainable approach, effect of bee decline and water pollution showed a reduction in the proportion of PSTs who chose the 'don't know' option upon completing the EE paper (Figure 4-6), percentage reduction observed were 7%, 5% and 19% respectively (Table 4-3).

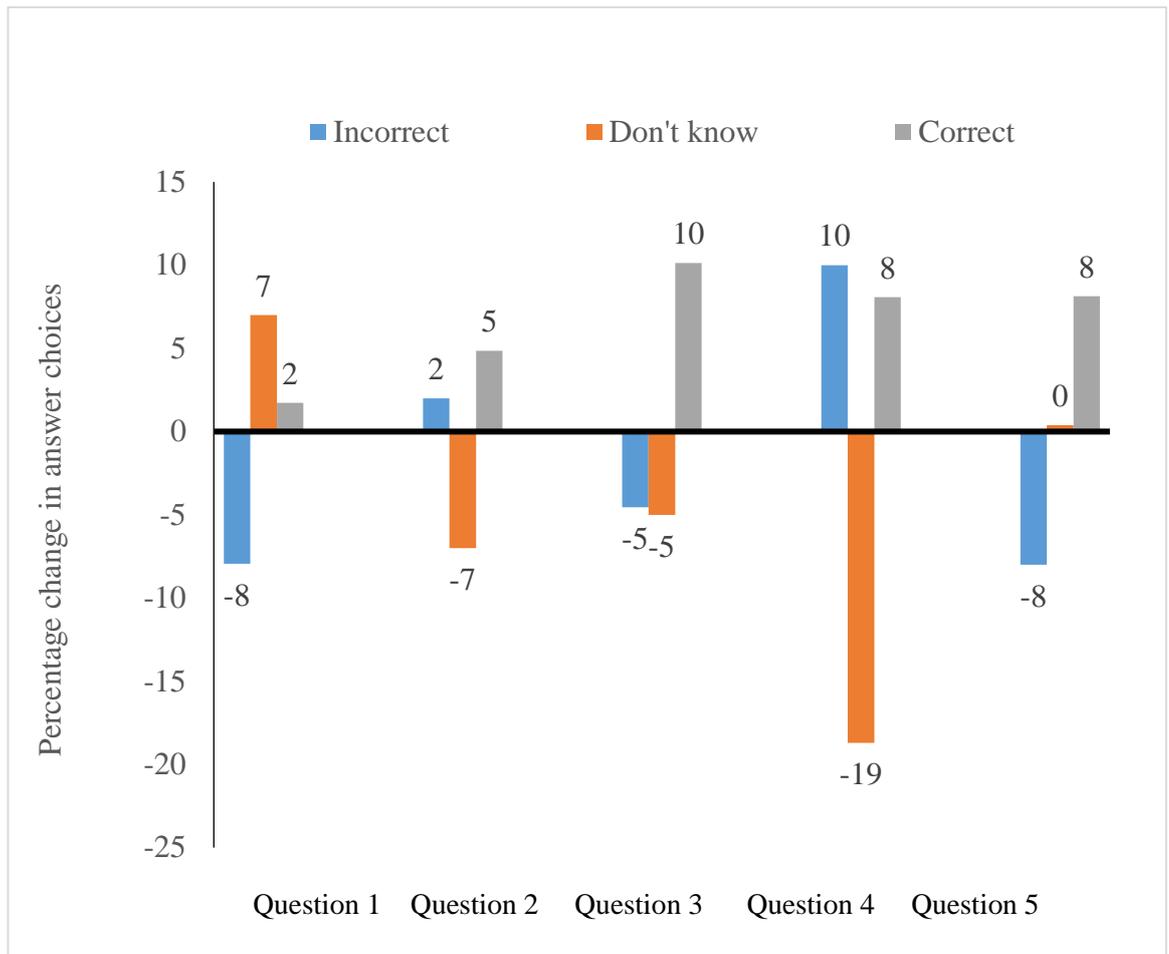


Figure 4-6 Observed changes (frequency) in PSTs answer choices to EK questions before and after completing the EE paper (post-test answer choices - pre-test answer choices)

The proportion of PSTs who chose the 'don't know' option to EK question on consumption and waste, prior to and upon completing the EE paper remained the same (8%). Hence no change was recorded. Still, in the category of PSTs who chose the 'don't know' option prior to and upon completing the EE paper, a 2% increase,

solely contributed to by the campus PSTs to question about ecosystem services was observed. An increase in the proportion of incorrect answer choices, 2%, and 10% respectively, was observed upon completing the EE paper with questions on sustainable approach and water pollution (Table 4-3).

Table 4-3 Frequencies and percentages of PST pre-test and post-test answer choices to environmental knowledge (%)

Environmental Knowledge questions (EK questions)		Correct (%)		Incorrect (%)		Don't know (%)	
		Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Which of the following services do New Zealand native forest ecosystems NOT provide? (n=88)	All PSTs	48	50	17	9	34	41
	Campus	39	37	24	12	37	51
	Online	61	67	8	6	31	26
Which of the following is an example of a sustainable approach? (n=87)	All PSTs	76	81	6	8	18	11
	Campus	78	75	4	10	18	16
	Online	72	81	8	6	19	3
What would happen if all the bees in New Zealand disappeared? (n=87)	All PSTs	85	95	6	1	9	4
	Campus	82	94	8	2	10	4
	Online	89	86	3	0	8	3
Which of the water pollutants from dairy farming in New Zealand can be controlled by the farmers fencing? (n=87)	All PSTs	43	51	21	31	37	18
	Campus	35	45	20	33	45	22
	Online	53	53	22	28	25	13
Of the following, which contributes the most to sustainability? (n=87)	All PSTs	44	52	48	40	8	8
	Campus	29	41	59	47	12	12
	Online	64	61	33	28	3	3

In terms of change towards increased environmental knowledge (i.e., reduction in proportions of incorrect and 'don't know' answer choices as well as increase in correct answer choices) observed among all PSTs prior to and upon completing the EE paper, questions related to ecosystem services and the example of sustainable approach reflected relatively least change (Figure 4-6). The highest level of change towards increased environmental knowledge was associated with the question on

effect of bee decline (Figure 4-6), which asked PSTs what would happen if all the bees in New Zealand disappeared. A 10% increase (Pre-test, 74 PSTs; Post-test, 79 PSTs) in the proportion of PSTs who chose the correct option upon completing the EE paper was observed. This was coupled with a 5% reduction in the proportions of PSTs who chose incorrect and 5% reduction in the proportion of those who chose 'don't know' options were observed (Table 4-3). From classroom observation (Workshop observation 2) the workshop tutor gave the PSTs the opportunity to watch an enlightening TEDx talk on bees and their roles in food production, in an attempt to broaden PSTs' knowledge of bees. These findings on PSTs' increased knowledge of the effect of bee decline are also in concert with observations made during the focus group discussion when PSTs were asked to share any memorable part of the EE paper and what they learned from the paper. Some the PSTs stated that topics about bees covered during the EE lecture and workshop were the most memorable. Their comments included:

For me, it is the bees, learning about them ... (PST1)

It made me more aware of the things around like the bees. I started noticing the bees around where before I did not really (PST6)

The focus group responses and findings from questionnaire answer choices indicate that the EE paper in some ways influenced PSTs' knowledge of bee decline and their role in food production.

Upon completing the EE paper, PSTs' answer choices to the question on consumption and waste indicated an 8% increase in the proportion of PSTs who chose the correct answer coupled with a 9% reduction in incorrect options. No change in the proportion (12%) of PSTs who chose 'don't know' was observed for both pre-test and post-test. During one of the workshops, PSTs had discussions about the hierarchical nature of the commonly used acronym, '3 Rs' (*which stands for Reduce, Reuse, Recycle*) associated with consumption and waste. 'Reduce' was deliberated on as being the most sustainable approach among the three (Workshop Observation 3). It is, therefore, interesting to observe an increase in the proportion of PSTs that chose the correct option upon completing the EE paper and a reduction in incorrect answer choices, although no change in the proportion of PSTs who

chose the don't know option was observed. As indicated in Section 4.2.2, prior to and upon completing the EE paper, responses to the open-ended question, what does sustainability mean to you, suggested the uncertainty in PSTs' knowledge about the commonly used acronym prior to taking the EE paper. Some of the pre-test respondents who defined sustainability in relation to resource use gave examples like '*...it also means re-use, reduce, recycle*' (PST 47, campus pre-test), '*it means reuse, recycle, reduce...*' (PST 49, campus pre-test). However, upon completing the EE paper, PSTs who gave such responses to the same open-ended question referred to the 3Rs in the right order: *reduce, reuse, and recycle*.

Comparing both cohorts of PSTs, the percentage increase of correct answer choices to the EK question which asked about what contributes the most to sustainability, was more pronounced among campus PSTs than their online counterparts (see Table 4-3). From PSTs' answer choices, they seem to be knowledgeable about an example of sustainable approaches and bee decline prior to taking the EE paper. However, upon completing the EE paper, an increase was observed with PSTs' knowledge of bee decline. A slight increase in PSTs' knowledge of an example of sustainable approaches was also observed. On the other hand, prior to taking the EE paper, PSTs had relatively low knowledge of ecosystem services, water pollution and consumption and waste. Upon completing the EE paper, only slight increases in PSTs' knowledge of these areas were observed and these increases were not statistically significant. On a cohort basis, the online PSTs appeared to be more knowledgeable on the specified environmental and sustainability issues than their campus counterparts.

To assess the overall environmental knowledge of PSTs prior to and upon completing the EE paper, the number of correct answer choices for each PST were scored and classified as either acceptable or unacceptable, in line with previously published literature (Coyle, 2005; Kaplowitz & Levine, 2005). The proportions of all PSTs per score is presented in Table 4-4. Prior to completing the EE paper, 42% of PSTs had acceptable levels of environmental knowledge while upon completing the EE paper, about half (51%) of PSTs demonstrated an acceptable knowledge of selected environmental concepts based on the NEETF (The national environmental education and training foundation) and Roper grading scale. For this study, the

environmental knowledge of PSTs is measured using grading scale utilised by NEETF and Roper (2001). The NEETF and Roper survey which presented their survey result as a report card calculate letter grades based on respondents' percentage of correct answers. NEETF and Roper's survey categorised scores of greater than 70% (grades A, B, and C) as passing scores, measures of adequate environmental knowledge. Scores below 69% (D or F) were regarded as inadequate levels of environmental knowledge.

Table 4-4 All PSTs scores for environmental knowledge questions

No of questions answered correctly	Percentage score (%)	Proportion of all PSTs per score (%)		Grading of scores
		Pre-test	Post-test	
5	100	11	19	Acceptable
4	80	31	32	Acceptable
3	60	24	26	Unacceptable
2 and below	40 and below	34	23	Unacceptable

From a statistical point of view, however, it was necessary to investigate if the observed increases in knowledge of environment and sustainability concepts were significant or not. To achieve this, mean, standard deviations and statistical significance of differences were calculated between pre-test and post-test knowledge means scores for each of the five EK questions. These are presented in Table 4-5. Increases in the mean scores of all EK questions, except the question related to water pollution were observed (Table 4-5).

Comparing the different cohorts, the mean EK score for campus PSTs was 11.65 with a standard deviation of 2.56 while the mean EK score for online PST was 11.92 with a standard deviation of 3.90. However, only the EK question associated with bee decline was statistically significant at 95% confidence levels upon completing the EE paper ($M= 2.94$, $SD = 0.289$) as compared to before taking the EE paper ($M= 2.79$, $SD = 0.531$), $t(87) = 2.23$, $p = .027$ (Table 4-5).

Table 4-5 Mean, standard deviations and statistical significance of differences

Item No.	Question	Pre-test		Post-test		t	p-value
		Mean	SD	Mean	SD		
1	Which of the following services do New Zealand native forest ecosystems NOT provide	2.31	.752	2.41	.658	.899	.370
2	Which of the following is an example of a sustainable approach	2.70	.573	2.72	.611	.239	.811
3	What would happen if all the bees in New Zealand disappeared?	2.79	.531	2.94	.289	2.23	.027*
4	Which of the water pollutants from dairy farming in New Zealand can be controlled by the farmers fencing	2.22	.769	2.19	.890	.201	.841
5	Of the following, which contributes the most to sustainability?	1.95	.963	2.12	.955	1.13	.260

* Significant at $p < 0.05$

Additionally, to control for the possibility of prior knowledge having undue influence on PSTs' environmental knowledge observable upon completing the paper, a one-way ANCOVA was conducted to determine if there was an overall statistically significant difference in post-test scores between the different cohorts of PSTs, once their means had been adjusted for pre-test scores. However, no statistically significant difference in post-test scores on the different cohorts was observed after controlling for pre-test for the environmental knowledge questions, $F(1, 86) = .457, p < .05$.

4.2.4 Pre-service teachers' perceived knowledge

PSTs' self-reported level of perceived knowledge on seven environmental and sustainability issues: water pollution (Question 40), climate change (Question 41), consumption and waste (Question 42), endangered species (Question 43), child poverty (Question 44), racial discrimination (Question 45), and bee decline

(Question 46) in New Zealand was also examined. A 5-point Likert-type scale (1=very uninformed to 5=very informed) was employed.

Prior to completing the EE paper, a high proportion of PSTs rated themselves as either informed or very informed on the two environmental and sustainability issues not included in the EK questions: child poverty (Pre-test-71%) and racial discrimination (Pre-test-61%) (See Figure 4-7).

Upon completing the EE paper, no change was observed in the proportion of PSTs who were either informed or very informed on child poverty (Post-test-71%) while a reduction in the proportion of PSTs either informed or very informed was observed for racial discrimination (Post-test-51%) (Figure 4-7). On the contrary, prior to completing the EE paper, less than half of the PSTs rated themselves as informed/very informed on the remaining five of the seven environmental and sustainability issues specified (water pollution, climate change, consumption and waste, endangered species and bee decline). Upon completing the EE paper however, PSTs' self-reported level of information on these five environmental and sustainability issues increased: water pollution (Pre-test-40%, Post-test-47%), climate change (Pre-test-49%, Post-test-60%), consumption and waste (Pre-test-47%, Post-test-59%), endangered species (Pre-test-54%, Post-test-67%) and bee decline (Pre-test-36%, Post-test-80%). Among the observed increases in PSTs' level of information of the five-mentioned environmental and sustainability issues, only increases in PSTs' level of information on consumption and waste and bee decline, were observed to be statistically significant (see Table 4-6).

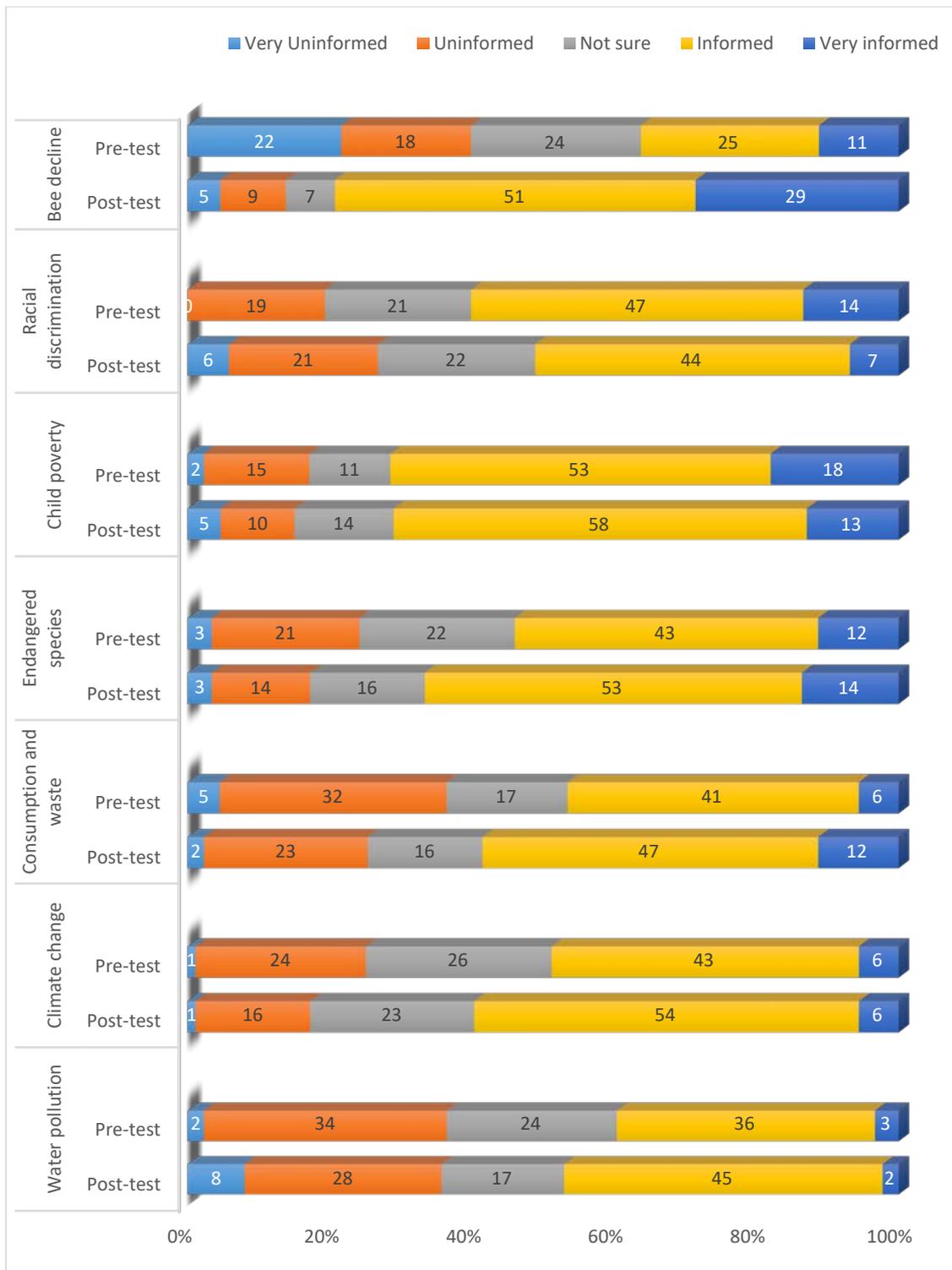


Figure 4-7 PSTs' environmental information prior to and upon completing the EE paper (n = 88 [pre-test], n = 87 [post-test])

Table 4-6 Independent t-test comparing PSTs' pre-and post-test environmental information scores

Environmental sustainability issues	and	Pre-test		Post-test		t	p-value
		Mean	SD	Mean	SD		
Water pollution		3.05	0.97	3.06	1.071	-0.078	0.938
Climate change		3.28	0.934	3.47	0.874	-1.369	0.173
Consumption and waste		3.11	1.066	3.43	1.041	-1.956	0.052*
Endangered species		3.38	1.048	3.6	1.005	-1.403	0.163
Child poverty		3.7	1.008	3.66	0.998	0.326	0.745
Racial discrimination		3.55	0.958	3.26	1.054	1.898	0.059
Bee decline		2.86	1.323	3.9	1.068	-5.678	0*

*Statistically significant at $p > 0.05$, $n = 88$ (pre-test), $n = 87$ (post-test)

These findings again resonate with earlier findings that the increase in PSTs' knowledge about the two chief environmental and sustainability issues discussed in the EE paper, consumption and waste and bee decline, may have been due to their learning in the paper. The EE paper also appeared to have increased the PSTs' informed status but not significantly on the other environmental and sustainability issues specified.

4.2.5 Section summary

Overall, prior to taking the EE paper, a high proportion of PSTs' rated their understanding of the natural environment as good. Upon completing the EE paper, a major shift towards a very good understanding of the natural environment was observed across the two cohorts of PSTs. The EE paper completed seem to broaden their perceptions of the importance of the natural environment especially in relation to the course content. PSTs were able to demonstrate their improved understanding of the natural environment by their responses to the open-ended question asked. For example, upon completing the EE paper, PSTs were able to link the importance of the natural environment to new concepts such as *ecosystem* and *biodiversity*. However, an anthropocentric conception of the natural environment was still predominant among the PSTs upon completing the EE paper.

Substantial increases in PSTs' understanding of sustainability were observed upon completing the EE paper. In both pre-test and post-test, PSTs' definitions of sustainability were more related to the *environment, resources, future generations, and future*. A novel observation from PSTs' definitions of sustainability was relating sustainability to a process, involving decision making. Upon completing the EE paper PSTs were also able to define sustainability in respect of its three aspects (environmental, socio-cultural and economic) and their interrelationships, as taught in the EE paper taken by PSTs.

From PSTs' answer choices to the environmental knowledge questions asked and even their self-rating of their informed status, significant increases in PSTs' knowledge was principally associated with the two key environmental and sustainability issues discussed in the EE paper, consumption and waste, and bee decline. This may have been due to their learning in the paper. Although slight increases were observed in PSTs' knowledge of the other environmental and sustainability issues specified, these increases were not significant. This finding could imply that PSTs were not able to relate the knowledge gained to other areas. In summary, using a grading scale previously used by researchers to assess PSTs' environmental knowledge (NEETF and Roper survey), prior to taking the EE paper, less than half (42%) of the PSTs had an acceptable level of environmental knowledge. Upon completing the EE paper, slightly above half (51%) of the PSTs demonstrated an acceptable level of environmental knowledge based on the environmental knowledge questions used in this study.

4.3 Impact on Pre-service teachers' environmental affect

This section presents findings on PSTs' environmental affect and environmental concern on selected environmental and sustainability issues. As influencers of environmental literacy in schools, PSTs need to believe in their ability to promote environmental literacy and to nurture that of their future students. Consequently, the environmental affect section of the questionnaire included three components. The first two components comprised of statements which focused on PSTs' locus of control (Questions 8-10, see Appendix A) and personal responsibility (Questions 11-12, see Appendix A), while the third component had statements exploring the

PSTs' environmental worldviews (Questions 13-19, see Appendix A). These statements were adapted from the NEP scale (Dunlap et al., 2000). In all, the environmental affect section of the questionnaire comprised of 11 statements to which the PSTs could state their extent of agreement, based on a 5-point Likert-type scale (1= strongly disagree, 2=disagree, 3= undecided, 4=agree, 5=strongly agree). The environmental affect section had a Cronbach's alpha reliability coefficient of 0.69, suggesting that the items have high internal consistency. Findings from each of these components of PSTs' environmental affect are presented in turn.

4.3.1 Locus of control

Prior to completing the EE paper, PSTs overwhelmingly agreed (51% agreed, and 41% strongly agreed) that they could contribute to the quality of the environment through their personal behaviour (Question 8). Although the proportion of those who agreed remained unchanged upon completing the EE paper, there was more inclination towards strongly agreeing to the statement upon completing the paper (Figure 4-8). It is interesting to observe that prior to and upon completing the EE paper, no PST strongly disagreed that they can contribute to the quality of the environment through their personal behaviour.

The next statement on the locus of control posited that even if a PST conserves water, electricity or purchases environmentally friendly products, it won't make a difference if others don't do the same (Question 9). Prior to completing the EE paper, about half of the PSTs (52%) either strongly disagreed or did not agree with this statement while this proportion increased slightly to 56% upon completing the EE paper. The percentage of those who were undecided or agreed with the statement also reduced slightly upon completing the EE paper (undecided - 2%; agreed - 4%).

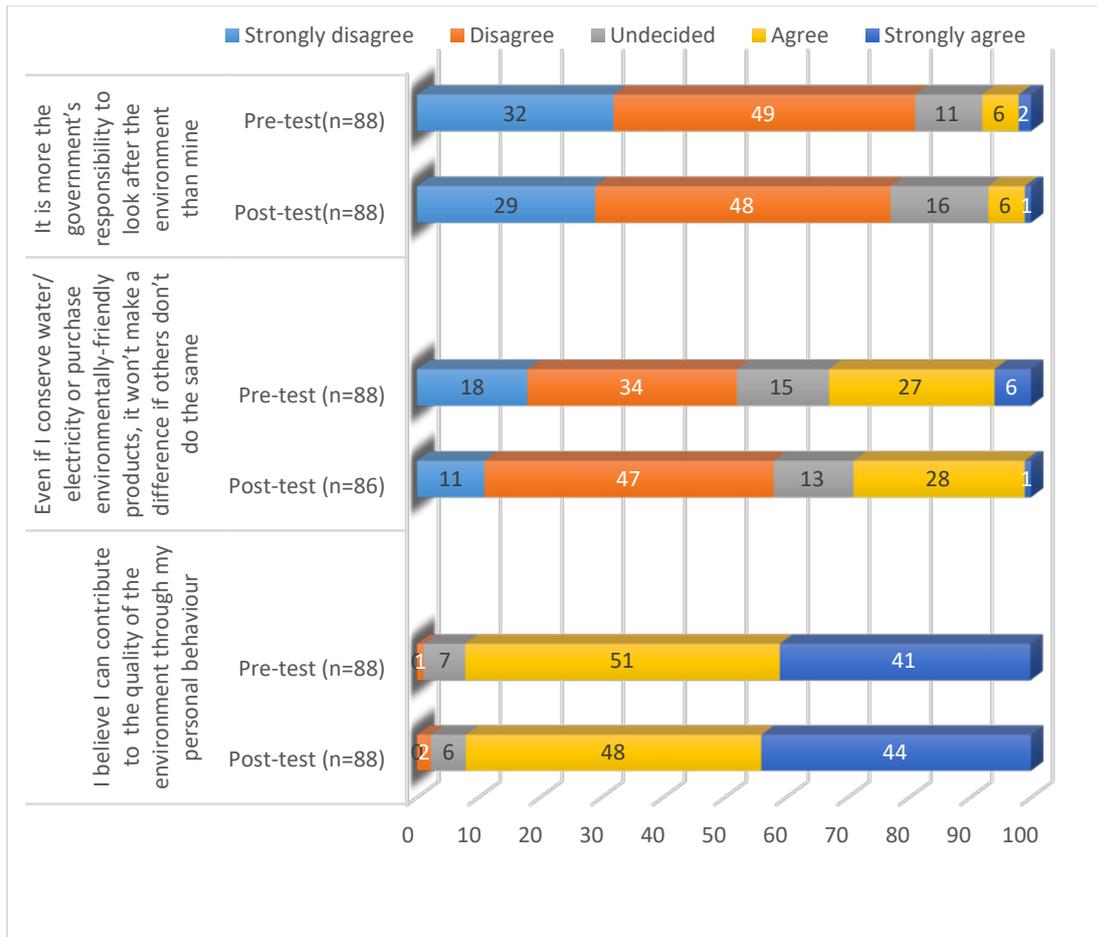


Figure 4-8 PSTs' locus of control prior to and upon completing the EE paper

Analysis of responses collected from PSTs after completing the EE paper indicated that PSTs demonstrated self-awareness of the impact they can make towards the quality of the environment. However, when the questionnaire statement posited that it's more of the government's responsibility to look after the environment than the PST respondent (Question 10), prior to taking the EE paper, 81% of PSTs either strongly disagreed or did not agree with the statement. Upon completing the EE paper, minor changes (4% reduction) were observed in the views of PSTs about government responsibility coupled with a slight increase in the proportion of PSTs who were undecided (5%) after completing the EE paper. Data from the focus group discussion supported this finding of general agreement with the role of the government to look after the environment and some indecision. Participants were asked: In your personal life, do you think you can make a difference that might contribute to the quality of the environment? The following extract illustrates a range of thinking:

PST1: For me, that's why I am wanting to do this conjoint environmental planning, because as I actually said in my assignment I want to basically help the community and I don't understand why we are not planting fruit trees in local parks and more of communal effect, even things like sidewalks, why just grass? There are no opportunities to have trees providing fruits, and vegetables.

PST8: To me, it's controversial. I know we have spent the whole time learning how we can make a difference individually but realistically I think it needs to change at the government level, and I think they are going to change when things get really bad... So for me, I think it needs to be the big picture.

PST1: My counter, thanks for that, though I think for that though is the government is owned by all of us, spending the money, and you are not going to get change with the government, and it needs to be collective.

PST9: But you are not going to get that big collective amount of people because not many people care.

PST1: But that's what we should be doing as teachers.

PST8: That's why I recommend it has to be drastic impact before something is going to change

PST2: But something tells me that nothing drastic is going to change in [this city].

PST8: ... I think that it needs to become way bigger scale and many more people, and contacting the people who can make a change a difference.

These findings reveal that despite PSTs' acknowledgement of their individual roles in making a difference towards the quality of the environment, some still feel that to make a difference there must be the involvement of some 'powerful others' such as the government.

4.3.2 Personal responsibility

PSTs were asked if they feel responsible for any part played in contributing to environmental problems in their community (Question 11). Prior to taking the EE

paper, 75% of the PSTs agreed with the statement and upon completing the EE paper, the proportion of PSTs who agreed with the statement increased by 6% (see Figure 4-9). There were small changes to the proportion of PSTs who were undecided prior to completing the EE paper (5% reduction) and of those who either strongly disagreed or disagreed prior to completing the EE paper (25% reduction)

Apart from feeling responsible for contributing to environmental problems, PSTs were also asked if they felt responsible for contributing to solutions to environmental problems (Question 12). Prior to completing the EE paper, over one-third (39%) of PSTs were undecided in their response to this statement. The proportion of PSTs who reported feeling undecided reduced by 6% upon completing the EE paper with a concurrent rise in the PST population who either strongly agreed or agreed with this statement (pre-test-52%, post-test-59%). These findings suggest a slight shift over the duration of the paper towards feelings of responsibility for the problems and solutions to the environmental issues in our community.

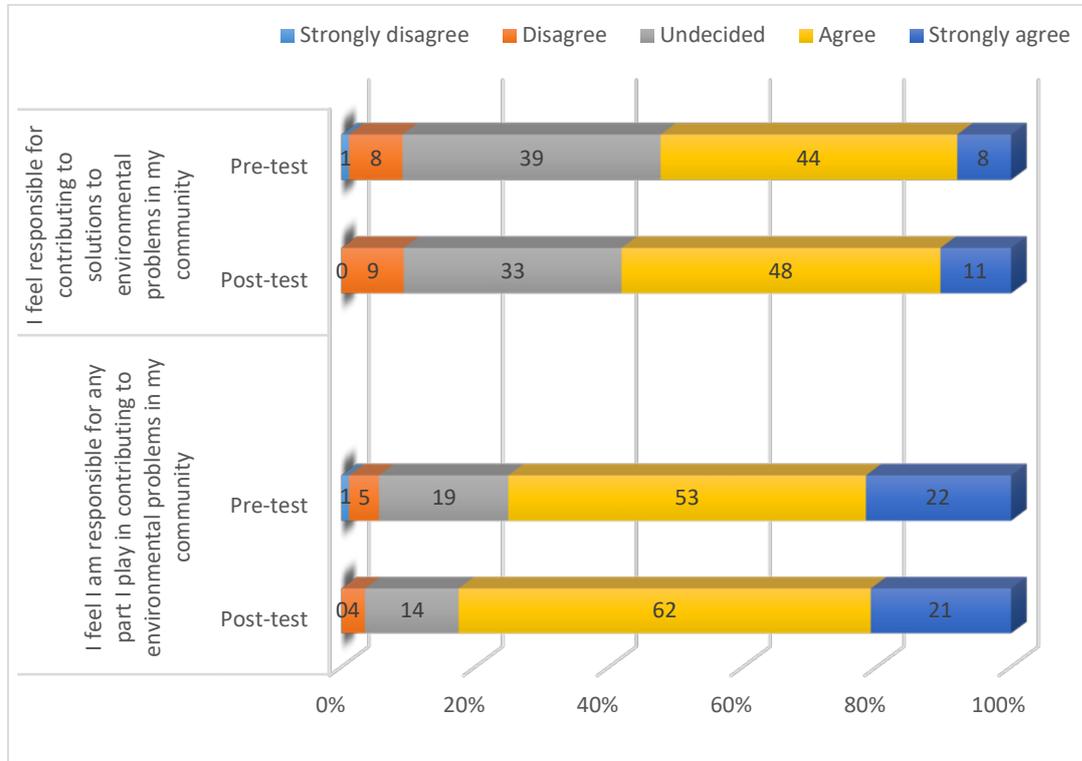


Figure 4-9 PSTs’ personal responsibility prior to and upon completing the EE paper

4.3.3 Environmental worldviews

Statements assessing the PSTs' environmental worldviews using items adapted from the NEP scale represented stances related to anti-anthropocentrism (two statements), balance (three statements), limits (one statement) (Dunlap et al., 2000) and a statement assessing PSTs' stance on economic growth and environmental quality. The first statement assessing PSTs' stance on the concept of anti-anthropocentrism was, 'plants and animals have as much right as humans to exist' (Question 14). Prior to completing the EE paper, a majority of the PSTs agreed (40% agreed, and 49% strongly agreed) to the statement. Upon completing the EE paper, the proportion of this category remained the same (89%). However, more of the PSTs shifted to the strongly agreed (33% agreed and 56% strongly agreed) (Figure 4-10).

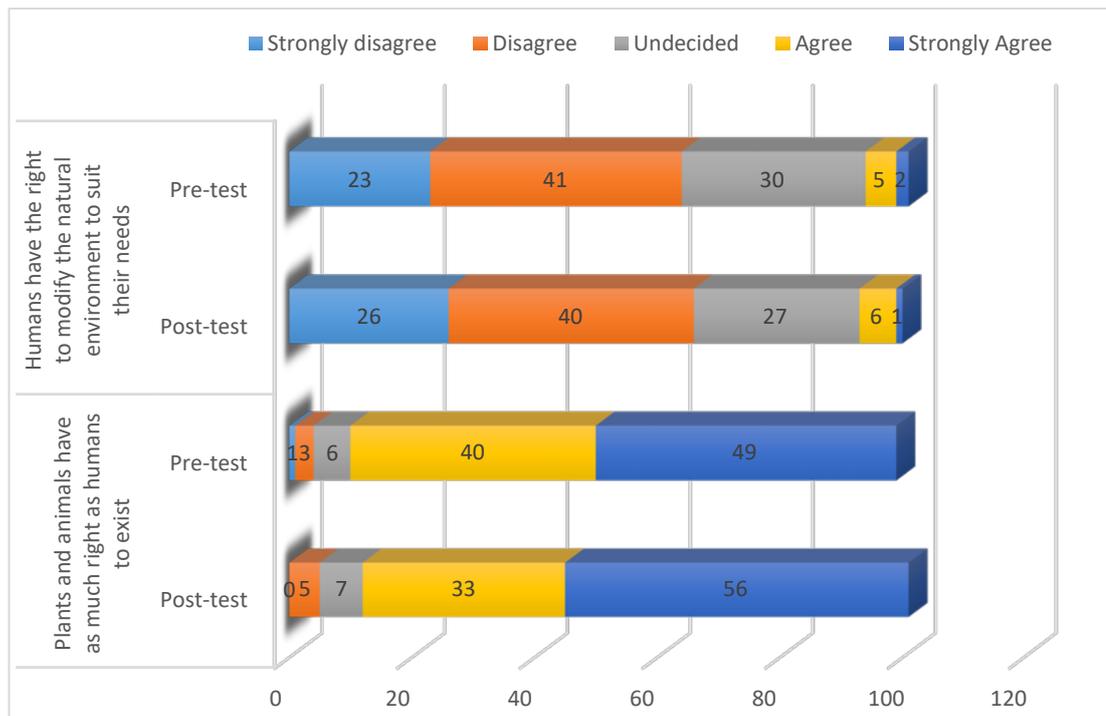


Figure 4-10 Percentages of PSTs' responses to anthropocentrism statements (environmental worldview) prior to and upon completing the EE paper

The second statement 'humans have the right to modify the natural environment to suit their needs' (Question 17), also probed PSTs' stance on anthropocentrism. Prior to completing the EE paper, two-thirds (64%) of the PSTs either disagreed or strongly disagreed with the statement, while upon completing the EE paper, a minor

(2%) increase was observed in the proportion of PSTs that disagreed with the statement. Almost one-third of the PSTs were undecided (30%) prior to completing the EE paper and upon completing the EE paper, a slight reduction of 3% was observed (27%).

Findings from these responses indicate that although many PSTs seem to hold more pro-environmental views than anthropocentric views, there are some who are unsure and experiences in the EE paper did little to change the proportion of these views. The PSTs also seemed to demonstrate mainly pro-environmental views based on their response to the three statements on balance (Figure 4-11).

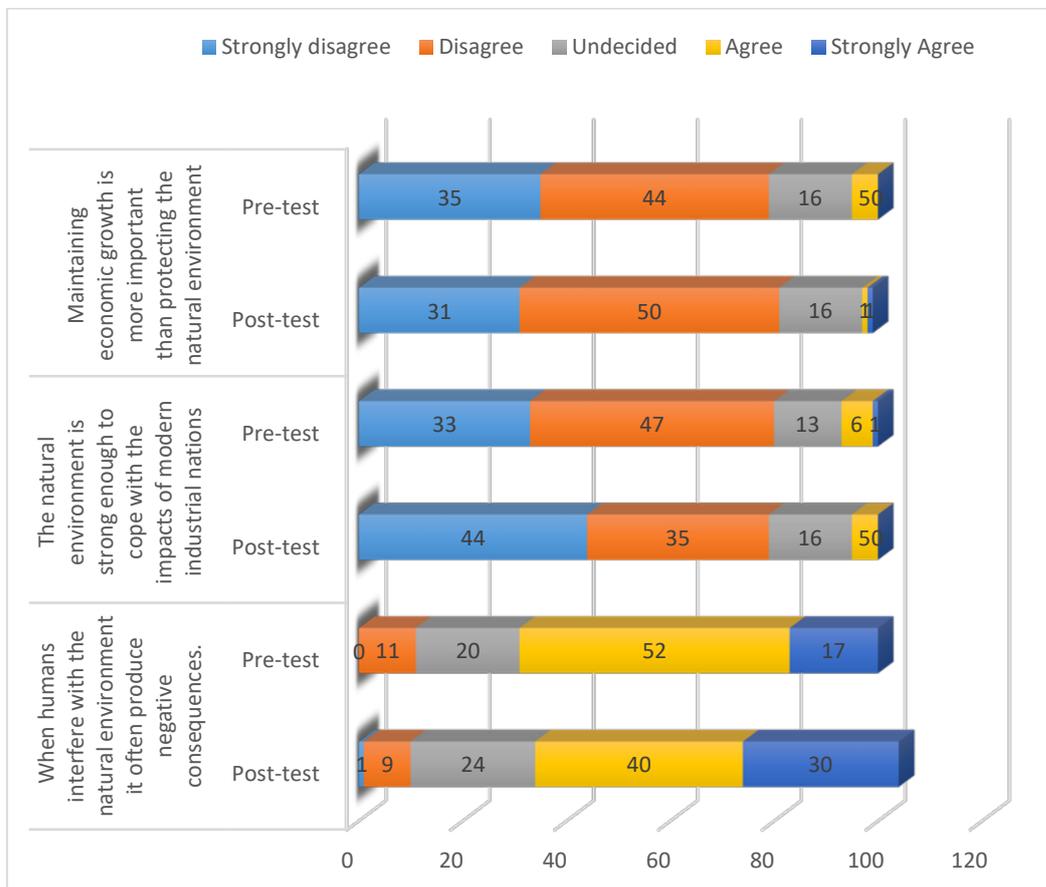


Figure 4-11 Percentages of PSTs responses to balance statements (environmental worldview) prior to and upon completing the EE paper

In responding to the statement, ‘when humans interfere with the environment, it often produces disastrous consequence’ (Question 13), 52% agreed and 17% strongly agreed prior to completing the EE paper. Upon completing the EE paper,

there was an increase in the proportion of PSTs who strongly agreed with the statement (40% agreed, and 30% strongly agreed) but overall agreement remained the same. The proportion of PSTs who were undecided or disagreed in response to their experiences in the EE paper reduced slightly (4% and 2% respectively).

The second statement on balance was ‘the natural environment is strong enough to cope with the impacts of modern industrial nations’ (Question 16). Prior to completing the EE paper, 80% of the PSTs either disagreed or strongly disagreed with the statement and about the same proportion were still in this category upon completing the EE paper. A 2% reduction in the percentage of those who agreed was also observed (Figure 4-11). The majority of PSTs, therefore, indicated that the relationship between humans and the natural environment is weighted in favour of humans, but that it should not be.

The last statement on balance posited that maintaining economic growth is more important than protecting the natural environment. Prior to completing the EE paper, 79% either disagreed or strongly disagreed with the statement, while upon completing the EE paper, this proportion increased to 81%. A small (3%) reduction in the proportion of those who either agreed or strongly agreed prior to completing the EE paper was observed (Figure 4-11). A majority of the PSTs appeared to demonstrate a view that Earth’s resources are not limited based on their responses to the statement, ‘the Earth has plenty of natural resources if we just learn how to develop them’ (Question 15). Prior to completing the EE paper, 66% agreed or strongly agreed with this statement, while just a 1% reduction of PSTs in this category was observed upon completing the EE paper. There was a slight overall shift towards a view that Earth’s resources are limited in response to experiences in the EE paper (Figure 4-12).

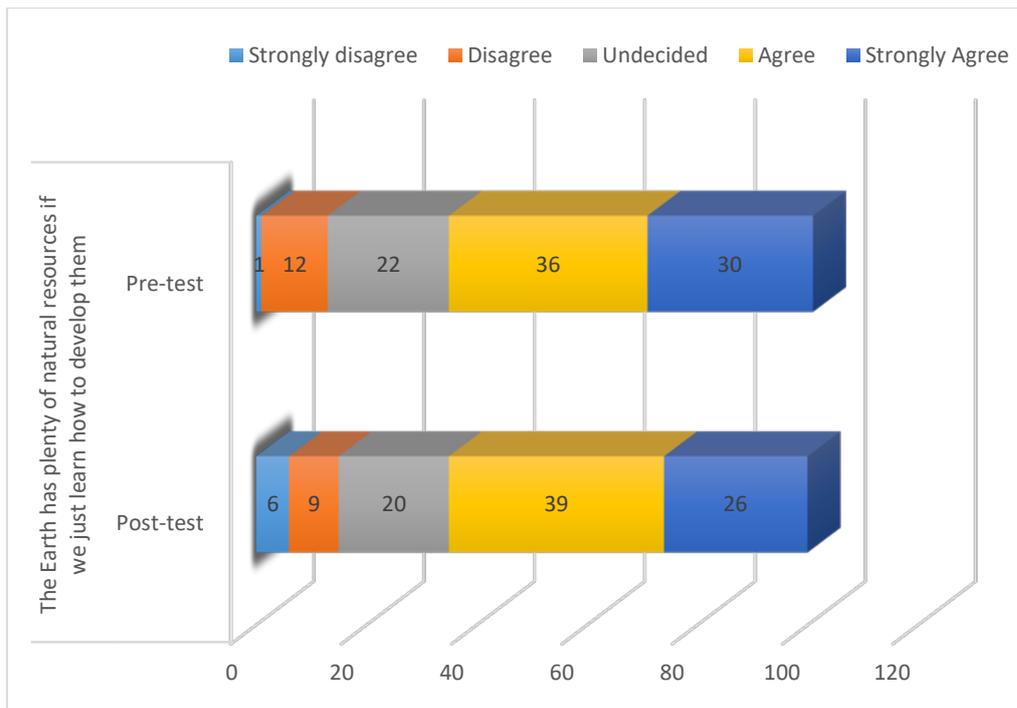


Figure 4-12 Percentages of PSTs’ responses to limit statement (environmental worldview) prior to and upon completing the EE paper

4.3.4 Section summary

On the whole, these findings reveal PSTs’ acknowledgement of their individual roles in making a difference towards the quality of the environment, shown by increased internal locus of control, upon completing the EE paper. Some PSTs, however, still feel that to make a difference, there must be the involvement of some ‘powerful others’ such as the government.

A slight shift over the duration of the paper towards feelings of responsibility for the problems and solutions to the environmental issues in our community was also observed among PSTs. Regarding PSTs’ worldviews, findings indicate that although many PSTs seem to hold more pro-environmental views than anthropocentric views, there are some who are unsure and their experiences in the EE paper may have done little to change these views. This finding ties in with what was reported in Section 4.2.1, where conceptions of PSTs about the importance of the natural environment were derived from their responses to the open-ended question asked. Some PSTs upon completing the paper still expressed an anthropocentric view of the natural environment. Finally, prior to completing the

EE paper, a majority of PSTs demonstrated a view that Earth's resources are not limited. In response to experiences in the EE paper, however, there was a slight overall shift towards a view that Earth's resources are limited.

Overall, as shown in Table 4-7, the mean scores (combined scores for items in each subsection for the three components of environmental affect) either showed no change or a slight increase in response to the EE paper, leaving a small increase in overall environmental affect.

Table 4-7 Independent t-test for post-test versus pre-test PSTs' environmental affect (n = 88)

Environmental Affect	Pre-test		Post-test		P value	t-value
	Mean	S.D	Mean	S.D		
Locus of control	3.89	0.51	3.89	0.50	0.988	0.016
Personal Responsibility	3.70	0.28	3.80	0.29	0.772	0.332
Environmental world view	3.72	0.71	3.74	0.69	0.946	0.069
Overall Environmental Affect	3.76	0.58	3.79	0.56	0.890	0.140

Note: Scores range from '1' = strongly disagree, to '5'=strongly agree,

*During statistical analysis, the negatively worded statements were reversed (i.e., strongly agree =1 instead of 5)

Statistically, however, these mean differences between the pre-test scores and post-test scores were not significant. To control for the possibility of pre-test environmental affect having undue influence on PSTs' environmental affect observable upon completing the paper, a one-way ANCOVA was conducted to determine if there was an overall statistically significant difference in post-test scores between the different cohorts of PSTs, once their means had been adjusted for pre-test scores. Statistically, a significant difference was observed among post-test scores of the different cohorts after controlling for pre-test scores for the environmental affect statements, using $F(1, 86) = .004, P < .05$). The online post-test mean score for environmental affect statements was significantly higher than their campus counterparts (Campus - 38.88, Online - 43.69).

4.4 Impact on Pre-service teachers' environmental concern

PSTs' environmental concern on seven environmental and sustainability issues was assessed using a 5-point Likert-type scale (1 = very unconcerned to 5 = very concerned). These environmental and sustainability issues include water pollution (Question 18), climate change (Question 19), consumption and waste (Question 20), endangered species (Question 21), child poverty (Question 22), racial discrimination (Question 23) and bee decline (Question 24). Among these environmental and sustainability issues, increases in the proportion of PSTs who were concerned or very concerned upon completing the EE paper were associated with only two: consumption and waste (2% increase) and bee decline (17% increase) (see Figure 4-13).

These two environmental and sustainability issues were discussed extensively in the EE paper completed by PSTs. A decline in the proportion of PSTs who were concerned or very concerned about the other five specified environmental and sustainability issues was observed upon completing the EE paper (See Figure 4-13). However, the different cohorts of PSTs demonstrated different environmental concern upon completing the EE paper. Among the Campus PSTs, upon completing the EE paper, increases in the level of concern were observed for all but two (child poverty and racial discrimination) of the environmental and sustainability issues (see Appendix A). Meanwhile, among their online counterparts, a decrease in concern for all but one (bee decline) of the environmental and sustainability issues was observed upon completing the EE paper (see Appendix A).

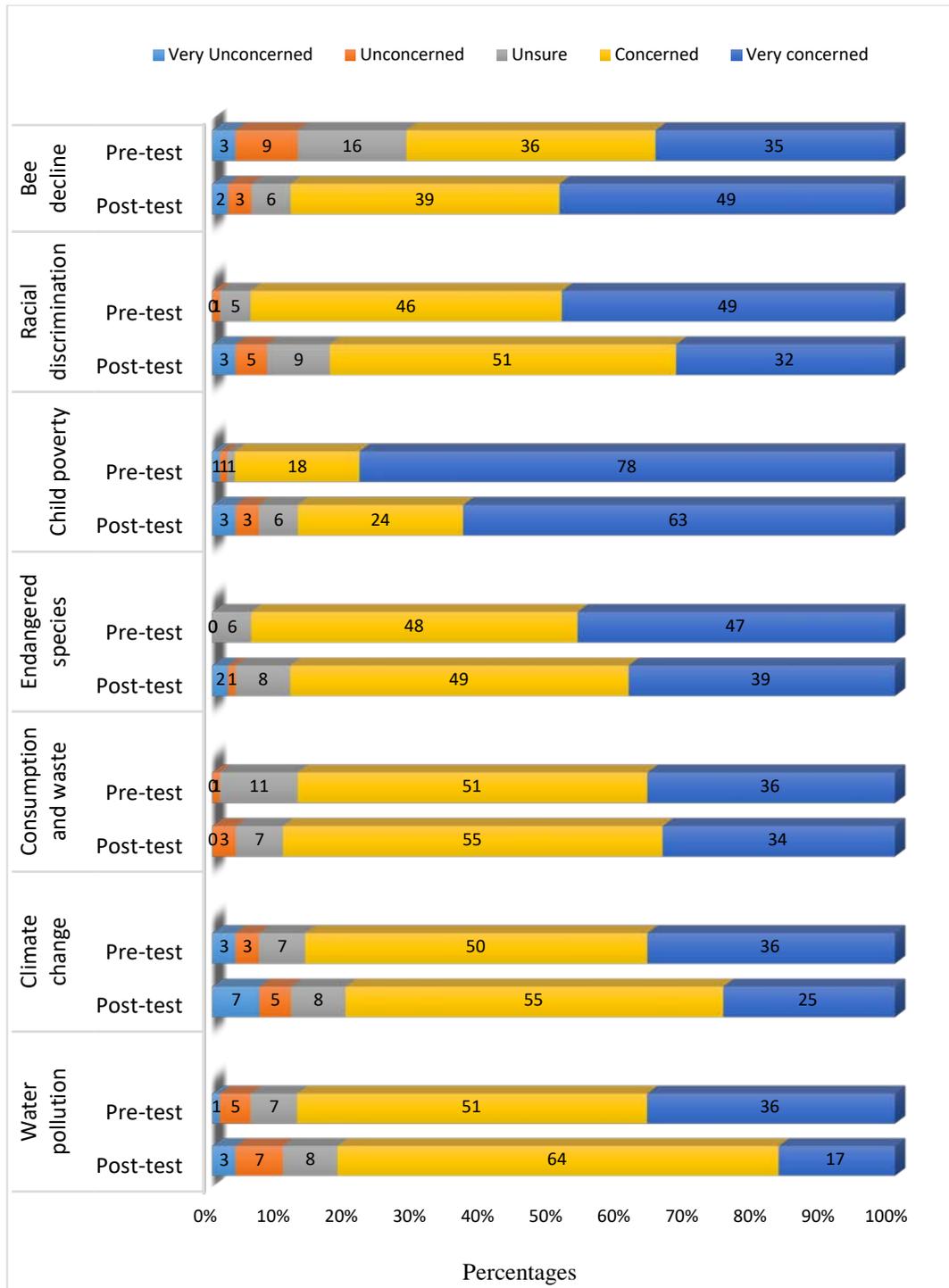


Figure 4-13 PSTs’ environmental concern prior to and upon completing the EE paper

(n = 88 [pre-test], n = 87 [post-test])

Considering all PSTs as shown in Table 4-8, a decrease in post-test mean scores was observed particularly for environmental and sustainability issues that were not

stressed in the EE paper: water pollution, child poverty, and racial discrimination (Table 4-8). Increases in post-test mean scores were associated with consumption and waste, and bee decline. Overall, these findings indicated that the only issue in which concern significantly increased was linked to bee decline which was emphasised in the EE paper taken.

Table 4-8 Independent t-test comparing PSTs' pre-and post-test environmental concern scores

Environmental and sustainability issues	Pre-test		Post-test		T	p-value
	Mean	SD	Mean	SD		
Water pollution	4.17	0.834	3.85	0.909	2.427	0.016*
Climate change	4.13	0.932	3.87	1.065	1.662	0.098
Consumption and waste	4.23	0.69	4.24	0.855	0.957	0.34
Endangered species	4.41	0.6	4.22	0.827	1.748	0.082
Child poverty	4.72	0.66	4.4	0.994	2.462	0.015*
Racial discrimination	4.42	0.638	4.03	0.958	3.14	0.002*
Bee decline	3.91	1.09	4.3	0.904	-2.574	0.011*

*Statistically significant at $p > 0.05$, $n = 88$ (pre-test), $n = 87$ (post-test)

4.5 Impact on pre-service teachers environmental behaviour

The *Belgrade Charter* states that a person cannot be regarded as an environmentally literate person by just being aware of environmental issues, but also needs to have affective dispositions that would be translated into actions that are environmentally responsible (UNESCO, 1976). Affective dispositions, on the other hand, do not directly determine behaviour, rather they influence behavioural intentions (intention to act) (Kollmuss & Agyeman, 2002). This section, therefore, reports on findings about PSTs' intentions to act in environmentally responsible ways (Section 4.5.1) followed by PSTs' self-reported behaviour regarding different environmental aspects (Section 4.5.2).

4.5.1 Pre-service teachers' intention to act

Intention to act could be a determinant of pro-environmental behaviour (Bamberg & Möser, 2007) and as such PSTs were provided with five statements about their willingness to act in an environmentally friendly manner (Questions 25-29, see

Appendix A). PSTs were asked to indicate their level of agreement with the given statements, using a 5-point Likert scale (1= strongly disagree to 5=strongly agree). The intention to act scale had a Cronbach's alpha reliability coefficient of 0.83, suggesting that the items have high internal consistency.

On the whole, upon completing the EE paper, indications of either no change in PSTs' willingness to act or decline in PSTs' willingness to act on the given environmental friendly activities were observed. Prior to taking the EE paper, a high proportion of PSTs indicated a strong intention to act regarding the protection of New Zealand endangered species (83%), purchase of costlier products that are produced from companies not guilty of polluting the environment (82%), and donating to feed a poor child in their community (77%). Although upon completing the EE paper, a slight reduction or no change was observed in the proportion of PSTs' responses to these statements (77%, 79% and 77% respectively), the proportions were still high (see Figure 4-14). On the contrary, prior to taking the EE paper and even upon completing the EE paper, PSTs indicated a relatively low intention to act in regards to participating in a protest such as a march or a rally on a sustainability issue (pre-test 43%, post-test 43%).

PSTs expressed the least intention to act with regards their willingness to refrain from eating meat as a sustainable lifestyle. Prior to taking the EE paper, 25% agreed with this statement and upon completing the EE paper, a 2% reduction in the proportion of those who agreed to the statement was observed. The difference in the pre-test and post-test PST mean scores for all the willingness to act statements were not statistically significant (Table 4-9).

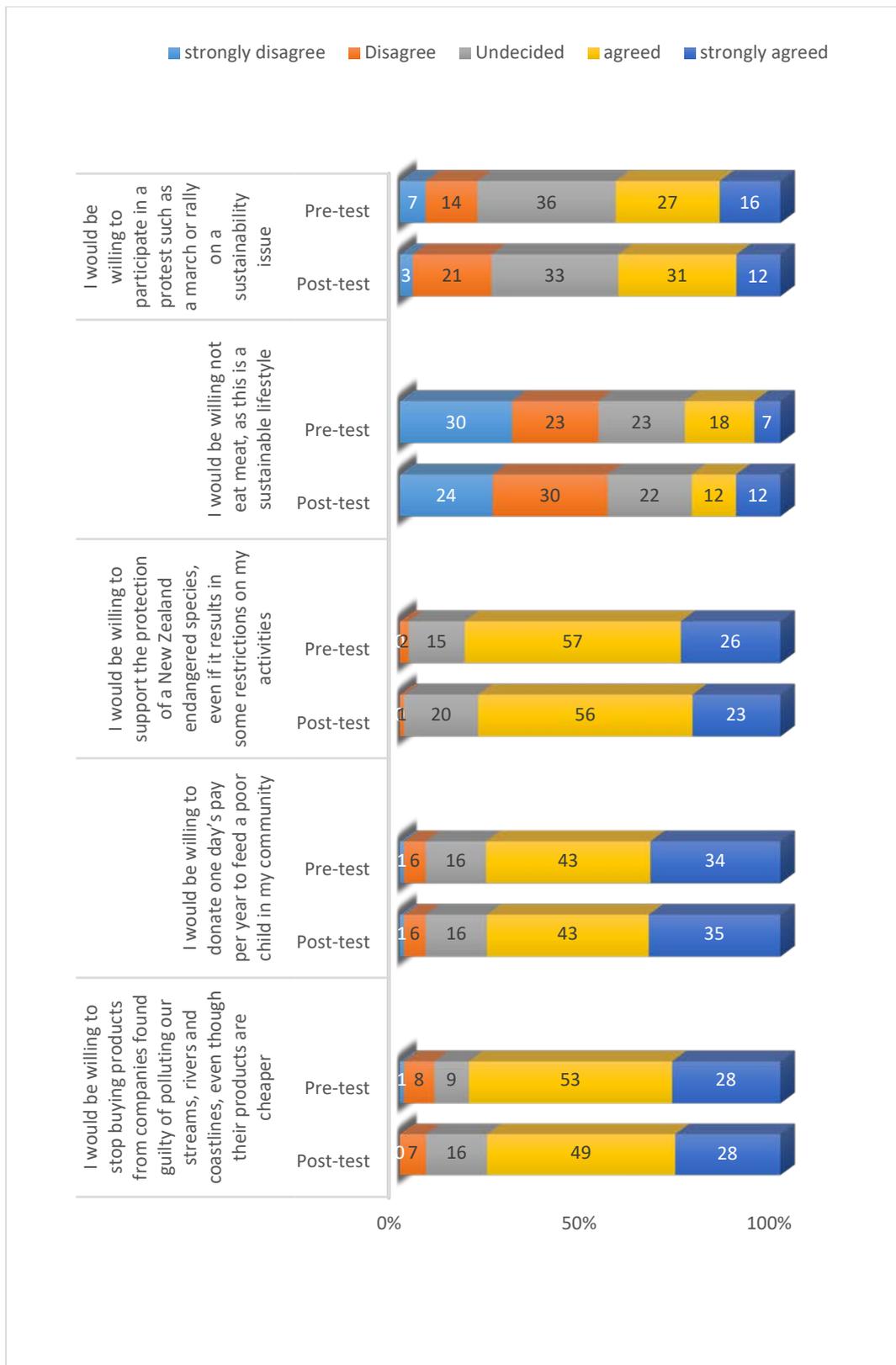


Figure 4-14 PSTs intention to act prior to and upon completing the EE paper (n = 88 [pre-test], n = 87 [post-test])

Table 4-9 Independent t-test comparing PSTs' pre- and post-test Intention to Act scores

I would be willing to	Pre-test		Post-test		t	P value
	Mean	SD	Mean	SD		
stop buying products from companies found guilty of polluting our streams, rivers, and coastlines, even though their products are cheaper	4	0.90	3.98	0.85	0.174	0.862
donate one day's pay per year to feed a poor child in my community	4.03	0.92	4.03	0.92	0.003	0.998
support the protection of a New Zealand endangered species, even if it results in some restrictions on my activities	4.07	0.71	4.01	0.69	0.536	0.592
not eat meat, as this is a sustainable lifestyle	2.5	1.28	2.56	1.30	0.298	0.766
participate in a protest such as a march or a rally on a sustainability issue	3.32	1.11	3.26	1.02	0.333	0.74

*Statistically significant at $p > 0.05$, $n = 88$ (pre-test), $n = 87$ (post-test)

These findings give some indications of PSTs' values. They seem to value endangered species and were prepared to make financial commitments, but were not prepared to be seen to be an activist, or give up an entrenched habit. On the whole, the EE paper had little observable effect on PSTs' intention to act.

4.5.2 Pre-service teachers' self-reported Environmental behaviour

The questionnaire administered had a section that sought to assess PSTs' environmental behaviour by asking them to state to what extent they carried out ten environmentally related activities (Questions 30-39, see Appendix A). A Likert – type scale with five possible choices (1=Never, 2=rarely, 3=sometimes, 4=Often, 5=Very often) was used. The environmental behaviour scale comprised of questions related to consumer action (Question 30-33), eco-management (Question 33-34),

persuasion (Question 35-36), community giving (Question 37), environmental activism (Question 38) and nature-related leisure (Question 39). Data in each category is presented in turn.

4.5.2.1 Consumer action

Upon completing the EE paper, the proportion of PSTs who reported that they often or very often purchase a product because it was packaged in a reusable or recyclable bag increased by 3%, indicating a slight movement towards more sustainable consumer action (see Figure 4-15). A majority (71%) was already carrying out this activity at least sometimes, so a big shift was unlikely to be seen.

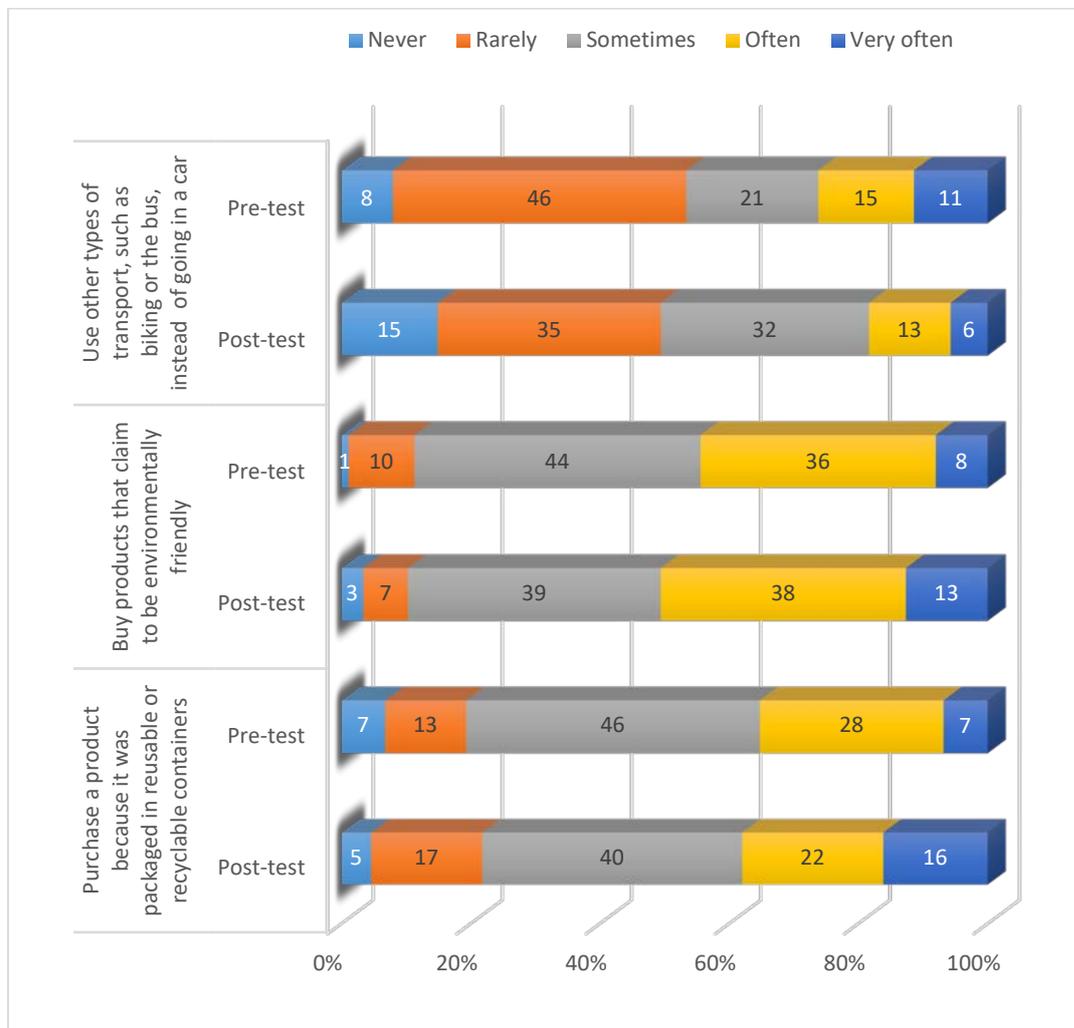


Figure 4-15 PSTs' consumer action behaviour prior to and upon completing the EE paper (n = 88 [pre-test], n = 87 [post-test])

Similarly, the proportion of PSTs who reported that they often or very often buy products which claim to be environmentally friendly increased by 6% upon completing the EE paper, again indicating a slight movement towards more sustainable consumer action. (Figure 4-15).

A 7% reduction in the proportion of PSTs who often or very often use other types of transport (e.g., bike instead of car) was observed upon completing the EE paper. PSTs were observed to demonstrate less environmentally-related behaviour when comparing their choice of means of transport with the other two activities constituting consumer action (purchase a product packaged in a reusable or recyclable container and other products that claim to be environmentally friendly (Figure 4-15). This finding resonates with PSTs' responses during the focus group discussion in which PSTs were asked if they would prefer to walk or use another means of transport instead of bringing their car to university to reduce environmental impact. PSTs' responses indicated that if they did opt for using other means of transport, it was less connected with saving fossil fuels and reducing environmental pollution, and more due to other reasons such as cheaper cost. Overall, mean scores for items associated with consumer action for pre-test and post-test were about the same (see Table 4-10).

Table 4-10 Independent t-test comparing PSTs' pre-and post-test environmental behaviour scores

	Pre- test		Post-test		t	p-value
	Mean	SD	Mean	SD		
Consumer action	3.11	0.32	3.12	0.46	0.050	0.962
Eco management	3.33	0.16	3.46	0.12	0.856	0.482
Persuasion	3.55	0.46	3.54	0.83	0.013	0.991
Community giving	3.69	1.01	3.84	0.99	-0.961	0.338
Environmental activism	2.25	1.15	2.00	1.11	1.465	0.145
Nature related leisure	3.92	0.90	3.86	1.12	0.38	0.705
Overall environmental behaviour	3.29	0.53	3.31	0.64	0.046	0.964

*Statistically significant at $p > 0.05$, $n = 88$ (pre-test), $n = 87$ (post-test)

4.5.2.2 Eco-management

A small trend was observed in the proportion of PSTs who aimed to conserve water at home by showering for less than 10 minutes a day. The proportion of PSTs who often or very often conserve water at home by showering for less than 10 minutes a day increased by 10% upon completing the EE paper with the proportion of those who sometimes conserve water remaining the same prior to and completing the paper.

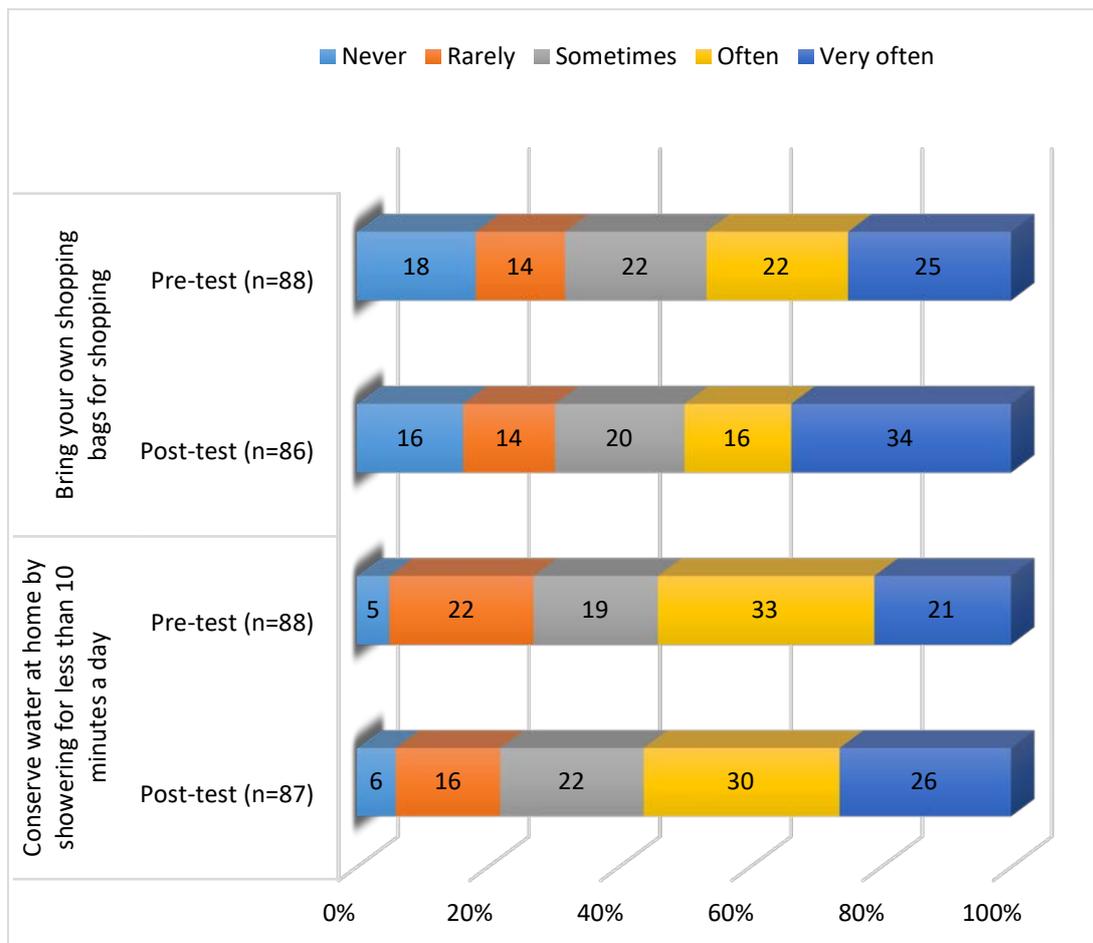


Figure 4-16 PSTs' eco-management behaviour prior to and upon completing the EE paper

Equally, a small trend was observed towards PSTs bringing their shopping bags for shopping. Whilst there was little shift in the proportions of PSTs not, or sometimes, exhibiting the behaviour, the EE paper may have encouraged those doing it often to do it more often. An increase in the overall post-test mean scores of PSTs' Eco-management actions was observed upon completing the EE paper (Table 4-10).

4.5.2.3 Persuasion

Prior to completing the EE paper, 70% of PSTs reported often or very often encouraging people at home to recycle glass, paper or food scraps. This proportion increased slightly by 3% upon completing the EE paper (Figure 4-17). Whereas in the post-test, an 8% reduction was observed in the proportion of PSTs who often or very often try to persuade people to stop activities that could harm the environment. These findings provide evidence that PSTs seem to be more willing to encourage than to persuade people in regards to ERB.

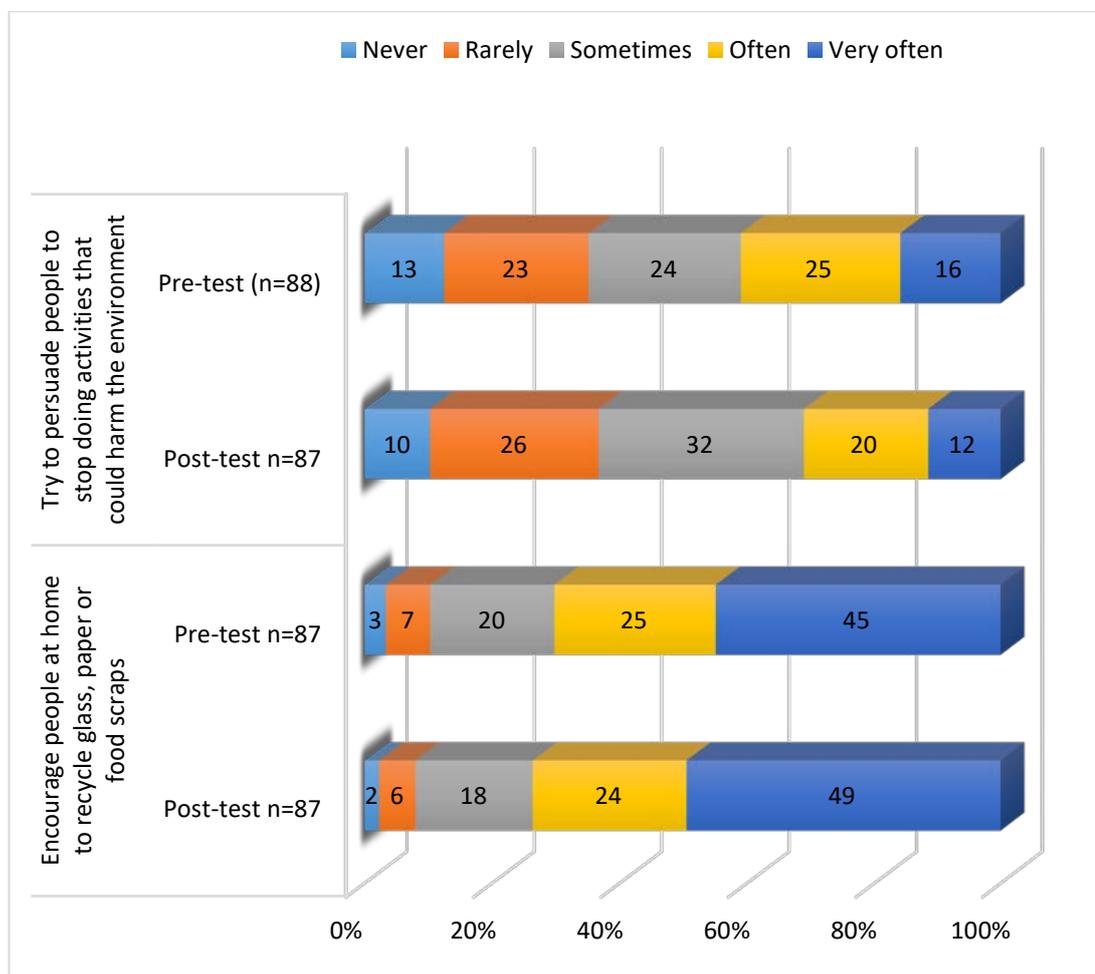


Figure 4-17 PSTs' persuasion behaviour prior to and upon completing the EE paper

4.5.2.4 Other environmental behaviours

Upon completing the EE paper, the proportion of PSTs who reported giving to charity (e.g., money, books) increased by 4% coupled with a 6% reduction in the proportion of PSTs who never or rarely give to charity (Figure 4-18).

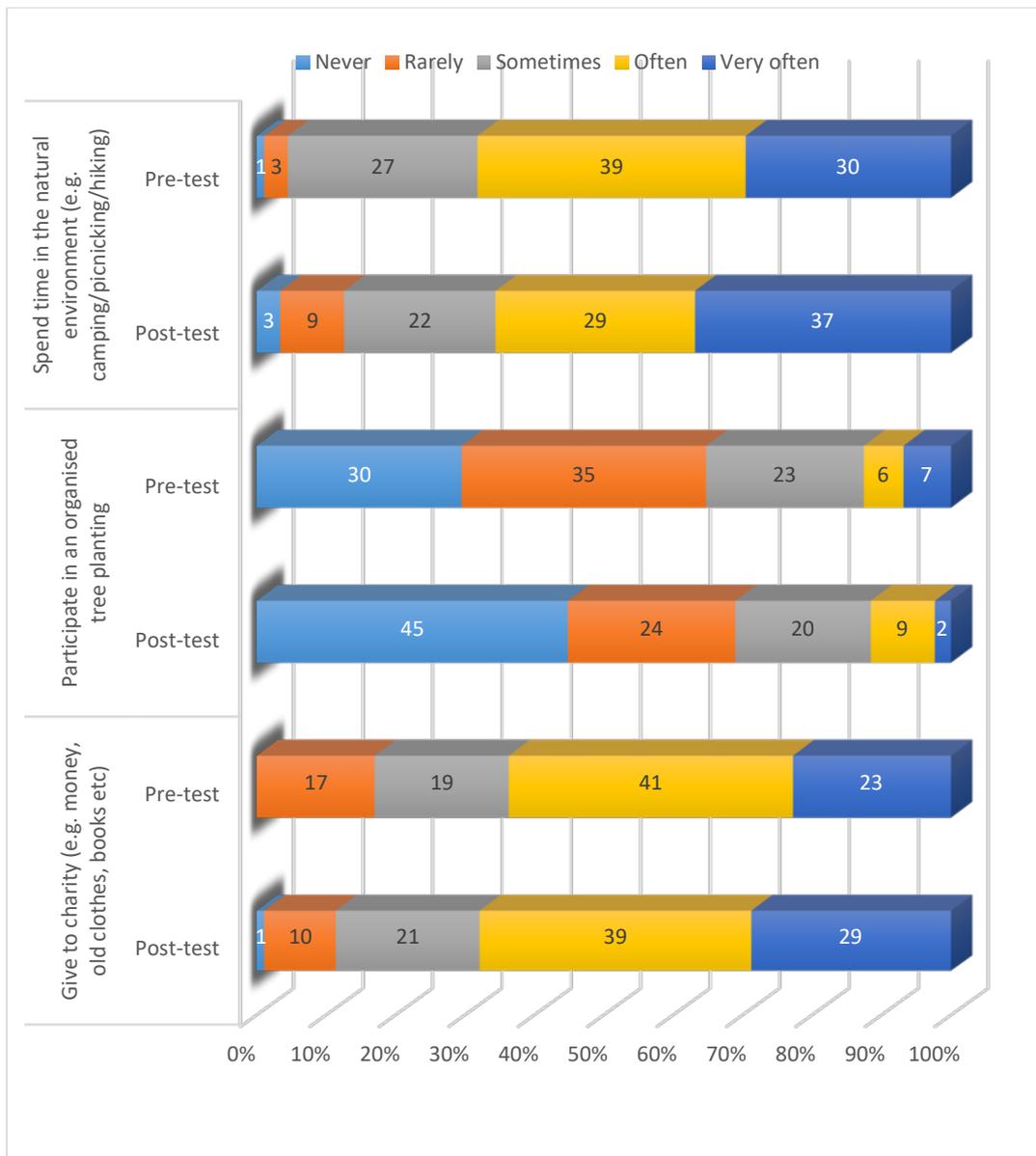


Figure 4-18 PSTs’ personal responsibility prior to and upon completing the EE paper (n = 88 [pre-test], n = 87 [post-test])

When asked if they have participated in an organised tree planting, the PSTs’ response shows limited environmental related behaviour as only 11% often or very often had participated in organised tree planting, upon completing the EE paper (Figure 4-18). Also, upon completing the EE paper, a 4% increase was observed in the proportion of PSTs who never or rarely participate in organised tree planting. The proportion of PSTs who reported that they often spend time in the natural environment reduced slightly by 3% upon completing the EE paper (Figure 4-18). A possible contribution to this reduction might have been because of increased study demands during their teaching programme.

Based on the various components that made up the environmental behaviour scale, nature-related leisure and community giving appeared to be the most frequently practised behaviours as they had the highest means in both pre-test and post-test responses, while environmental activism through tree planting was least frequently practised and had the lowest mean (see Table 4-10). Slight increases were observed in the overall mean scores as well as post-test means scores for all of the environmental behaviour component, except persuasion and environmental activism. However, the differences between the means were not statistically significant.

4.5.2.5 Section summary

In general, findings from PSTs' responses to intention to act statements indicates their values. They were more willing to act in regards to protecting endangered species and actions that involved financial commitments. On the other hand, they were not willing to act when it could affect their lifestyle nor were they willing to be involved in activities associated with environmental activism (see Section 4.5.1). Furthermore, there was little observable effect of the EE paper on PSTs' intention to act.

Similar to findings from PSTs' intention to act, PSTs' self-reported environmental behaviour for pre-test and post-test both indicate that PSTs mostly carry out nature related and community giving activities. On the other hand, they least carry out activities associated with persuasion and environmental activism. Overall, it can be argued that PSTs least engage in activities that involve collective actions and would be unwilling to carry out actions that would intensely alter their lifestyle. On the other end, they are willing and would easily carry out activities that require some financial commitments and protecting nature as well as the species inhabiting it. In sum, there was little observable effect of the EE paper on PSTs' behaviour.

4.6 Relationships between environmental literacy components

To explore relationships between environmental literacy components, Pearson product moment correlation coefficient and Path analysis were used. Pearson

product moment correlation is a measure of the linear correlation between two variables X and Y, giving a value between +1 and -1 inclusive, where 1 is positive correlation, 0 is no correlation, and -1 is a negative correlation. Hence, it was used to explore the linear relationship that exists between paired environmental literacy components in this study (Sedgwick, 2012). The Path analysis, on the other hand, is used to describe the directed dependencies among a set of variables in which models could be derived from multiple regression analysis among other forms of analysis (Garson, 2013). This study employed multiple regression analysis to describe the directed dependencies among the environmental literacy components. Findings from this analysis will be reported in turn for the pre-test and post-test scores.

4.6.1 Correlations among environmental literacy components.

This section reports on findings of the Pearson product moment correlation coefficient both pre-test and post-test EL scores.

4.6.1.1 Environmental knowledge

Pre-test environmental knowledge scores were not significantly correlated with any of the pre-test environmental literacy components scores. Upon completing the EE paper, however, significant correlations were observed between post-test environmental knowledge scores and post-test environmental affect scores ($r=.470$, $p=.000$), post-test intention to act scores ($r=.252$, $p=.000$) and post-test environmental behaviour scores ($r=.336$, $p=.000$) (See Table 4-11)

4.6.1.2 Environmental concern

Pre-test environmental concern scores were significantly correlated with pre-test intention to act scores ($r =.610$, $p =.000$), with the highest correlation observed, pre-test environmental behaviour scores ($r=.534$, $p=.000$) and pre-test environmental affect scores ($r=.505$, $p=.000$) (Table 4-11). Post-test environmental concern scores were not found to correlate significantly with any of the environmental literacy components: Post-test environmental affect scores ($r=.05$, $p=.651$) post-test environmental behaviour scores ($r=.106$, $p=.333$) and post-test intention to act scores ($r=.126$, $p=.247$)

4.6.1.3 Environmental affect

Pre-test environmental affect scores were significantly correlated with pre-test environmental concern scores ($r=.545$, $p=.000$), pre-test intention to act scores ($r=.439$, $p=.000$) and pre-test environmental behaviour scores ($r=.418$, $p=.000$). Meanwhile, post-test environmental affect scores were significantly correlated with post-test intention to act scores ($r=.485$, $p=.000$), post-test environmental knowledge scores ($r=.470$, $p=.000$) and post-test environmental behaviour scores ($r=.392$, $p=.000$)

4.6.1.4 Intention to act

Pre-test intention to act scores were significantly correlated with pre-test environmental affect scores ($r=.439$, $p=.000$), pre-test environmental concern scores ($r=.610$, $p=.000$) and pre-test environmental behaviour scores ($r=.524$, $p=.000$). Increases in these significant correlations were observed with the post-test intention to act scores with post-test environmental affect scores ($r=.485$, $p=.000$) and post-test environmental behaviour scores ($r=.540$, $p=.000$). Although no correlation was found between post-test environmental concern scores and post-test intention to act scores ($r=.126$, $p=.247$), it is noteworthy to find significant correlations between post-test intention to act scores and post-test environmental knowledge scores ($r=.252$, $p=.000$)

4.6.1.5 Environmental behaviour

Pre-test environmental behaviour scores were significantly correlated with pre-test environmental affect scores ($r=.418$, $p=.000$), pre-test environmental concern scores ($r=.534$, $p=.000$) and pre-test intention to act scores ($r=.524$, $p=.000$). No correlation was found between pre-test environmental behaviour scores and pre-test environmental knowledge scores ($r=-.028$, $p=.800$). A similar correlation trend observed with the post-test intention to act scores above was found with post-test environmental behaviour scores. No correlation was found between post-test environmental concern scores and post-test environmental behaviour scores ($r=.106$, $p=.333$). Environmental behaviour scores were significantly correlated with post-test environmental affect scores ($r=.392$, $p=.000$), post-test intention to act scores ($r=.540$, $p=.000$) and post-test environmental knowledge scores ($r=.252$, $p=.000$).

Table 4-11 Correlation coefficient between environmental literacy components

(a) Pre-test		EA	EC	ITA	EB	EK
EA	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	86				
EC	Pearson Correlation	.545**	1			
	Sig. (2-tailed)	.000				
	N	86	88			
ITA	Pearson Correlation	.439**	.610**			
	Sig. (2-tailed)	.000	.000			
	N	86	88			
EB	Pearson Correlation	.418**	.534**	.524**		
	Sig. (2-tailed)	.000	.000	.000		
	N	86	88	88		
EK	Pearson Correlation	-.094	-.028	-.073	-.028	1
	Sig. (2-tailed)	.394	.797	.503	.800	
	N	85	87	87	87	87
(b) Post-test		EA	EC	ITA	EB	EK
EA	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	84				
EC	Pearson Correlation	.050				
	Sig. (2-tailed)	.651				
	N	84	87			
ITA	Pearson Correlation	.485**	.126			
	Sig. (2-tailed)	.000	.247			
	N	84	86	86		
EB	Pearson Correlation	.392**	.106	.540**		
	Sig. (2-tailed)	.000	.333	.000		
	N	83	86	85	86	
EK	Pearson Correlation	.470**	.053	.252*	.336**	1
	Sig. (2-tailed)	.000	.637	.023	.002	
	N	79	82	81	81	82

Where EA = environmental affect, EC=environmental concern, ITA=Intention to act, EB= environmental behaviour, EK=environmental knowledge. ** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level.

On the whole, findings from Pearson product moment correlation coefficient analysis indicated that PSTs' environmental knowledge did not correlate significantly with any of the environmental literacy components prior to taking the EE paper (pre-test). Upon completing the EE paper, significant correlations were found between PSTs' environmental knowledge and other environmental literacy components except environmental concern. PSTs' environmental concern as highlighted in Section 4.4 seems to decline upon completing the EE paper especially on issues that were not focused on in the EE paper taken by PSTs. This may have led to findings showing no correlation between environmental concern and the other environmental literacy components for the post-test scores.

4.6.2 Path Analysis with multiple regression

Path analysis was used to examine the direct and indirect hypothesised relationships among environmental knowledge, environmental affect, environmental concern, intention to act and environmental behaviour. The hypothesised model had two layers of multiple regression. The first layer had intention to act as the criterion with environmental affect, environmental concern, and environmental knowledge as the predictors. This first layer was influenced by the findings from the Pearson product moment correlation coefficient in Section 4.6.1 that showed statistically significant positive correlations between some of these environmental literacy components and intention to act. Accordingly, the model hypothesises a start from environmental affect, environmental concern and environmental knowledge and an end in intention to act for the first layer. The second layer had environmental behaviour as the criterion with environmental affect, environmental concern, environmental knowledge, and intention to act as the predictors. The hypothesised model for the pre-test and post-test scores is reported in turns.

4.6.2.1 Pre-test hypothesised Model

Findings from the first layer of the model reveal that PSTs' environmental affect and environmental concern could directly predict PSTs' Intention to act. The R^2 (coefficient of determination) value indicates that the model can explain 41% of variation in PSTs' pre-test Intention to Act (see Table 4-12, Table 4-13 and Figure 4-19).

Table 4-12 Getting the first layer multiple regression for the hypothesised model.

Model Summary					
Model	R	R Square			
1	.641 ^a	.411			

^a Predictors: (Constant), EK, EA, EC

Coefficients						
Model		Unstandardized		Standardized		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-3.295	3.152		-1.045	.299
	EA	.134	.068	.200	1.958	.054
	EC	.516	.104	.505	4.965	.000
	EK	-.052	.097	-.046	-.534	.594

^a Dependent Variable: ITA

Table 4-13 Getting the second layer multiple regression for the hypothesised model

Model summary					
Model	R	R Square			
1	.588 ^a	.346			

^a Predictors: (Constant), EK, EA, EC, ITA

Coefficients						
Model		Unstandardized		Standardized		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.427	6.112		.397	.692
	EA	.181	.135	.149	1.344	.183
	EC	.476	.229	.256	2.081	.041
	ITA	.523	.214	.288	2.443	.017
	EK	-.035	.186	-.017	-.189	.850

^a Dependent Variable: EB

Where EA = environmental affect, EC=environmental concern, ITA=Intention to act, EB= environmental behaviour, EK=environmental knowledge.

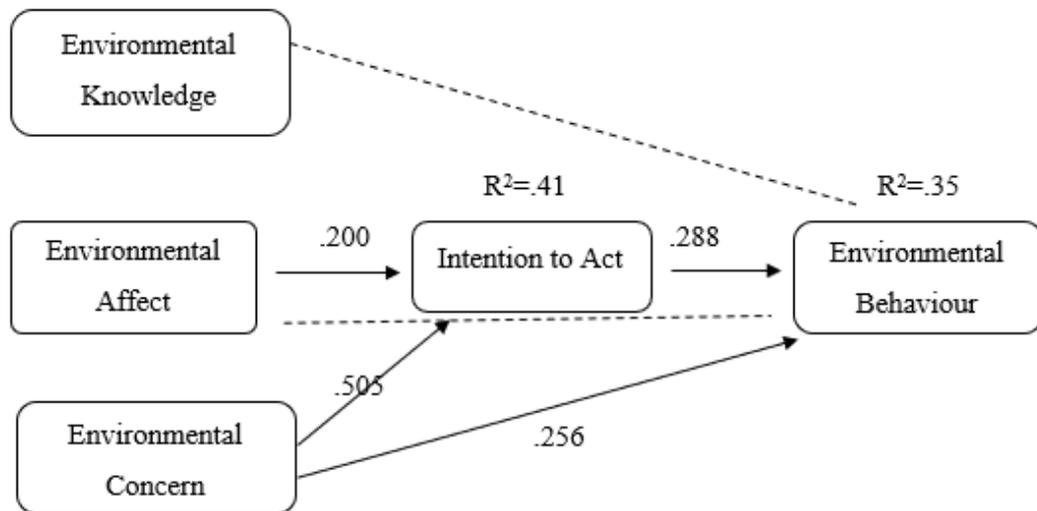


Figure 4-19 Path analytic model of pre-test environmental literacy components. Broken lines show non-significant paths at $p=0.05$ level ($n=88$)

Environmental knowledge was not found to predict directly intention to act which agrees with the findings from Pearson product moment correlation coefficient in Section 4.6.1, which indicated no correlation between PSTs' pre-test environmental knowledge and intention to act.

Considering the second layer of the hypothesised model, environmental concern and intention to act were observed to predict environmental behaviour directly with an R^2 value indicating that the model can explain 35% of the variation in PSTs' pre-test environmental behaviour (Figure 4-19). Although Pearson product moment correlation coefficient analysis indicated that environmental affect correlated with environmental behaviour, path analysis indicated that, in the backdrop of other environmental literacy components, environmental affect could not directly predict environmental behaviour.

4.6.2.2 Post-test hypothesised model

Similar to the first layer of the pre-test hypothesised model, a post-test hypothesised model (Table 4-14) reveals that PSTs' environmental affect and environmental concern could directly predict PSTs' intention to act. Comparing pre-test and post-test regression coefficients for standardised data (β), an increase in the β value for environmental affect was observed (Pre-test, $\beta=.200$, Post-test, $\beta = .409$), while a

reduction in the β value for environmental concern (Pre-test, $\beta=.505$. Post-test, $\beta=.225$) was observed (Figure 4-19 and Figure 4-20). The R^2 (coefficient of determination) value indicates that the model can explain 28% of the variation in PSTs' post-test intention to act which is much lower than the pre-test.

Table 4-14 Getting the first layer multiple regression for the full model

Model Summary						
Model	R	R Square				
1	.529 ^a	.280				
^a Predictors: (Constant), EK, EA, EC						
Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	Std. Error	Beta	t	
1	(Constant)	-.349	3.376		-.103	.918
	EA	.273	.074	.409	3.670	.000
	EC	.165	.072	.225	2.287	.025
	EK	.138	.183	.084	.755	.452
^a Dependent Variable: ITA						

Where EA = environmental affect, EC=environmental concern, ITA=Intention to act, EB= environmental behaviour, EK=environmental knowledge.

Table 4-15 Getting the second layer multiple regression for the full model

Model summary						
Model	R	R Square				
1	.575 ^a	.331				
Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	Std. Error	Beta	t	
1	(Constant)	4.923	6.239		.789	.433
	EA	.093	.155	.073	.600	.550
	EC	.117	.136	.086	.862	.392
	ITA	.756	.215	.405	3.508	.001
	EK	.609	.334	.199	1.824	.072
^a Dependent Variable: EB						

Where EA = environmental affect, EC=environmental concern, ITA=Intention to act, EB= environmental behaviour, EK=environmental knowledge.

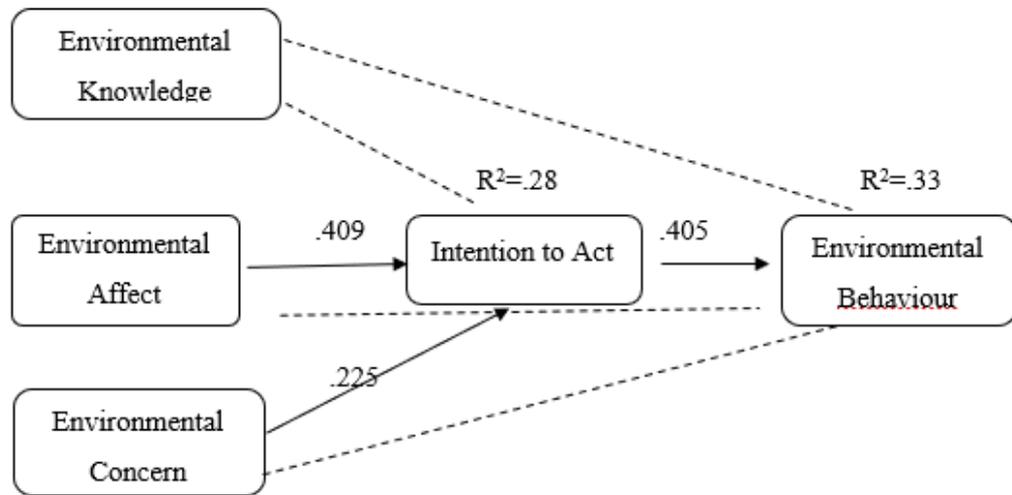


Figure 4-20 Path analytic model of post-test environmental literacy components. Broken lines show non-significant paths at $p=0.05$ level ($n=88$)

Although post-test environmental knowledge correlated with post-test intention to act from Pearson product moment correlation coefficient analysis in Section 4.6.1, path analysis shows that post-test environmental knowledge could not predict post-test intention to act directly, when in conjunction with another environmental literacy component. Considering the second layer of the post-test hypothesised model (Table 4-15), only intention to act was observed to predict environmental behaviour directly with an R^2 value indicating that the model can explain 33% of the variation in PSTs pre-test environmental behaviour (Figure 4-20).

Summarily, path analysis for pre-test and post-test hypothesised models shows that intention to act could be a strong predictor of environmental behaviour as both models affirm this. Also, environmental concern and environmental affect directly predict intention to act either solely or in combination with other environmental literacy components.

4.6.3 Section summary

Findings from the exploration of relationships between environmental literacy components of this study reveal that the strongest correlation observed among the environmental literacy components were correlations between intention to act and environmental concern ($p = 0.610$), and intention to act and environmental behaviour ($p = 0.540$) for both pre-test and post-test scores respectively. PSTs'

environmental knowledge did not correlate with any of the environmental literacy components prior to taking the EE paper. Upon completing the EE paper, it was interesting to observe correlations between PSTs' environmental knowledge and PSTs' environmental affect ($p=0.470$), environmental behaviour ($p=0.336$) and intention to act ($p=0.252$).

Based on the path analysis result, pre-test and post-test analysis indicated that intention to act was a strong predictor of environmental behaviour consistently. Environmental concern and environmental affect were also strong predictors of PSTs' intention to act.

4.6.4 Contribution of other factors to PSTs' Environmental Literacy.

The possibility of other influences on PSTs' environmental literacy was explored among the PSTs after they completed the EE paper. PSTs were asked to indicate the level of contribution a variety of factors had on their environmental literacy (Questions 77-83, see Appendix A). These factors included completion of the EE paper, completion of other University papers, participation in the field trip, media, experiences with family and friends or any other experience. A 5-point Likert scale ranging from 1 (no contribution) to 5 (very strong contribution) was employed.

According to the PSTs' responses, the factor that had the strongest contribution to their environmental literacy was the completion of the EE paper and participation in the field trip (Figure 4-21). A total of 72% of the PSTs reported that the EE paper either strongly or very strongly contributed to their environmental literacy. Mean scores and S.D are 3.83 and 0.97, respectively (see Table 4-16). Similarly, a total of 54% of PSTs reported that the field trip contributed strongly or very strongly to their environmental literacy. Completion of other papers at the University (10%) and other experiences at the university (26%) contributed the least to the PSTs environmental literacy. On the whole, these findings indicate that the PSTs believed that the EE paper contributed the most to their environmental literacy, which was closely followed by learning outside the classroom through field trip experience.

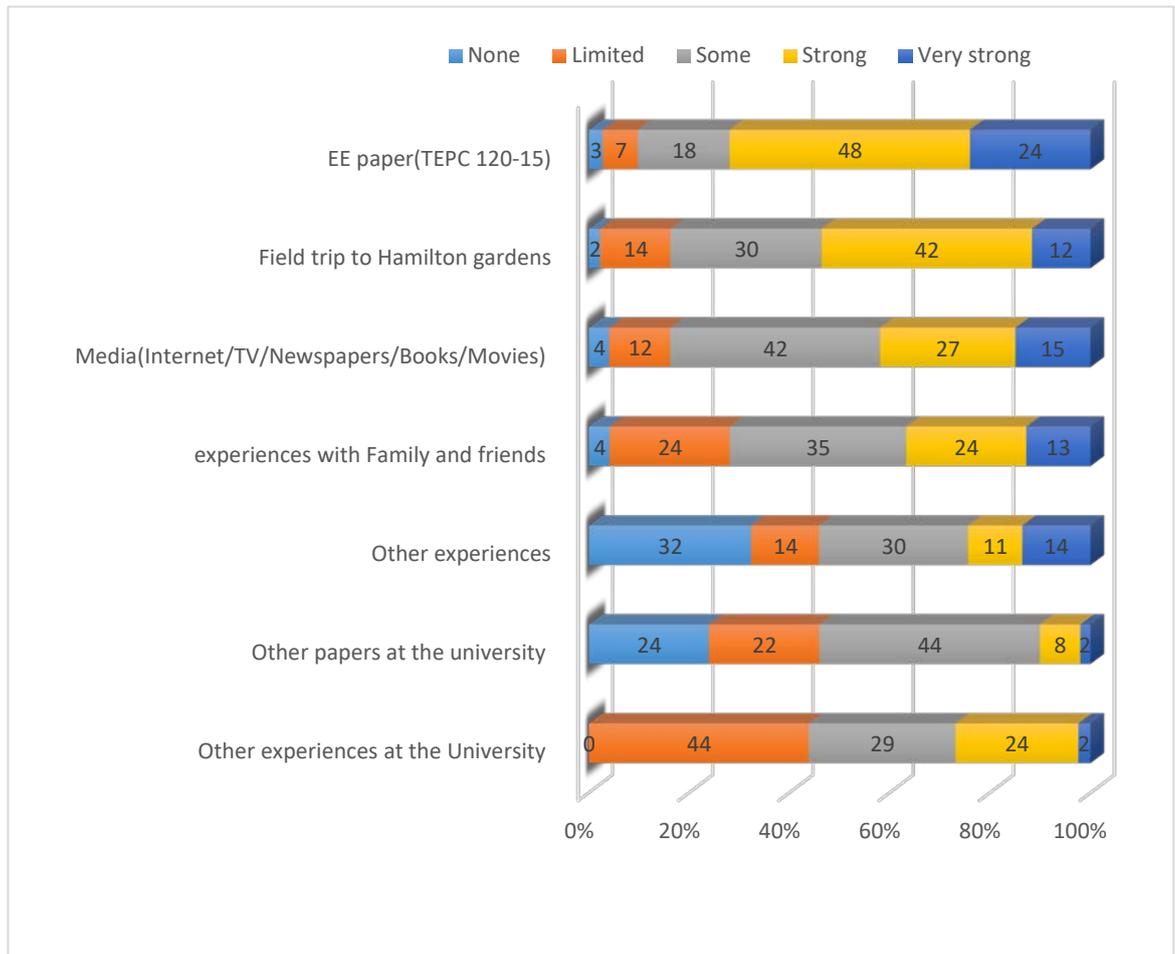


Figure 4-21 Contributory factors to PSTs' environmental literacy upon completing the EE paper.

Table 4-16 Contributory factors to PSTs' environmental literacy. SD represents standard deviations of data means.

Contributions	Mean	SD
Contribution of EE paper (TEPC 120-15)	3.83	0.97
Contribution of field trip to Hamilton Gardens	3.47	0.96
Contribution of media (Internet/TV/Newspapers/Books/Movies)	3.36	1.02
Contribution through experiences with family and friends	3.17	1.07
Contribution through other experiences	2.59	1.40
Contribution of other papers at the University	2.42	1.01
Contribution of other experiences at the University	1.85	0.88

4.7 Pre-service teachers' preparedness to teach EE

In addition to PSTs' environmental literacy, this study sought to explore PSTs' preparedness to teach EE upon completing their programme. For effective implementation of EE in schools, teachers need to be well prepared regarding balanced curriculum and pedagogical content knowledge to be confident to incorporate EE into their classroom (Öztürk et al., 2013). This section, therefore, reports on findings from the questionnaire administered to PSTs that examined their preparedness to teach EE prior to and upon completing the EE paper. This assessment was based on:

- a) PSTs' level of understanding of the teaching and learning outcomes of the EE paper
- b) PSTs' reflection on their learning in the EE paper
- c) PSTs' beliefs about the influence of the EE paper
- d) PSTs' confidence in teaching EE

4.7.1 PSTs' level of understanding

Prior to and upon completing the EE paper, PSTs were asked to indicate their level of understanding on four teaching and learning outcomes of the EE paper (Questions 52-55, Appendix A), on a scale ranging from 1 (poor understanding) to 5 (very good understanding). Document analysis shows that both cohorts of PSTs (Year 1 and Year 3) had similar learning outcomes (see Appendix J and K) outlined in the EE paper they completed. Prior to completing the EE paper, PSTs rated themselves as having either good or very good understanding with respect to three of the teaching and learning outcomes of the EE paper: significance of environmental and sustainability issues (50%), use of personal experience (53%) and understanding of people (50%) (see Table 4-17).

Upon completing the EE paper, increases were observed in the proportion of PSTs who rated their understanding as either good or very good with respect to these three teaching and learning outcomes: significance of environmental and sustainability issues (82%), use of personal experience (86%) and understanding of people (77%).

Moreover, prior to completing the EE paper, a very low proportion (27%) of PSTs rated their understanding as either good or very good, with respect to the fourth teaching and learning outcome, an understanding of the four dimensions of sustainability. It was interesting to observe that upon completing the EE paper, this proportion of PSTs who rated their understanding as either good or very good tripled (81%). The mean difference between the pre-test and post-test mean scores were statistically significant for all the four teaching and learning outcomes (see Table 4-17).

Table 4-17 Independent t-test comparing PSTs' pre-and post-test level of understanding of teaching and learning outcomes

Level of understanding of:	Pre-test		Post-test		t	P value
	Mean	SD	Mean	SD		
the significance of the environment and associated issues	3.38	0.81	3.93	0.58	-5.053	0.00*
the interdependence of the ecological, social, cultural and economic dimensions of sustainability	2.99	0.86	3.9	0.62	-7.964	0.00*
people's demonstration of attitudes, values and perspective that influence behaviour towards the environment	3.44	0.82	3.9	0.62	-4.189	0.00*
the use of personal experience and reflections (e.g., field trips) in understanding local/global environmental issues	3.44	0.82	3.87	0.68	-3.734	0.00*

*Statistically significant at $p > 0.05$, $n = 88$ (pre-test), $n = 87$ (post-test)

4.7.2 PSTs' reflection on their learning

Reflecting on their learning during the semester, PSTs were asked to indicate whether they would have liked to have had more, less or about the same learning opportunities on six key areas of the EE paper taken (Questions 66-71, see Appendix A). The most commonly identified areas where PSTs would have liked

to have had more learning was about taking students outside the classroom to learn in the environment (65%) and about helping students learn about environmental issues (62%). The least commonly identified area (44%) where PSTs would have liked to have had more learning was about helping students explore the values in environmental and sustainability issues (see Figure 4-22).

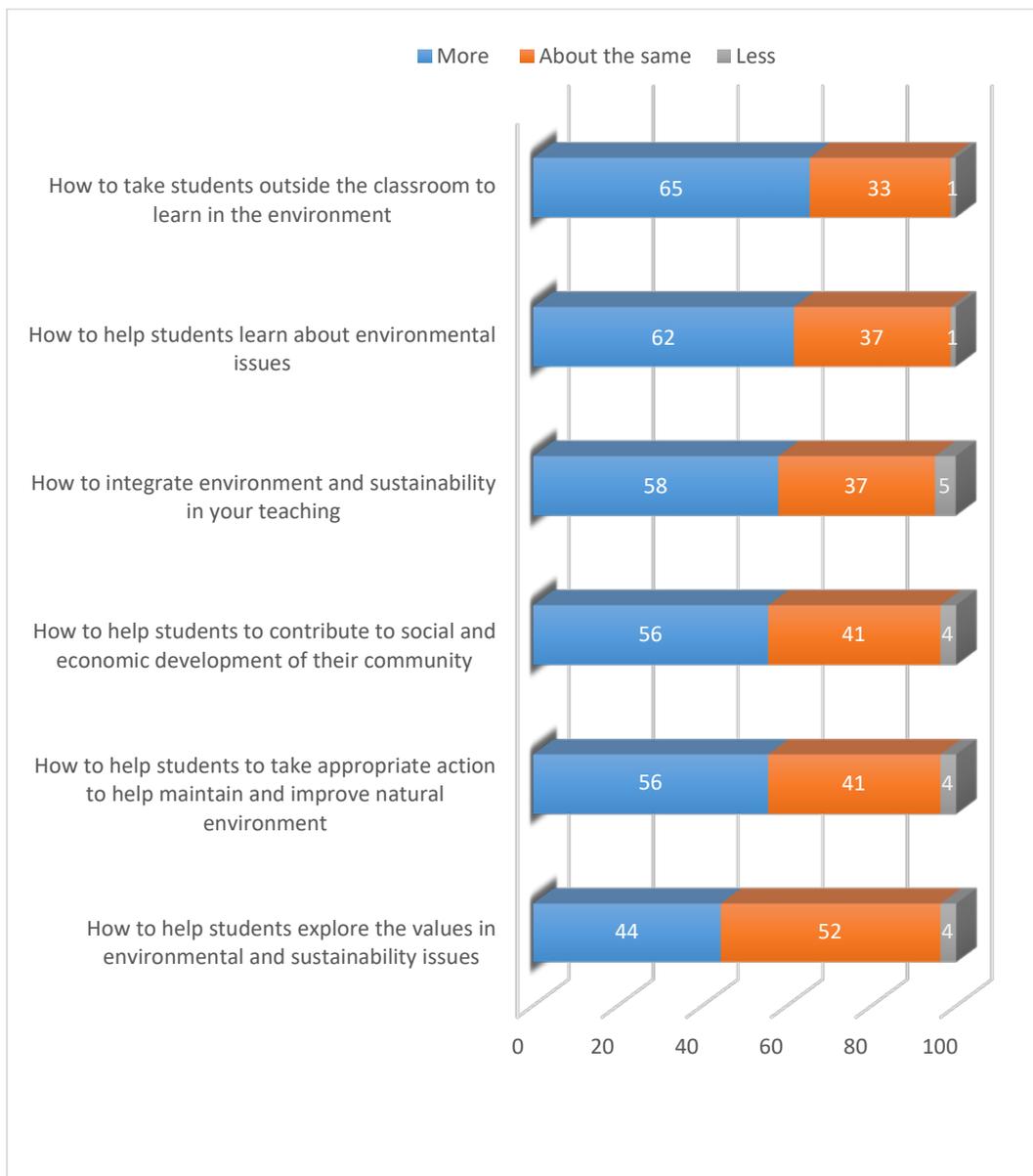


Figure 4-22 PSTs' reflection on whether they would have liked more, less or the same learning opportunities in the EE paper (n =81)

4.7.3 PSTs' beliefs about the influence of the EE paper

PSTs were asked to what extent completing the EE paper influenced their environmental literacy (environmental knowledge, affect, intention to act and

behaviour) and also encouraged them to teach environmental and sustainability issues (Questions 72-76, see Appendix A). The highest proportion, 72% of PSTs, responded that the EE paper influenced their knowledge of environmental and sustainability issues quite a lot or a great deal (see Figure 4-23). Sixty-six percent of the PSTs had been encouraged quite a lot or a great deal to teach environmental and sustainability issues. A total of 60% and 55% of PSTs respectively reported that completing the EE paper significantly influenced their attitude towards the environment and their willingness to act in a more environmentally responsible and sustainable way. However, the proportion that reported that the EE paper had influenced their behaviour to any great extent was least reported, as less than 49% of the PSTs indicated this, although a further 38% did indicate some influence.

4.7.4 PSTs' confidence in teaching

Prior to and upon completing the EE paper, PSTs were given a list of EE objectives (Question 56-61, see Appendix A) and asked to indicate how confident they were in teaching to achieve these objectives in primary schools. Findings indicate increased confidence in teaching all the highlighted objectives upon completing the EE paper. The highest change (56%) was observed with PSTs having enhanced confidence to teach EfS in primary schools. Prior to completing the EE paper only 25% of PSTs reported being confident or very confident to teach EfS in primary schools, while upon completing the EE paper, the proportion of PSTs more than tripled, as 81% reported being confident or either confident to teach EfS in primary schools (see Figure 4-24). The second highest change (35%) was observed with the improved confidence of PSTs in helping students to explore the values in environmental and sustainability issues. Prior to taking the EE paper, 41% of the PSTs reported being confident and very confident in helping students explore the values in environmental and sustainability issues while upon completing the EE paper, 76% reported being confident and very confident. The least change, a 12% increase, was observed with confidence in taking students outside the classroom to learn in the environment.

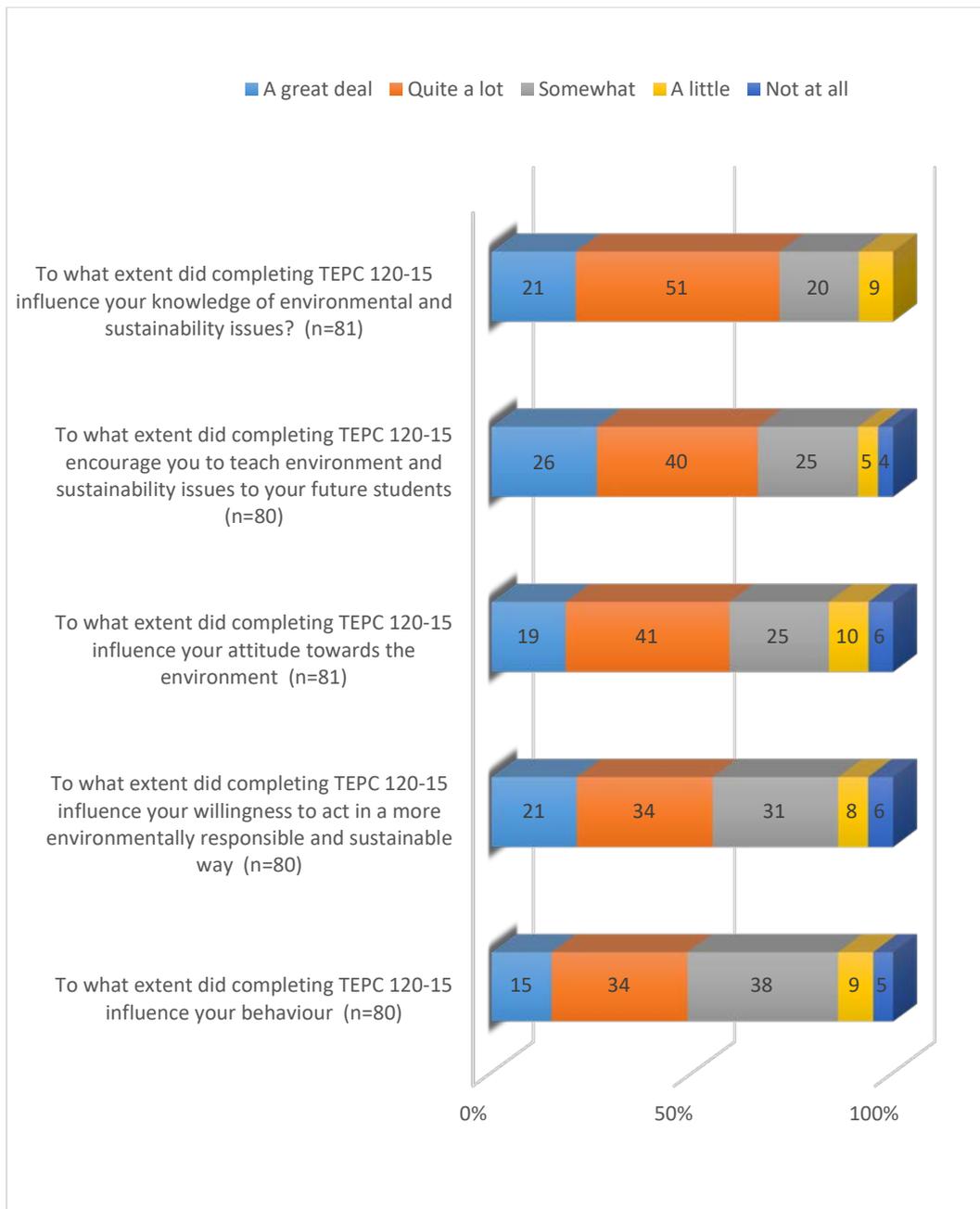


Figure 4-23 PSTs' beliefs about the influence of the EE paper

It is interesting to note that statistically significant differences were observed in the pre-test and post-test mean scores on all the objectives (see Table 4-18), except in confidence in taking students outside the classroom to learn in the environment, although an increased proportion showed slightly more confidence upon completing the EE paper. These data concur with the findings in Section 4.7.2 where 65% of PSTs indicated that they would have liked to have had more learning about taking students outside the classroom to learn in the environment.

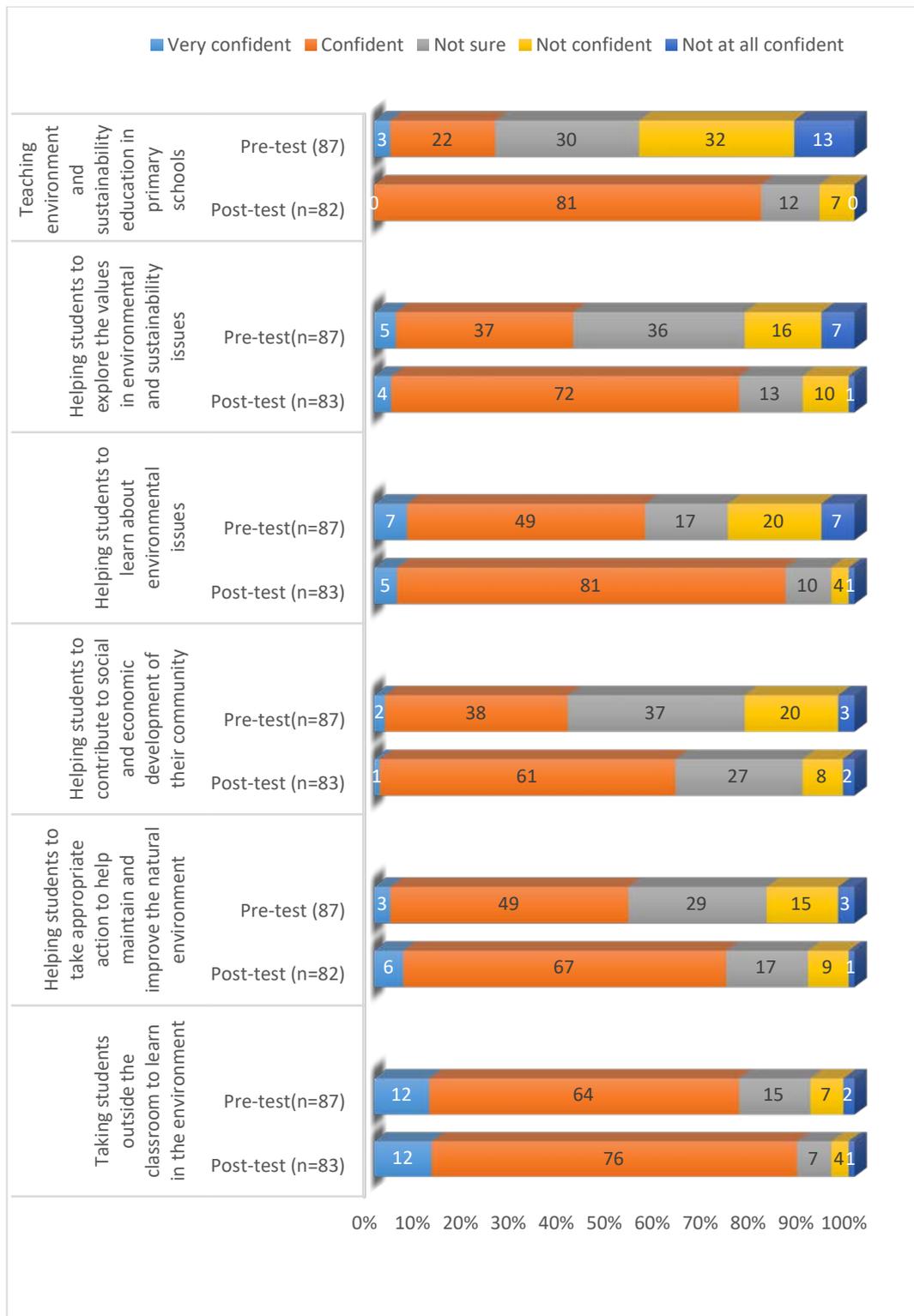


Figure 4-24 PSTs' confidence in teaching prior to and upon completing the EE paper

Table 4-18 Independent t-test comparing PSTs' pre-and post-test confidence in teaching

Item	Pre-test		Post-test		t	P value
	Mean	SD	Mean	SD		
Confidence in teaching environment and sustainability education in primary schools	2.71	1.056	3.73	0.589	-7.686	0*
Confidence in helping students to learn about environmental issues	3.3	1.08	3.84	0.614	-4.016	0*
Confidence in helping students to explore the values in environmental and sustainability issues	3.16	0.987	3.67	0.751	-3.807	0*
Confidence in taking students outside the classroom to learn in the environment	3.76	0.835	3.94	0.669	-1.557	0.121
Confidence in helping students to contribute to social and economic development of their community	3.16	0.888	3.51	0.771	-2.701	0.008*
Confidence in helping students to take appropriate action to help maintain and improve the natural environment	3.34	0.9	3.68	0.768	-2.62	0.01*

*Statistically significant at $p > 0.05$, $n = 88$ (pre-test), $n = 87$ (post-test)

4.7.5 Section summary

PSTs' self-rating of their level of understanding for all the four teaching and learning outcomes greatly increased upon completing the EE paper. These increases in PSTs' level of understanding for all the four teaching and learning outcomes were statistically significant. In regards to PSTs' belief on the influence of the EE paper taken on their environmental literacy, the highest proportion of PSTs believed that the EE paper taken influenced their knowledge of environmental and sustainability issues quite a lot to a great deal. The least influence the PSTs think the EE paper made was the influence on their environmental behaviour.

Reflecting on their learning in the EE paper, about a third (65%) of the PSTs would have wanted more learning in how to take students outside the classroom to learn in the environment. Equally, PSTs' confidence in teaching increased significantly on all the EE objectives highlighted (see Section 4.7.4) except one associated with PSTs' confidence in taking students outside the classroom to learn in the environment. Evidence from this study suggests that PSTs seem to be unsure of their ability to help students learn in the environment.

To triangulate PSTs' self reported EL and preparedness to teach EE in primary schools, this study interviewed tutors of Year 1 PSTs in order to understand their perceptions about the EE paper taken, EL and their perception about the preparedness of PSTs to teach EE based on the EE paper taken. The next section presents PSTs' tutors' perspective on the immediate impact of completing an EE paper on PSTs' EL.

4.8 Tutors' Perceptions of the impact of EE paper and preparedness of PSTs to teach EE

This section presents findings from interviews conducted with three tutors of PSTs who were involved in the lectures and workshops related to the EE paper taken by PSTs. The findings data presented in this section relates to these tutors' opinions on the EE paper just concluded by PSTs, their perceived impact on PSTs' EL as well as their views about the preparedness of PSTs to teach EE in primary school based on their learning in the EE paper. These findings are presented to shed more light

on PSTs' reported impact of the EE paper on their EL and other issues associated with the EE paper, relevant to this study.

The tutors agreed that PSTs' knowledge of environmental and sustainability issues was vital as not only does it develop their EL, but it equips them to help their future students. More so, considering the positioning of EE in New Zealand's curriculum, they are of the opinion that it is necessary for PSTs to be knowledgeable in that regard. For example, Tutor 1 recounted their view on the importance of the paper:

I would say very important because, but then I am looking a little bit beyond just the training to be a teacher, although I think that is a big part of it. But, for me, being involved in education, you have to think about the whole person and whole of life learning and all of those big picture ideas, if you don't have an understanding of the world you are living in and how you can contribute to that world carrying on from generation to generation then you're really not doing your job. If all you do is focus on English, Maths, social studies because that is what is in the curriculum, so teachers need to have those understandings if they will be able to support and develop those understanding in kids.

Regarding the affective dimension of EL, although the tutors feel it is important, they were not so sure of the practicalities in the EE paper just completed. Tutor 1 reported:

I think it is really important, but we are talking about a paper that can only really scratch the surface because it's an half paper and its only taught for 12 weeks so it's not an huge amount of affective changes you can bring about in that shortest space of time. By heightening the awareness you are kind of sowing the seed that can grow ... From an affect point of view, we get a better shift and reason with quite a lot of people so there is a latent acceptable attitude there anyway that we kind of tap into to help people a bit more aware.

Another tutor did not seem comfortable with the concept of affect especially as it relates to grouping some affects as pro environmental and others as not. She said:

[Affect] is incredibly important but I don't like this notion of these are positive attitudes and these are negative attitudes and you scale them and stuff like that. I think attitudes are ways a particular person is at a particular time and attitude can change but it is not necessarily this. I mean obviously there are some negative attitudes towards the environment and some positive ones towards the environment but I don't like this notion that we have got a particular attitude in mind that we want the students to have and that we are going to enlighten them and push them towards that particular way, so I think we need to problematize that (Tutor 2).

The tutors approved of the need for PSTs to learn about taking action on environmental and sustainability issues (ERB). However, they felt the EE paper could improve in addressing the behavioural component although the practicalities in an half paper were uncertain. For example, Tutor 1 responded to the question: How important do you think it is that PSTs learn how to take action about the environment and sustainability issues with:

It varies but it is not something we do very well and again that's because the nature of the paper is such that for anyone to really develop that capability of action competence is to involve people and take action and we don't have to do that. We are talking about over the year 140 people all taking action that can make a difference in relation to some sustainability issues. Managing that might be a challenge and when you have only got 25 hours of contact time, it is not really something we do. In the online paper, we used to have the compulsory task as focusing on taking some action so we're giving a little bit of exposure to them and again it is not huge and the face to face, it's just too hard in answer to the question. I think it is really important but it is not practical to do in the course that we have, all we can do is make them aware of the importance and show them examples.

These findings echo PSTs' belief that the EE paper had more impact on their environmental knowledge than it did on their environmental behaviour (see section 4.7.3). It gives evidence that the EE paper seemed to be more targeted at PSTs' knowledge.

The three tutors had the opinion that these PSTs were not prepared to teach EE based on the EE paper taken. This disagrees with PSTs' perceptions, as they felt they were confident and prepared to teach their future students (see Section 4.7.4). PSTs' perceptions might have been influenced by the excitement and enthusiasm they had upon completing the EE paper but then, they still have at least two years before they actually start teaching. Excerpts from tutors' responses to how well they think PSTs are prepared to teach EE after completing the paper are presented below:

Not very well because it is too little and too early on in the programme. I think we do a good job with the time we have available and there is a much greater awareness of what they should be learning and how they should be learning. This is an area that should be in the curriculum, this is quite an important part but I think doing a half paper alongside 8 other half papers in the first year and having 2 full years after that and going into schools and not necessarily seeing very much evidence of EfS with their associate teachers on practicum doesn't really equip them particularly well. I think we need a more coherent, more continuous kind of a programme (Tutor 1).

I don't think they are that well prepared and I wouldn't expect them to be. This is a taster and we could say this in regard to how well are they prepared to teach literacy, how well are they prepared to teach maths. Very mild on the first year and again I think it's an issue in terms of how the paper is positioned in their undergraduate degree. I think personally it will be better in the third year when they have got a lot of different knowledge to bring into the paper. I think in the first year it's like teaching an extension of secondary school for many of them.(Tutor 2).

I feel they are not fully prepared because teachers are not fully prepared after working with them for 5-10 years. It is a difficult process but we have made a start and again I think that's the catalyst and I think the paper is extremely important for them... I would love to have a second paper to work with, I would introduce initially and then rework on integration into curriculum in the third year if the degree is being restructured (Tutor 3)

Reasons given by the PSTs' tutors as to why they felt the PSTs were not prepared to teach relates to the positioning and duration of the EE paper during PSTs' teacher education program. Also, a lack of experience of EE, prior experience, or practicum experience was given.

These tutors perceive time as a barrier to successfully preparing PSTs to teach EE. For example:

There is an ongoing tension between providing diverse, useful learning experiences and the time needed for in-depth discussion on certain ideas and issues as they arise, and the time for discussion always take longer than anticipated but if you don't take time for that discussion there is not enough time to explore ideas. The fact that very few of our students have experienced education for sustainability in their own school is a challenge (Tutor 1)

In agreement with time and framing of EE paper as an issue, Tutor 3 reported:

Time is an issue and I think scheduling some sessions I know we had some breaks and we didn't have tutorials or whatever to accommodate that timing of the paper, rather than having those breaks, what I would like to have instead of missing a double hour is maybe we can have a single hour over two weeks such that you still keep the continuity going, for me this year some of the scheduled break broke continuity (Tutor 3).

Reacting to the issues associated with limited time for the EE paper, a notable finding across all tutors was their desire for a change in the current curriculum and pedagogical approaches used in the EE paper:

...I think we should as much as possible with an half year paper try to model what you would do in an EE classroom and integrate the assessment into that rather than this unit planner removed from their practicum ...(Tutor 2).

Still on the pedagogical approach used in the EE paper, when asked what they would have done differently, Tutor 3 said:

[I would have] followed an inquiry theory role to build their understanding. I would like to make it more practical across the 10 weeks. I would like to follow an inquiry approach across the 10 weeks.

Overall, findings from interviews with tutors of PSTs provided some in-depth understanding of the EE paper, their perceptions about EL as a concept and barriers to successful preparation of PSTs to teach EE. These tutors agreed that EE plays a role in developing environmental knowledge, but given the nature of the EE paper used as case study, they felt that developing environmental affect and behaviour does not seem practicable. The tutors, however, acknowledged the need for more focus on the behavioural component of EL. All the three tutors interviewed felt the PSTs were not prepared to teach EE in primary schools and reasons given relate mainly to the positioning of the EE paper in the degree. The EE paper seems too early because the PSTs still had about two years before they begin their teaching career. They suggested the need for another paper that could serve as a refresher in the third year or some kind of continuous EE education through the course of PST education. The tutors identified constraints on time as a barrier to the successful preparation of PSTs during their teacher education programme. They also yearn for a change in existing curriculum and pedagogical approach used in the teaching of EE to help the PSTs to be able to meet the challenge of integrating EE into teaching in primary schools.

4.9 Chapter summary

This chapter explored the immediate impact of completing an EE paper on PSTs' EL and preparedness to teach EE upon graduation. The findings showed that PSTs' self-rating of their understanding, and their demonstrated knowledge of the natural environment, both increased upon completing the EE paper. The increased knowledge related to the aspects focused on in the EE paper. Moreover, findings indicated that the PSTs retained primarily anthropocentric views about the environment through the EE paper.

In a similar vein, PSTs demonstrated increased knowledge of sustainability, especially on how it relates to the three components; environmental, socio-cultural and economic, as emphasized in the EE paper. However, PSTs' definitions of

sustainability showed a stronger inclination towards the environmental component. PSTs' demonstrated knowledge, and beliefs of their own knowledge, of some environmental and sustainability issues significantly increased in terms of aspects focused on in the EE paper, including issues on bee decline and consumption and waste. On the whole, these findings suggest that their learning in the EE paper might have contributed significantly to their knowledge, especially of issues discussed in the EE paper.

Before undertaking the EE paper, PSTs already expressed positive environmental affect and thus significant changes were not expected nor observed upon completing the EE paper. Upon completing the EE paper, some PSTs still felt that the involvement of some 'powerful others' such as the government is needed to make a difference. Nevertheless, a slight shift over the duration of the paper towards feelings of responsibility for the problems and solutions to the environmental issues in the community was also observed among PSTs. Similar to findings on PSTs' knowledge of the natural environment, their environmental worldview showed a more anthropocentric view of the environment, and their learning in the EE paper did not seem to influence such position. On the whole, a mixed worldview was observed among PSTs upon completing the EE paper. They demonstrated more pro-environmental worldviews in relation to the statements related to humanity over nature (the balance of nature). However, they did not express pro-environmental worldviews regarding statements related to the limits of growth.

Significant increases in PSTs' environmental concern was associated with the environmental and sustainability issues focused on in the EE paper, bee decline and consumption and waste. It was surprising to observe reduced concern about environmental and sustainability issues not focused on in the EE paper. Although the reasons for this reduced concern are unclear, it indicates to some extent that PSTs' learning in the EE paper had a significant effect on their concern for the period of their learning.

Similar trends were observed in PSTs' environmental behaviour assessed through their intention to act in an environmentally responsible manner, and their self-reported engagement in some specific environmental activities. Prior to taking the

EE paper, PSTs expressed high levels of intention to act (in pre-test mean scores) on behaviours related to protecting endangered species and financial commitments, coupled with low pre-test mean scores on behaviours associated with lifestyle changes and environmental activism. Upon completing the EE paper, few or no changes were observed in these mean scores. Equally, PSTs' self-reported behaviour indicated that they engaged most in community giving, via behaviour that required a financial commitment, and least in activities associated with environmental activism. Overall, PSTs' learning in the EE paper did not seem to influence their environmental behaviour.

Based on PSTs' reported data, the EE paper taken, followed by the field trip PSTs engaged in contributed the most to their EL. Evidence from this study shows that the EE paper achieved its stated goal and objectives. A significant increase in post-test mean scores related to PSTs' self-rating of their level of understanding for all four teaching and learning outcomes of the EE paper observed. However, the question is whether this fully encompasses the goal of EE in producing environmentally literate citizens who, in addition to theoretical knowledge, show the required affective disposition and appropriate behaviour towards current environmental and sustainability issues. Evidence from PSTs' self-reported data show that the EE paper had more influence on PSTs' knowledge and less influence on their affect and behaviour.

The majority of PSTs' (65%) in this study would have liked more learning on how to take students outside the classroom to learn in the environment. This finding is in agreement with the analysis of data examining PSTs' confidence in teaching. Among the specific areas highlighted, PSTs felt least confident in taking students outside the classroom to learn in the environment but most confident in teaching EE in primary school, upon completing the EE paper.

The perceptions of PSTs' tutors about the EE paper concurs with earlier findings in this study, that the objectives of the EE paper were more targeted towards environmental knowledge and not on affect and behavior of the PSTs. The tutors also felt the PSTs were not well prepared to teach EE in primary schools. Factors such as time constraints, positioning and duration of the EE paper, the existing

curriculum and the pedagogical approaches used in the EE paper were identified as barriers that might have influenced the successful preparation of PSTs to teach EE upon graduation.

Chapter Five: Findings - Year 3 PSTs

5.1 Overview of Chapter

This findings chapter seeks to answer the second research question of this doctoral thesis: *What are the environmental literacy levels of ready-to-graduate pre-service teachers (Year 3) and how prepared do they feel to teach environmental education based on their exposure to environmental education during their pre-service teacher education?*

As previously mentioned in Chapter 2, one of the goals of Environment Education (EE) is the development of environmental literacy (EL). Therefore, to answer this research question, findings on the environmental literacy of this cohort of PSTs (Year 3 PSTs) are reported followed by an analysis of their preparedness to teach EE. The sections in this chapter encompass findings on Year 3 PSTs' environmental knowledge (Section 5.2), environmental affect (Section 5.3), environmental concern (Section 5.4), and environmental behaviour which takes into account their intention to act (Section 5.5). Subsequent sections report on the relationships between these environmental literacy components (Section 5.6) and the impact of other factors on PSTs' environmental literacy (Section 5.7). The final sections present findings on PSTs' preparedness to teach EE (Section 5.8) and a case story: an in-depth interview with one of the PSTs (Section 5.9). A summary of these findings completes the chapter (Section 5.10).

5.2 Environmental knowledge of Year 3 pre-service teachers

The environmental knowledge of Year 3 PSTs was examined through the use of a questionnaire that comprised of closed and open-ended questions. The questionnaire administered to this cohort of PSTs was similar to the post-test questionnaire administered to Year 1 PSTs (See Appendix A). The questionnaire had a section targeted at PSTs' reported environmental knowledge and another on PSTs' actual knowledge. These sections of the questionnaire covered aspects on the 'natural environment', 'sustainability', as well as selected 'environmental and sustainability issues' in New Zealand.

5.2.1 PSTs' knowledge of the natural environment

Pre-service teachers were first asked to rate their understanding of the natural environment on a 10-point scale ranging from poor understanding (1) to excellent understanding (10). Presented in Figure 5-1 is a graph showing PSTs' self-reported ratings of their understanding of the natural environment. A categorisation of their self-ratings was done such that ratings from 1-2 were classified as poor understanding, 3-4 as rudimentary understanding, 5-6 as good understanding, 7-8 as very good understanding and 9-10 as excellent understanding.

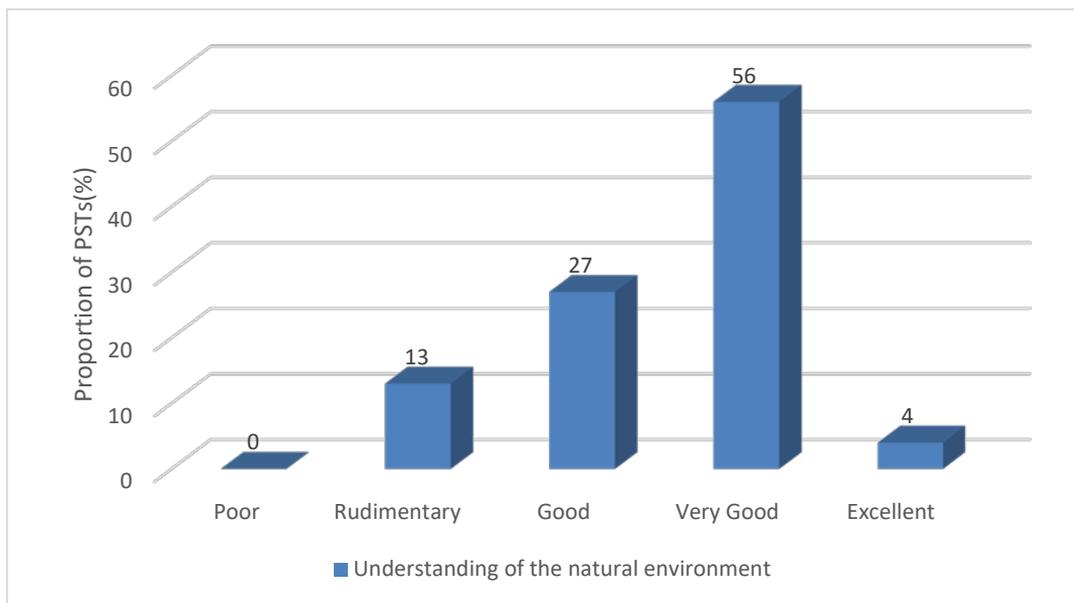


Figure 5-1 Percentage and distribution of PSTs' self-ratings of their understanding of the natural environment (n= 57)

Among the categories representing PSTs' understanding of the natural environment, the category 'very good understanding' was most prevalent (Figure 5-1). This was followed by those who rated themselves as having a good understanding of the natural environment (27%). Only 4% of the PSTs rated their understanding of the natural environment as excellent. It is interesting to observe that there was no one who rated their understanding of the natural environment as poor. Comparing these findings with the Year 1 counterparts, upon completing the EE paper, a greater proportion of Year 1 PSTs, 69%, rated their understanding of the natural environment as 'very good' (see Section 4.2.1). Arguably, more of the Year 1 PSTs expressed 'very good' understanding of the natural environment after taking the EE paper than their Year 3 counterpart two years after taking the EE paper. Although

the two cohorts (Year 1 and Year 3PSTs) were not the same but equivalent as exemplified by the document analysis carried out on the paper outline used in the teaching of the EE paper (see Appendices J and K). This finding could imply a reduced understanding of the natural environment by PSTs in their third year of study, having had little direct teaching about it since Year 1.

To further determine PSTs' understanding of the natural environment, an open-ended question asking why PSTs think the natural environment is important was asked in the questionnaire administered. Among the 57 PSTs who responded to the had only related the importance of the environment to what it does questionnaire, only 36 PSTs provided responses to this open-ended question. The responses received were analysed thematically, and range of responses analysed developed the categories describing PSTs' conceptions of the environment. Some PSTs' responses were placed in more than one category. To avoid skeweness in coding PSTs' responses, care was taken to ensure that individual responses were not placed in more than three categories, except for two PSTs' responses that clearly portrayed 4 and 5 categories. Since coding often produced more than one category per PST, the number of coded responses (n=54) exceeded the total number of PST respondents (n=36) in this study.

From the inductive analysis of PSTs responses, 13 categories were identified. These categories were then regrouped into five main themes that reflected PSTs' understanding of the natural environment, similar to the approach used for the Year 1 PSTs (Section 4.2.1).

The main themes and categories were:

- The environment does something for people and other living species – provisioning and cultural. This theme, similar to the findings from the Year PSTs (Section 4.2.1) had the highest number of responses. A majority of the PSTs viewed the environment as important because of the role it plays in providing the basic needs of life for humans and other living species.
- Environment as a place where animals/plants live - relates the importance of the environment to its function as a home for plants, animals and

humans. Of the 9 responses across the categories under this theme, only 3 responses solely cited home for humans (see Table that (1 5 suggests that PSTs seem to recognise that the natural environment caters for more than humans but also other living species

- The environment is irreplaceable and must be protected – PSTs’ responses under this theme relates the importance of the environment to its irreplaceable nature and thus needs to be protected. Some responses also highlighted that environmental problems are largely caused by the influence of human activities.
- People and the environment are in a mutually sustaining relationship – relates the importance of the natural environment to its ecosystem services and how its functioning impacts people
- Environment and future perspective – relates the importance of the environment to the future and future generations.

Table 5-1 Themes and categories from PSTs’ responses to question: Why do you think the natural environment is important? (n=54)

Themes	Categories	number (%)
Environment does something for people and other living species		23 (43)
	Provisioning	18
	Climate regulation	1
	Cultural	4
Environment as place		9 (17)
	Home for animals	1
	Home for humans	3
	Home for plants and animals	2
Environment is irreplaceable and should be protected	Home for animals, plants, and humans	3
		8 (15)
	Humans are responsible for environment	2
	One Earth	6
People and the environment are in mutually sustaining relationship		3 (6)
	Ecosystems	3
Environment and Future Perspective		5 (9)
	Future Generation	4
	Future	1
Uncategorisable		6 (11)

The theme with the highest number of responses (43%, n=54) was *Environment does something for people and other living species*. These PSTs viewed the environment as important because of the role it plays in providing the basic needs of life for humans and other living species. The basic needs of life according to the PST responses includes water, food, shelter and survival (support for life, oxygen). Examples of responses under this theme are:

Our natural environment provides us with basics for life - water, healthy foods, shelter, etc. Not only provides for us but plants and wildlife too (PST 25).

The natural environment is important because it helps us to survive (PST 56).

Among the PSTs' responses that were classified as being under the theme, "*Environment does something for people and other living species*", 7% related to cultural importance of the environment, with particular reference to its aesthetic value and cultural beliefs. Examples are:

It is also important as it is part of our gift from our ancestors (PST 17).

Because it is beautiful and peaceful ... (PST 42).

The theme with the second highest number of responses, accounting for 17% of PSTs' coded responses, was "*Environment as a place*". PSTs related the importance of the environment to its function as home for all living species: plants or animals, and in particular humans. Examples of responses under this category are:

I feel it is important because the natural environment is what we live in. Therefore we should respect it (PST 2).

Habitat/environment for all living things; animals, insects and plants (PST 9).

Some PSTs responses (15%) were placed under the theme, *Environment is irreplaceable and should be protected*. These responses highlighted the inimitable nature of the Earth and hence, the need for humans to protect the environment. Two of the eight responses categorized under this theme recognised the impact of human

activities on the environment. Examples of responses categorized under this theme are:

Once it is destroyed we cannot get it back so we need to look after it now (PST 49).

Once the nature is gone, we can't buy it back or make it again ... it is being deteriorated by human greed (PST 53).

PSTs responses (9%) that associated the importance of the natural environment to its benefits for the future and future generations were placed under the theme, ***Environment and future perspective***. Examples are:

To protect what is already there so it is plentiful for future generations to enjoy and continue to look after (PST 1).

We need to look after it to avoid destroying our chances of life in the future (PST 12).

Few PSTs' responses (6%) linked the importance of the natural environment to the functioning of the ecosystem and were grouped under the theme, ***People and the environment are in a mutually sustaining relationship***. Examples of such responses are:

Our impact on the natural environment affects plants and other animals which in turn affects the ecosystem (PST 16).

Once an ecosystem has been destroyed it is either virtually impossible to rejuvenate or rectify the damage which ultimately impacts on human life (PST 57).

Some of the PSTs' responses (11%) were not placed in any of the categories mentioned above and were grouped as 'Uncategorisable'. Examples of such are:

It is important because without it NZ environment quality would go down (PST 39).

Anything to do with animals I am very passionate about. Not buying products tested on animals and trying to avoid parabens and palm oil when possible. The environment makes our world go around (PST 21).

A further thematic analysis of responses from PSTs, when asked why they think the natural environment is important, categorised each response as expressing either mainly anthropocentric (human-centred), ecocentric (environment-centred) or theocentric (faith-centred) conceptions. Not all the responses could be categorised into the aforementioned categories and were therefore categorised as uncategorisable. This category was made up of responses that failed to address the question asked and some other responses which had elements related to the context of the question asked but could not be placed under any category as the information embedded in such responses was insufficient for objective placement.

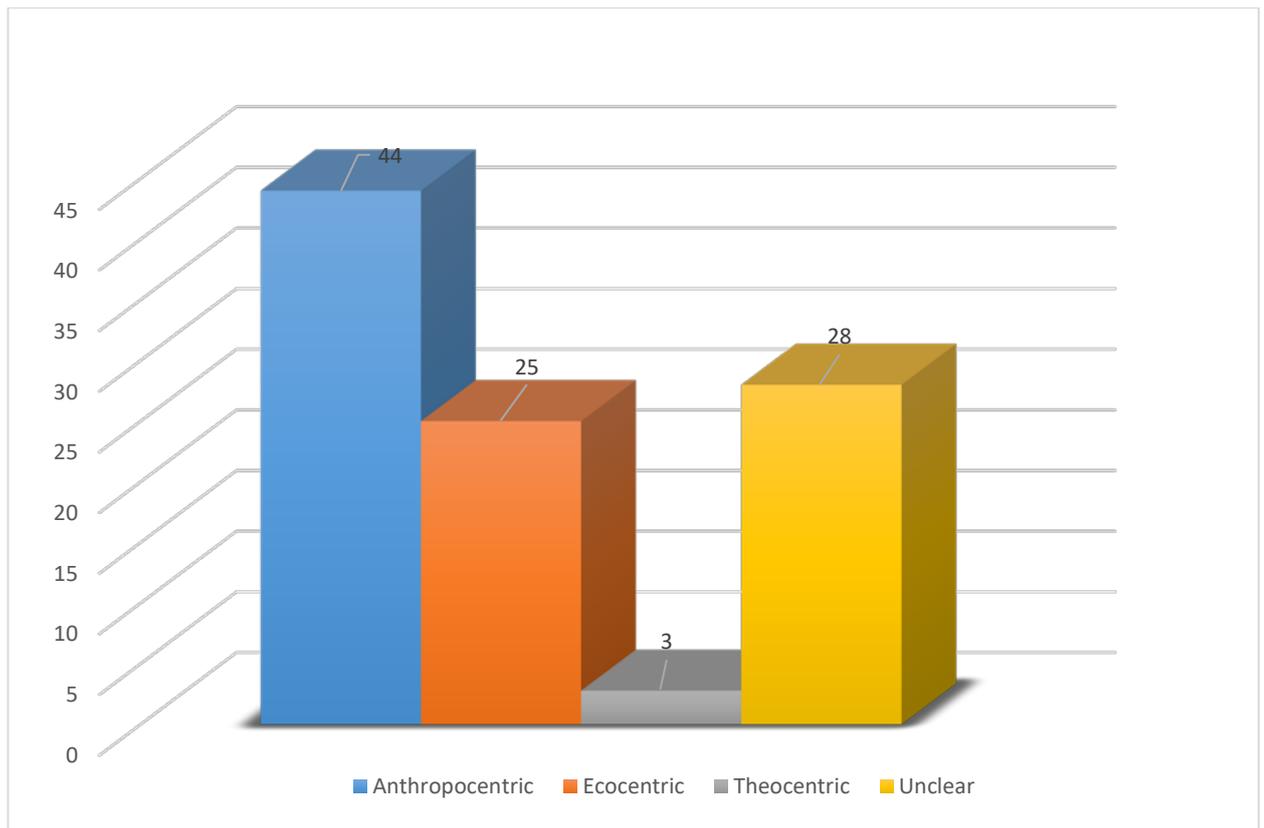


Figure 5-2 Percentage and distribution of PSTs' conceptions of the natural environment (n=36)

As shown in Figure 5-2, almost half (44%) of PSTs that responded held an anthropocentric view of the importance of the natural environment. Examples of responses under this category include:

Everything we use, buy and consume comes from the natural environment. For us as consumers, it is extremely important (PST 40).

A quarter (25%) of PSTs were observed to hold an ecocentric view based on their responses. Examples of responses under this category are:

The natural environment provides for more than human needs. Our impact on the natural environment affects plants and other animals that in turn affects the ecosystem... (PST 16).

Our natural environment provides us with basics for life - water, healthy foods, shelter, etc. Not only provides for us but plants and wildlife too (PST 25).

Two of the 54 PSTs related the importance of the natural environment to God's creation and the given mandate to protect it. An example of such responses was:

Once the nature is gone, we can't buy it back or make it again. It aligns with my Christian faith of the beautiful creation that is being deteriorated by human greed (PST 53).

One third of PSTs responses was not grouped under any of the highlighted conceptions as the position of PSTs through their responses were either unclear or failed to address the question. Examples of such are:

We need to look after it in order to have a sustainable future for generations to come (PST 20).

Once it is gone, it is gone (PST 32)

The environment makes our world go around (PST 21)

Summarily, although about two-thirds of PSTs rated themselves as having very good to excellent understanding of the natural environment, PSTs' responses to the open-ended question reflected that the majority of PSTs think of the environment

with respect to what it does for people and other living species. Very few of PSTs' responses related their understanding of the environment in terms of the mutual relationships existing between the environment and other living species. This finding is somewhat similar to findings from year 1 PSTs, where the majority of PSTs prior to completing the EE paper had only related the importance of the environment to what it does for people and other living species. Upon completing the EE paper, substantial shifts were observed as more Year 1 PSTs' responses reflected the mutual relationships existing between the environment and other living species (Section 4.2.1). This finding therefore provides evidence that two years after taking the EE paper, the Year 3 PSTs did not show evidence of retention of their learning about the natural environment, assuming that their knowledge was developed when they took the EE paper in 2013.

5.2.2 PSTs' knowledge about sustainability

To assess PSTs' knowledge about sustainability, the administered questionnaire asked PSTs to rate their understanding of sustainability on a 10-point scale ranging from poor (1) to excellent (10) understanding. For the purpose of analysis, a categorisation of these PSTs' self-rating was done with ratings from 1-2 designated as poor understanding, 3-4 as rudimentary understanding, 5-6 as good understanding, 7-8 as very good understanding and 9-10 as excellent understanding.

As shown in Figure 5-3, the most common self-rating (42%) observed in the questionnaire response was the third category, i.e. PSTs who rated themselves as having a good understanding of sustainability. The second most common (34%) self-rating category consisted of PSTs who rated themselves as having very good understanding. Only 4% rated their understanding of sustainability as excellent while no one was classified as being of a poor understanding of sustainability, based on PSTs' self-ratings.

Comparing PSTs' self-rating of their understanding on sustainability with their understanding on the natural environment, a greater proportion of PSTs seem to indicate better understanding of the natural environment than was observed for sustainability.

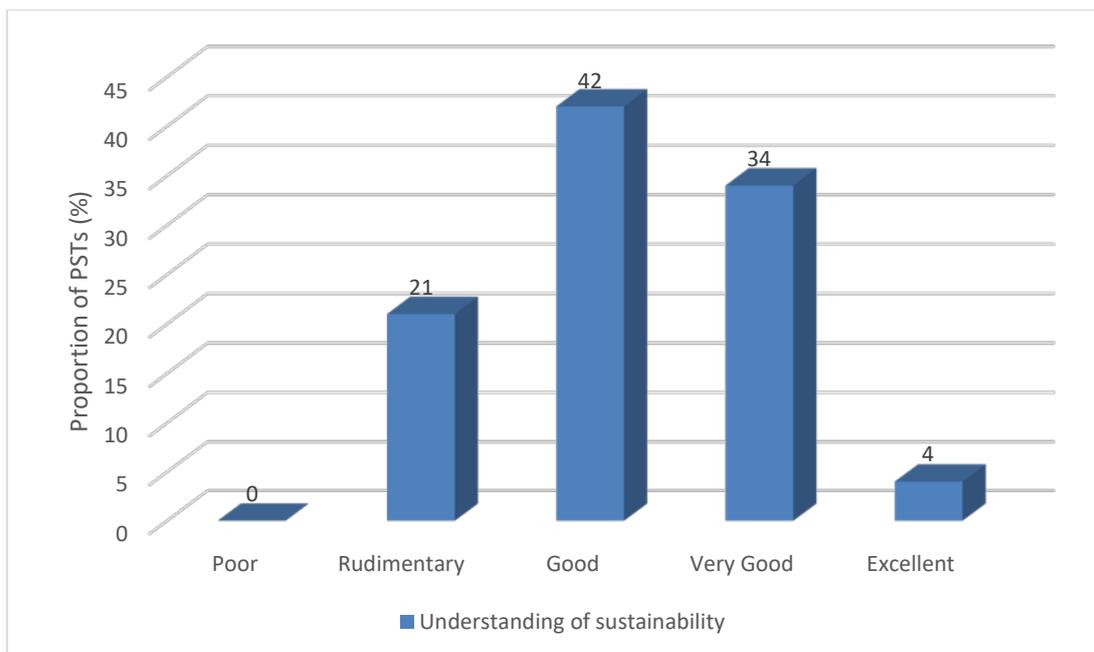


Figure 5-3 Percentage and distribution of PSTs' self-ratings of their understanding of sustainability (n=56)

To further assess PSTs' understanding of sustainability, an open-ended question, 'what does sustainability mean to you' was asked. Among the 57 PSTs that participated in the questionnaire survey, only 32 PSTs responded to this open-ended question. Their responses were thematically analysed to identify PSTs' conceptions about sustainability. Some PSTs' responses were placed in more than one category, hence, the number of responses placed in categories (n=56) exceeded the total number of PST respondents (n=32) in this study. This coding approach with more than one category per respondent is in line with a previously published study, (Yavetz et al., 2014), similar to the current study.

Using a general inductive approach, 10 codes emerged from the analysis of PSTs responses, from which seven categories were developed. These categories were then placed into five themes partly informed by Summers et al. (2004) and similar to the approach used for Year 1 PSTs in Chapter 4. Although fewer categories emerged from the analysis of Year 3 PSTs compared to the Year 1 PSTs, there was evidence for four of the seven main themes identified by Summers et al. (2004) namely: *purpose, nature, human focus and time scale* in the Year 3 PSTs' responses. Evidence for geography scale, controversy and aesthetic were absent in the analysis of PSTs' responses.

As shown in Table 5-2, the highest proportion of PSTs defined sustainability in regard to its *purpose*. Forty-six percent of PSTs' responses (n=56) were grouped under this theme and categories that emerged included resources, continuous flow and reducing negative impacts. The second most prevalent theme was related to *nature* of sustainability. PSTs' definitions of sustainability with elements portraying any of the three aspects of sustainability were placed under this theme. About one-third (29%) of PSTs' responses associated their understanding of sustainability with the environment, while 9% of PSTs' responses were related to social-cultural aspects of sustainability. None of the PSTs defined sustainability in regard to its economic nature. Few of the PSTs' responses related their understanding of sustainability through human populations and/or their needs (7%), and these were categorised as future generations under the theme, *human focus*. Other PST responses (7%) that defined sustainability in regard to future dimensions were placed under the theme, *timescale*.

Table 5-2 Themes, categories, proportions and examples of PSTs' responses

Themes	Categories	Number of responses per category, (% of respondents, n=56)	Examples of coded PSTs' responses
Purpose		26(46)	
	Resources	18	Using resources in a way that means it does not run out...
	Continuous flow	4	To keep things long lasting
	Reducing negative impact	4	Having neutral or positive impact on the environment.
Nature		21(38)	
	Environment	16	Looking after the environment
	Social-cultural	5	Working together
Human Focus	Future generations	4(7)	Sustainability is equal to intergenerational equity
Time-scale	Future	4(7)	...there will always be resources for the future.
	Uncategorisable	1(2)	I strongly value it, it is part of my life, identity and part of my teaching

Similar to the approach employed for Year 1 PSTs, an attempt was made to categorise PSTs' responses into the three aspects of sustainability (environmental, social-cultural and economic). To achieve this, individual PSTs' responses to the open-ended question were re-analysed based on three aspects of sustainability. It was observed that 24 of the 32 (75%) definitions of sustainability were related to the environment while five of the 32 (16%) definitions of sustainability had elements of the socio-cultural aspect. No PSTs' response was related to the economic aspect of sustainability. Some PSTs' responses (3 out of 32- 9%) were not appropriate for any of the categories and hence were grouped as 'uncategorisable'.

Overall, findings suggest that PSTs were aware of their level of understanding of sustainability. This viewpoint is informed by the observation that PSTs did not overly rate their level as being excellent or very good. Only about one-third of the PSTs rated their level of understanding as being in this category. Evidence of this conservative self-rating was also found in the lack of comprehensiveness observed in their definition of sustainability. For instance, a majority of the PSTs defined sustainability with respect to the environment rather than a definition that reflects the three aspects of sustainability as taught in the EE paper. Only a few PSTs linked the definition of sustainability to its social-cultural aspects while the economic aspect was completely left out. This pattern of sustainability definition that fails to capture all the three aspects of sustainability was also prevalent among the Year 1 PSTs prior to taking the EE paper. This finding among the Year 3 PSTs somewhat suggest that they seem to have forgotten their learning on the aspect of sustainability in the EE paper they had two years earlier.

5.2.3 PSTs' knowledge of environmental and sustainability concepts

To assess PSTs' knowledge of some selected environmental and sustainability concepts or knowledge (EK), a section of the questionnaire administered had questions that were related to ecosystem services (Question 47), an example of a sustainable approach (Question 48), the effect of bee decline (Question 49), and consumption and waste (Question 51). A question on water pollution (Question 50) was also included (see Appendix A for the full questionnaire). All EK questions were multiple-choice questions with five possible choices, which included three

options that would be considered not to represent environmental sustainability (coded as incorrect), one option that would (correct), and a 'don't know' option. For the purpose of analysis, the incorrect option was coded as '-1', don't know option as '0' while the correct answer choices were coded as '1'. The non-response rate was very low as only one PST failed to provide an answer to four of the environmental knowledge questions asked. Non-responses were therefore exempted from the analysis.

Analysis of PSTs' environmental knowledge of the selected concepts was done by (i) Calculating the proportion of answer choices (incorrect, don't know and correct) for each of the five EK questions and (ii) Classifying PSTs' answer choices into groups based on the total number of EK questions answered correctly to assess PSTs' overall environmental knowledge of the selected concepts.

As shown in Figure 5-4, the EK question most often answered correctly by PSTs was the question on effect of bee decline, as 90% of PSTs chose the correct answer. One possible explanation for this could be that PSTs still retained the knowledge gained on bee decline even two years after completing the EE paper. This may have been because classroom observation of the Year 1 PSTs showed that a great proportion of the EE paper taken was devoted to the effect of bee decline on food production. This position is also supported by responses recorded during an interview with one of the Year 3 PSTs who, when asked what she learnt in the EE paper taken 2 years ago said,

... about bees, I didn't really realise that bees were quite endangered until after taking the paper...

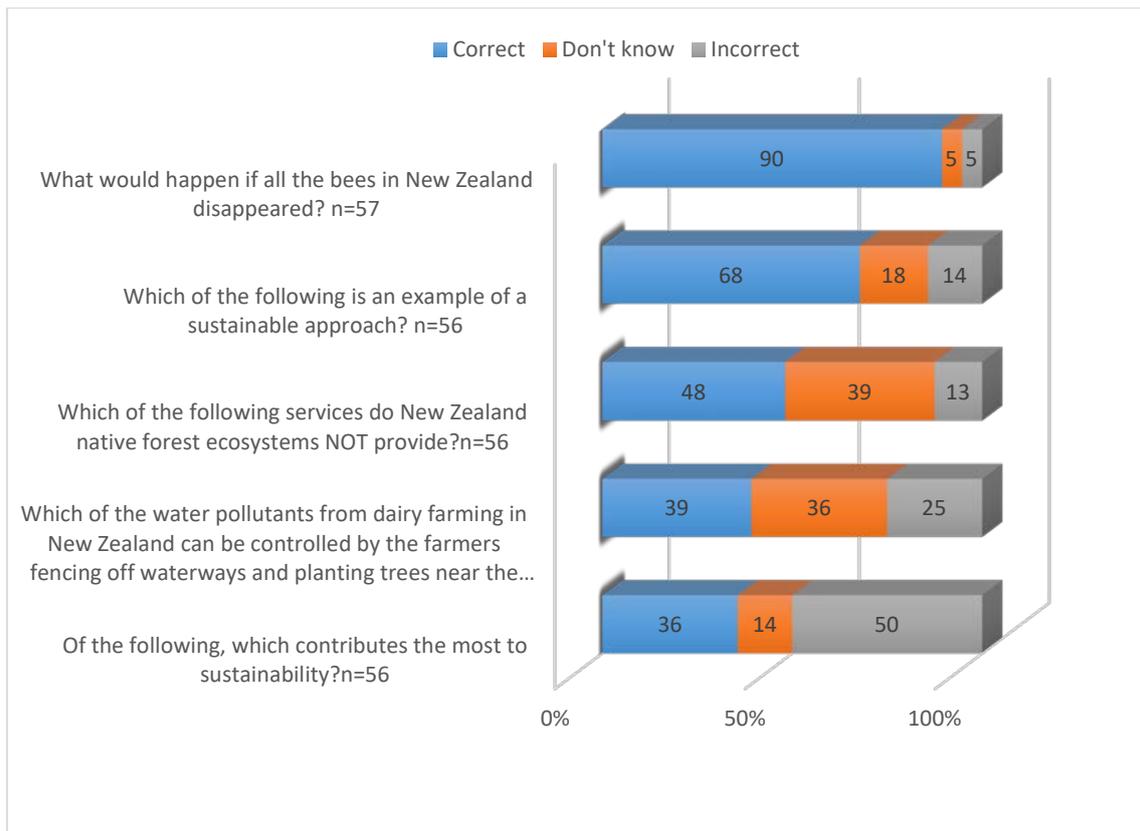


Figure 5-4 Percentage and distribution of PSTs' answer choices to environmental knowledge questions.

PSTs also scored well on questions related to an example of a sustainable approach (68% of PSTs gave correct answers). The questions with the lowest number of correct responses were associated with water pollution (39% correct answers) and consumption and waste (36% correct answers). PSTs seem to have a limited level of knowledge of water pollution which is one of the issues of concern in the local community. In respect to consumption and waste, PSTs answer choices reveal that over two-thirds of the PSTs either were uncertain or didn't know what contributes the most to sustainability among the popularly used approaches to consumption and waste, *reduce, reuse, and recycle*.

To assess the overall environmental knowledge of PSTs, the number of correct answer choices for each PST were scored and classified as either acceptable or unacceptable, in line with previously published literature (Coyle, 2005; Kaplowitz & Levine, 2005; Tuncer Teksoz et al., 2009) using the NEETF (The National Environmental Education and Training Foundation) and Roper survey (see Section

4.2.3). As shown in Table 5-3, only 30% of PSTs were observed to demonstrate an acceptable level of environmental knowledge of selected environmental concepts based on the NEETF and Roper grading scale.

Table 5-3 All PSTs' scores for environmental knowledge questions

Number of questions answered correctly	Percentage score (%)	Proportion of PSTs per score (%)	Grading of scores
5	100	18	Acceptable
4	80	12	Acceptable
3	60	23	Unacceptable
2 and below	40 and below	47	Unacceptable

Although PSTs seem to demonstrate a notable level of environmental knowledge of the effect of bee decline and example of sustainable approaches, the majority (about 60%) of PSTs failed to choose the correct answer choices in the EK questions associated with ecosystem services, water pollution and consumption and waste. Buttressing the relatively low, overall level of PSTs' environmental knowledge, NEETF and Roper grading scale reveals that only a third of PSTs could be regarded as having an acceptable level of environmental knowledge. The proportion (30%) of Year 3 PSTs with an acceptable score level of environmental knowledge is highly comparable with the proportion observed among Year 1 PSTs who had not taken the EE paper. About 30% of Year 1 PSTs, prior to taking the EE paper had demonstrated an acceptable level of environmental knowledge but this increased to more than 50% after completing the EE paper (Section 5.2.3). One would have expected that the proportion of Year 3 PSTs with an acceptable score level of environmental knowledge would, at least, be on a par with Year 1 PSTs who had completed the EE paper, if the knowledge acquired two years ago had been retained. Given our findings of lower proportions of Year 3 PSTs with an acceptable level of environmental knowledge, there are indications that the Year 3 PSTs in this survey seem to have forgotten some of their learning from the EE paper two years ago.

5.2.4 PSTs' perceived knowledge

PSTs' self-reported level of their perceived knowledge on seven environmental and sustainability issues: water pollution (Question 40), climate change (Question 41), consumption and waste (Question 42), endangered species (Question 43), child

poverty (Question 44), racial discrimination (Question 45), and bee decline (Question 46) in New Zealand was also examined. A 5-point Likert-type scale (1=very uninformed to 5=very informed) was employed. As shown on Figure 5-5, the highest reported environmentally-informed status of PSTs was associated with child poverty.

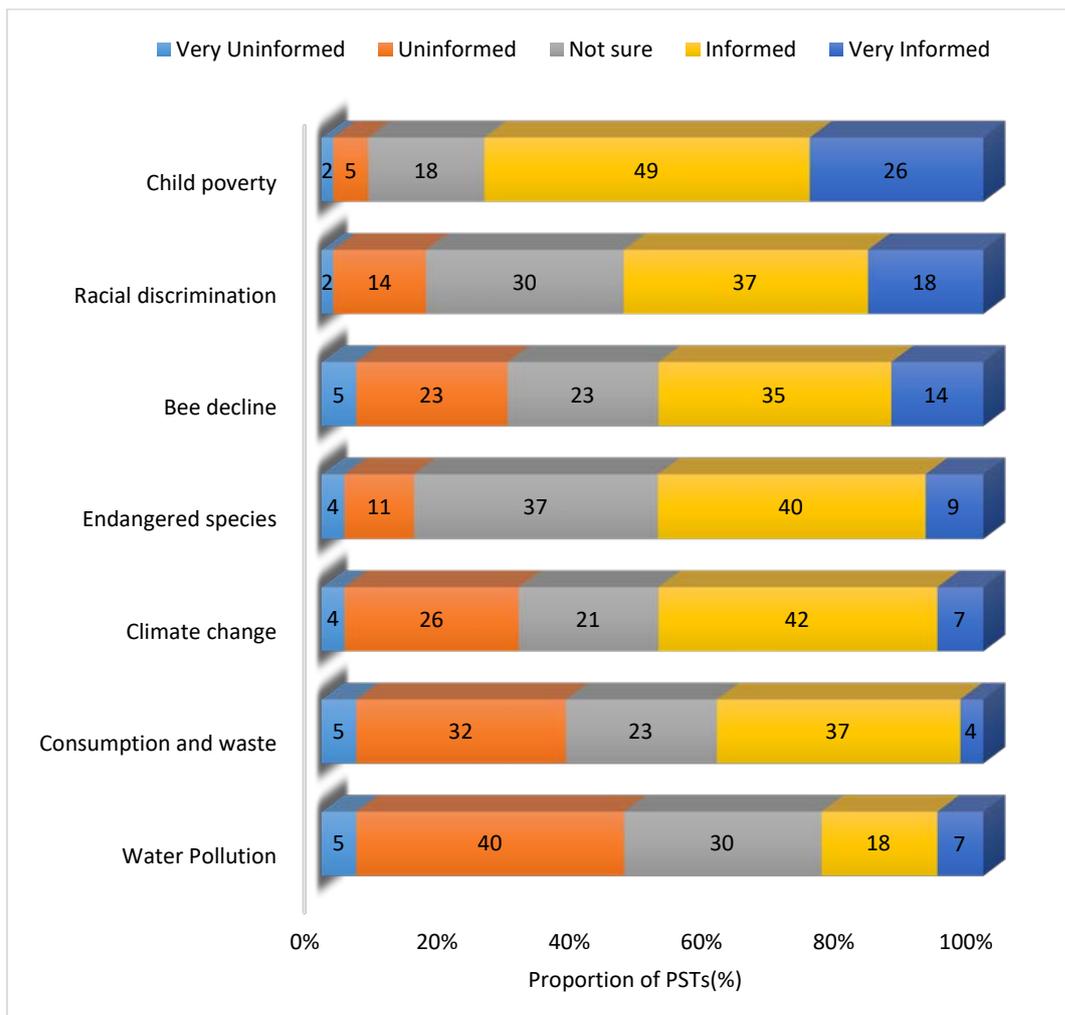


Figure 5-5 Percentage and distribution of PSTs' environmentally-informed status (n=57)

Three-quarters of PSTs expressed that they were either very informed or informed about child poverty, and only 7% proportion of PSTs rated their level of information about child poverty as either uninformed or very uninformed. The second highest environmentally-informed status of PSTs was racial discrimination; 55% of the PSTs rated their level of awareness on racial discrimination as either very informed or informed. Almost half of the PSTs rated themselves as at least informed on bee

decline, endangered species and climate change. Only a quarter (25%) of the PSTs felt they were informed about water pollution, which is probably the major environmental sustainability issue in the local region.

5.2.5 Section summary

Findings from this study indicate that PSTs mainly think of the environment with respect to what it does for people and other living species. Very few of their responses reflected their understanding of the environment in terms of the mutual relationships existing between the environment and other living species. This finding is somewhat similar to findings from Year 1 PSTs, prior to completing the EE paper. Meanwhile, upon completing the EE paper, substantial shifts reflecting the mutual relationships existing between the environment and other living species were observed. It can be suggested that the Year 3 PSTs expressed a rather more simplistic understanding of the natural environment than their Year 1 counterparts who had just completed the EE paper.

Overall, findings suggest that the Year 3 PSTs were aware of their level of understanding of sustainability and as such, they did not overly rate their level of understanding as being excellent or very good. Their level of understanding of sustainability seems comparable to their Year 1 counterpart, before taking the EE paper. Specifically, only a few PSTs linked the definition of sustainability to its social-cultural aspects while the economic aspect was left out. This indicates that they seem to have forgotten their learning on the aspects of sustainability in the EE paper they had taken two years earlier. They were, however, able to recollect their learning on bee decline (focused on in the EE paper taken). Overall, only a third of PSTs could be regarded as having an acceptable level of environmental knowledge (NEETF and Roper, 2001) comparable with the proportion observed among Year 1 PSTs who had not taken the EE paper. It could be expected that the proportion of Year 3 PSTs with an acceptable score level of environmental knowledge would, at least, be on par with Year 1 PSTs who had completed the EE paper, if the knowledge acquired two years ago had been retained.

PSTs reported being least informed about water pollution, despite it being a prevalent issue in New Zealand. They, however, consider themselves as very

informed or informed on issues related to child poverty and racial discrimination. Interestingly, child poverty and racial discrimination issues were not focused on in the EE paper. These findings present indications that PSTs get their information on some environmental and sustainability issues from sources other than the EE paper completed.

5.3 Environmental affect of Year 3 pre-service teachers

This section presents findings on PSTs' environmental affect and environmental concern on selected environmental and sustainability issues. The environmental affect section of the questionnaire administered to PSTs included three components (see Appendix A). The first component comprised three statements on PSTs' perceived locus of control (Question 6-8), the second component had two statements on PSTs' perceived personal responsibility (Question 9-10), and the third encompassed six statements exploring PSTs' environmental worldviews (Question 11-16). These statements exploring PSTs' environmental worldviews were adapted from the NEP scale (Dunlap et al., 2000). In all, the environmental affect section of the questionnaire comprised 11 statements to which PSTs could state their extent of agreement, based on a 5-point Likert-type scale (1= strongly disagree, 2=disagree, 3= undecided, 4=agree, 5=strongly agree). Findings from each of these components are presented in turn.

5.3.1 Locus of control

PSTs expressed strong agreement with the first statement examining their locus of control, 'I believe I can contribute to the quality of the environment through my personal behaviour'. Eighty-eight percent of PSTs (n=56) either strongly agreed or agreed, while only 2% disagreed with the statement and 11% of PSTs were undecided (see Figure 5-6). As shown in Table 5-4 the high mean score (4.2) and low standard deviation indicates strong support for the statement. PSTs also demonstrated strong internal locus of control as observed from their responses to the statement, 'it is more of the governments' responsibility to look after the environment than mine'. Over two-thirds of PSTs disagreed with the statement, with only 5% agreeing, and 20% undecided. In respect to the third statement assessing PSTs' locus of control, 'even if I conserve water/electricity or purchase

environmentally friendly products, it won't make a difference if others don't do same', varied opinion was observed among the PSTs. Thirty-seven percent of PSTs disagreed with the statement, 38% agreed with the statement while a quarter of the PSTs (25%) were undecided (see Figure 5-6.) The relatively high standard deviation and low mean score (3.04) for this statement affirms weak support for the statement and the varied stance among PSTs towards the statement (Table 5-4).

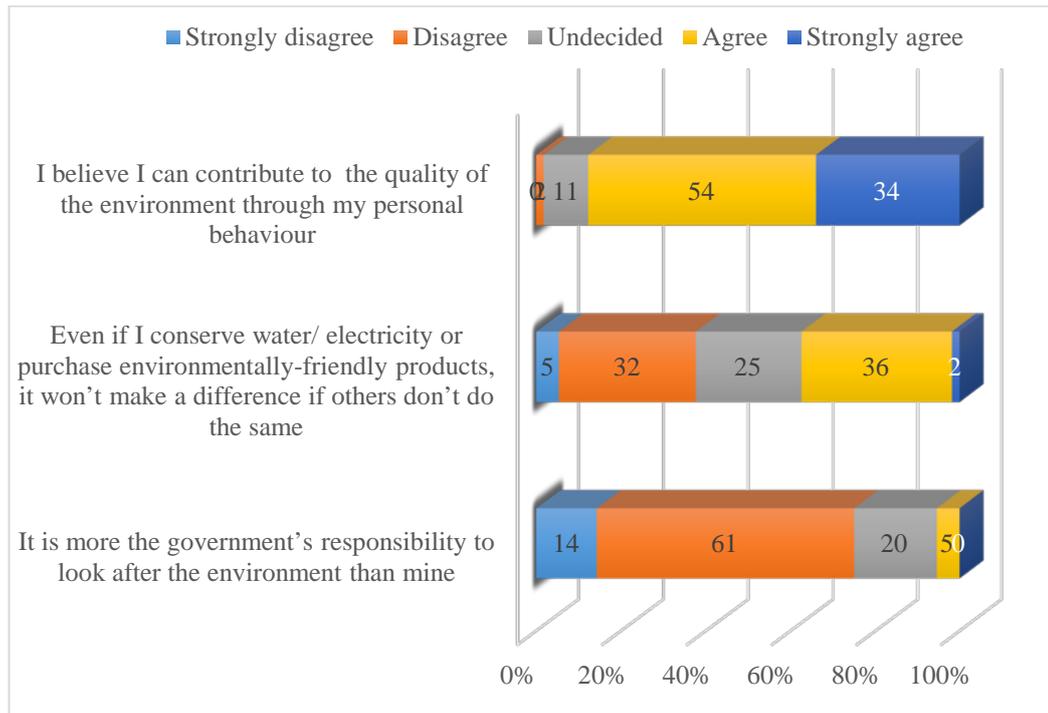


Figure 5-6 Percentage and distribution of PSTs' responses to locus of control statements (n=56)

Table 5-4 Means and standard deviations of PSTs' responses to locus of control statements (n=56)

Statements on PSTs locus of control	Mean	SD
I believe I can contribute to the quality of the environment through my personal behaviour	4.20	0.699
It is more the government's responsibility to look after the environment than mine	3.84	0.733
Even if I conserve water/ electricity or purchase environmentally-friendly products, it will not make a difference if others do not do the same	3.04	0.990

PSTs overall demonstrated strong internal locus of control, especially in regards to them believing that they can make a difference on a personal basis. They, however, had varied perceptions in terms of other peoples' involvement in making a

difference. PSTs appear to have the notion that their impact might not be felt or could be countered by other people’s indifferent behaviour towards the environment.

5.3.2 Personal responsibility

PSTs’ responses to the first statement assessing their personal responsibility indicate that a high proportion (84%) of PSTs feel responsible for any part they play in contributing to environmental problems in their community. Of the remainder, 13% of the PSTs were undecided and only 3% of the PSTs did not feel responsible (see Figure 5-7). The high mean and low standard deviation (see Table 5-5) indicate the uniformity in PSTs’ positions concerning their feelings of responsibility in contributing to environmental problems in their community. In regards to the second statement on personal responsibility, almost two-thirds (63%) of PSTs feel responsible for contributing to solutions to environmental problems in their community, while 26% of the PSTs were undecided and 11% did not feel responsible for contributing to solutions to environmental problems in their community. These findings indicate that a greater proportion of PSTs seem to agree more to being personally responsible for contributing to the problems in their community than to being personally responsible for contributing to the solutions in their community.

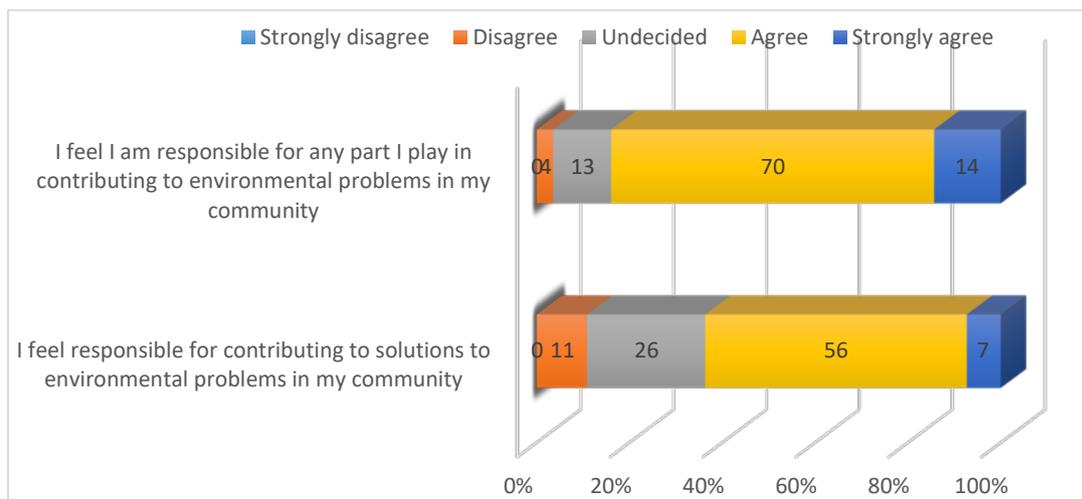


Figure 5-7 Percentage and distribution of PSTs’ responses to statements on personal responsibility (n=57)

Table 5-5 Means and standard deviations of PSTs' responses to personal responsibility statements (n=57)

Statements on PSTs personal responsibility	Mean	SD
I feel I am responsible for any part I play in contributing to environmental problems in my community	3.95	0.644
I feel I am responsible for contributing to solutions to environmental problems in my community	3.60	0.784

5.3.3 Environmental worldviews

Statements assessing PSTs' environmental worldviews using items adapted from the NEP scale represented stances related to anthropocentrism (two statements), balance (three statements) and limits (one statement) (Dunlap et al., 2000). As shown in Figure 5-8, PSTs overwhelmingly agreed (93%, n=57) with the first statement examining their anthropocentrism position, 'plants and animals have as much right as humans to exist'. Only 7% of PSTs were either undecided or signified disagreement with the statement.

The third statement on balance posited that 'the natural environment is strong enough to cope with the impacts of modern industrial nations'. PSTs overwhelmingly (83%) either strongly disagreed or disagreed with this statement. Just 16% of the PSTs were undecided and only 2% agreed with the statement. On the contrary, in regards to 'Earth limits', PSTs through their responses demonstrated a view that Earth's resources are not limited. A majority of PSTs either strongly agreed or agreed (71%) that the Earth has plenty of natural resources if we just learn how to develop them, while 29% were undecided and it was surprising to observe that no PST disagreed with this statement (Figure 5 8). The low mean (2.13) associated with the statement indicates PSTs' less environmental worldview while the low standard deviation indicated consensus among PSTs view on the statement (Figure 5 8, Table 5-6)

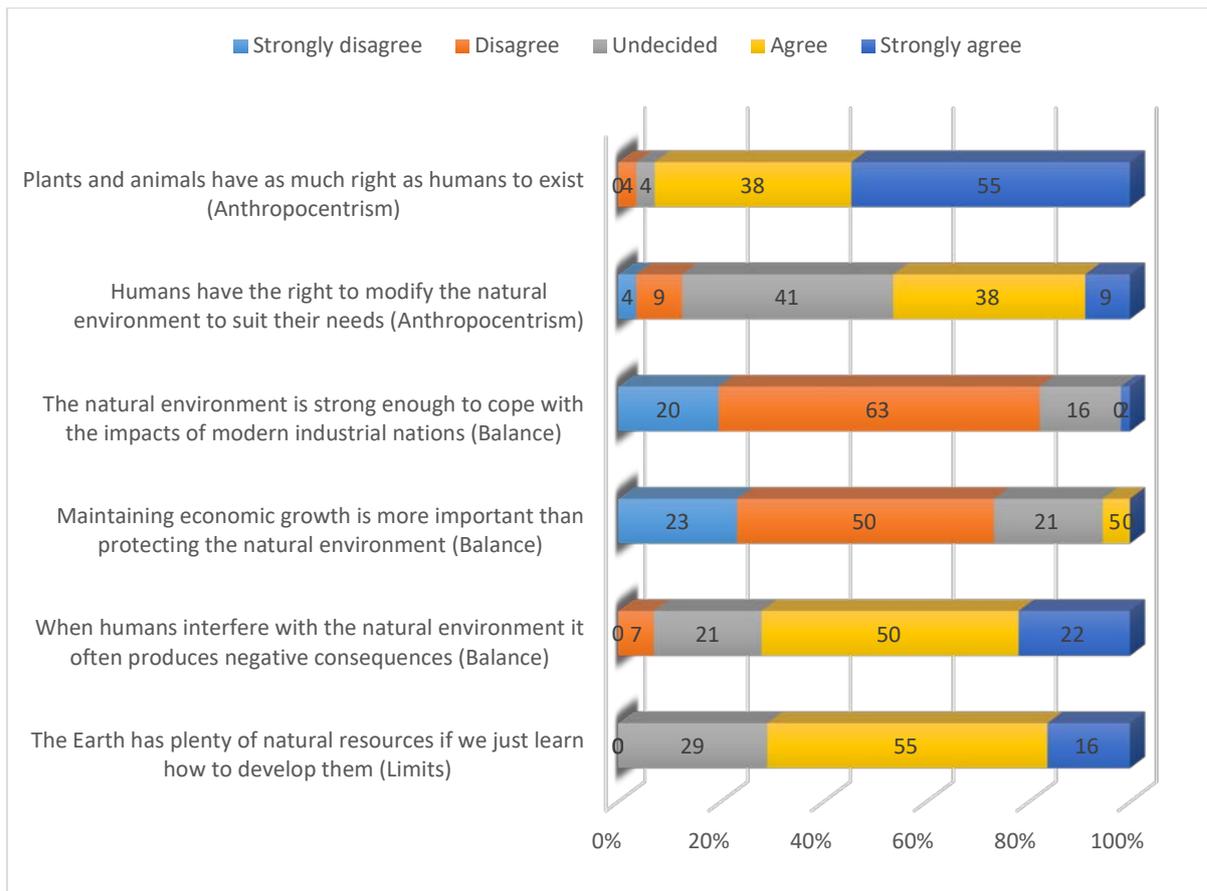


Figure 5-8 Percentage and distribution of PSTs' responses to statements on environmental worldview (n=57)

Table 5-6 Means and standard deviations of PSTs' responses to statements on environmental worldview (n=57)

Environmental worldview	Mean	SD
Plants and animals have as much right as humans to exist	4.44	0.739
*Humans have the right to modify the natural environment to suit their needs	2.61	0.908
*The natural environment is strong enough to cope with the impacts of modern industrial nations	3.98	0.726
*Maintaining economic growth is more important than protecting the natural environment	3.91	0.815
When humans interfere with the natural environment it often produces negative consequences	3.86	0.841
*The Earth has plenty of natural resources if we just learn how to develop them	2.13	0.668

*negatively worded items were reversed prior to mean calculation.

5.3.4 Section summary

Overall, the majority of PSTs showed strong levels of internal locus of control to the statements signifying making a difference on a personal basis. A varied perception however was observed in terms of PSTs' locus of control as it relates to other peoples' involvement in making a difference (collective responsibility).

PSTs' responses to the statements on personal responsibility clearly showed the acknowledgement of their personal responsibility towards problems and solutions of environmental issues in their community. PSTs however tend to agree more with feelings of being responsible in contributing to the problems in their community than feelings of being responsible in contributing to solutions in their community.

PSTs predominantly demonstrated pro-environmental worldviews to statements concerning balance as compared to anthropocentrism and limits. Regarding PSTs' anthropocentric stances, PSTs generally agreed that plants and animals should have equal rights to exist. However, in regards to humans having the right to modify the earth to suit their needs, most PSTs hold an anthropocentric view. In agreement with this finding, analysis of PSTs' responses to the open-ended question asked on the importance of the natural environment (Section 5.2.1) showed that more than half of PSTs had an anthropocentric conception of the natural environment. A majority of PSTs also seem to consider that there are no limits to Earths' resources.

5.4 Environmental concern of Year 3 pre-service teachers

PSTs' environmental concern about seven environmental and sustainability issues was examined using a 5-point Likert-type scale (1 = very unconcerned to 5 = very concerned). These environmental and sustainability issues include water pollution (Question 18), climate change (Question 19), consumption and waste (Question 20), endangered species (Question 21), child poverty (Question 22), racial discrimination (Question 23) and bee decline (Question 24). As shown in Figure 5-9, PSTs indicated high levels of concern for all the environmental and sustainability issues highlighted in the questionnaire. Concern for child poverty, endangered species, and racial discrimination ranked the highest among PSTs.

Among these three, more PSTs were very concerned about child poverty (67%) than they were for endangered species (46%) or racial discrimination (46%).

Furthermore, the highest mean and the lowest standard deviation associated with concern for child poverty issues depicts consensus among PSTs in regards to their concern for this issue (Table 5-7). Among the highlighted issues, PSTs' concern for climate change was the least, with 70% of PSTs indicating that they were either concerned or very concerned, 23% of PSTs, undecided and only 7% were unconcerned. Even though concern for climate change was the least among the highlighted environmental and sustainability issues, the level of PSTs' concern for climate change could still be regarded as high. It is interesting to observe a similarity in environmental concern of Year 3 PSTs' and their Year 1 counterparts prior to taking the EE paper (see Table 4-8). Specifically, concern for child poverty, racial discrimination and endangered species also ranked the highest. Upon taking the EE paper however, concern for bee decline and consumption and waste became dominant coupled with a significant decrease in concern for all other environmental and sustainability issues. Presumably, two years after taking the EE paper, a reemergence of their initial concern (concern for child poverty, racial discrimination and endangered species) could be seen. This finding might imply that Year 1PSTs' concern for bee decline and consumption and waste was as a result of the EE paper freshly taken and the effect was short-lived.

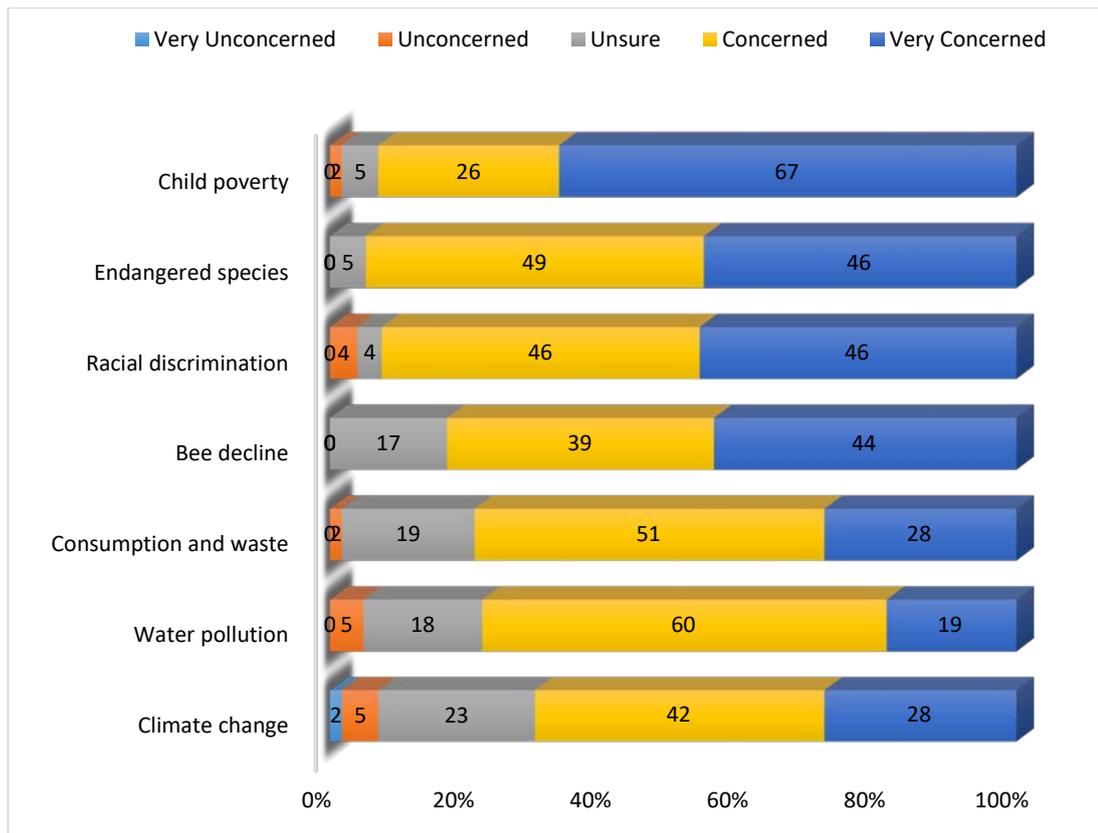


Figure 5-9 Percentage and distribution of PSTs' responses to statements on environmental concern (n=57)

Table 5-7 Means and standard deviations of PSTs' responses to environmental concern items (n=57)

Environmental and sustainability issues	Mean	S D
Child poverty	4.58	0.680
Endangered species	4.40	0.593
Racial discrimination	4.32	0.783
Bee decline	4.26	0.745
Consumption and waste	4.05	0.742
Water pollution	3.95	0.718
Climate change	3.89	0.939

5.5 Environmental behaviour of Year 3 pre-service teachers

This section reports on findings of PSTs' intention to act in environmentally responsible ways (Section 5.5.1) followed by PSTs' self-reported behaviour regarding different environmental aspects (Section 5.5.2).

5.5.1 PSTs' intention to act

Intention to act could be a determinant of pro-environmental behaviour (Bamberg & Möser, 2007), as such this study sought to assess PSTs' willingness to act in an environmentally responsible manner based on their response to five intention to act statements (Questions 25-29, see Appendix A). PSTs were asked to indicate their level of agreement with the given statements, using a 5-point Likert scale (1=strongly disagree to agree 5=strongly).. Figure 5-10 presents findings from PSTs' responses to intention to act statements that portray five environmental behaviour items.

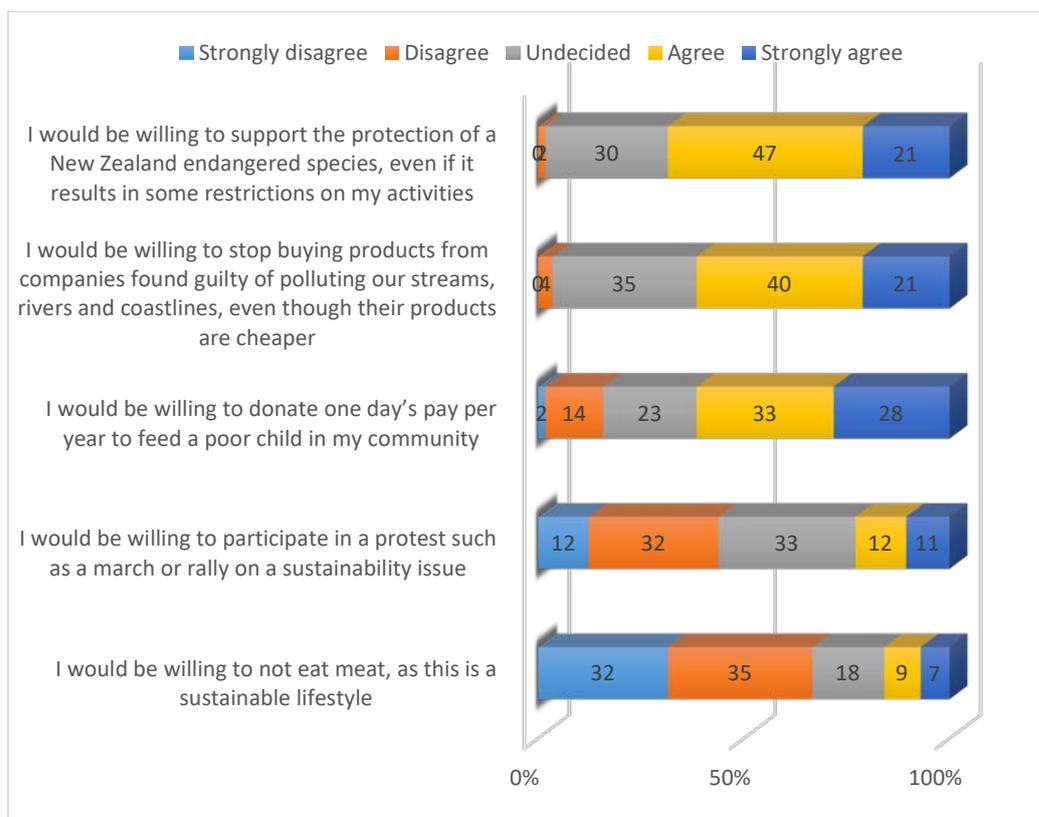


Figure 5-10 Percentage and distribution of PSTs' responses to statements on pre-service teachers' intention to act (n=57)

The behaviour PSTs were most willing to carry out was the protection of New Zealand endangered species, as more than 65% of the PSTs indicated that they agree or strongly agree to support such behaviour. Also, among the intention to act statements (see Table 5-8), this item had the highest mean (3.88) and lowest standard deviation (.76), confirming strong support among PSTs for their willingness to carry out this behaviour. Apart from the protection of New Zealand

endangered species, the behaviours PSTs were next most willing to carry out were not buying products from companies found guilty of polluting the environment, and donating one day's pay to feed a poor child in their community. Just under two-thirds of PSTs (61%) showed their support for both environmental behaviours by either agreeing or strongly agreeing with the statements. Willingness to stop eating meat even if it is a sustainable lifestyle was observed to be the least favoured, as only 16% of the PSTs were willing to engage in this type of environmental behaviour. This item was associated with the least mean and highest standard deviation, signifying weak support for the statement, but equally a varied stance among the PSTs towards the item. Only a small minority of PSTs (23%) expressed their willingness to participate in a protest on a sustainability issue.

Table 5-8 Means and standard deviations of PSTs' responses to intention to act statements (n=57)

I would be willing to:	Mean	S. D
support the protection of a New Zealand endangered species, even if it results in some restrictions on my activities	3.88	0.76
stop buying products from companies found guilty of polluting our streams, rivers and coastlines, even though their products are cheaper	3.79	0.82
donate one day's pay per year to feed a poor child in my community	3.72	1.08
participate in a protest such as a march or rally on a sustainability issue	2.77	1.15
not eat meat, as this is a sustainable lifestyle	2.25	1.20

On the whole, analysis of PSTs' responses likewise indicated that high standard deviations were associated with the mean scores of PSTs' responses to some of the intention to act statements. This was most profound among PSTs' responses to the statements that sought to establish if they would be willing to participate in a protest on a sustainability issue, refrain from eating meat, or donate a day's pay to feed a poor child in the community. The high standard deviations associated with these items indicate that the responses were dispersed around the mean and lacked uniformity in PSTs' positions concerning their intention to act towards the specified environmental behaviours. Interestingly, the observed trends among the Year 3 PSTs' intention to act were similar to the observations among their Year 1

counterparts who had just completed the EE paper (Section 4.5.1). PSTs were willing to make adjustments regarding issues that concern community giving and protecting endangered species but were not willing to be seen as activists or modify entrenched lifestyles.

5.5.2 PSTs' self-reported environmental behaviour

The administered questionnaire had a section that sought to assess PSTs' environmental behaviour by asking them to state to what extent they carried out ten environmentally related activities (Questions 30-39, see Appendix A). A Likert – type scale with five possible choices (1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often) was used. The environmental behaviour scale comprised of questions related to Consumer Action (Question 30-33), Eco-management (Question 33-34), Persuasion (Question 35-36), Community giving (Question 37), Environmental activism (Question 38) and Nature-related leisure (Question 39). Data from each category is presented in turn.

5.5.3 PSTs' Consumer action

Analysis of PSTs' responses to the questions which sought to assess their level of consumer action indicated that the PSTs were more disposed to buying products that claim to be environmentally friendly or purchasing a product because it was packaged in reusable containers. At least 75% of the PSTs responded that they engage in these actions, sometimes, often or very often (Figure 5-11). Compared to the two consumer actions that focused on product information and packaging, PSTs were averse to using types of transport other than going in a car. This is shown by the 38% of the PSTs who indicated that they sometimes, often or very often opt for alternative transport means, e.g. biking or public transport.

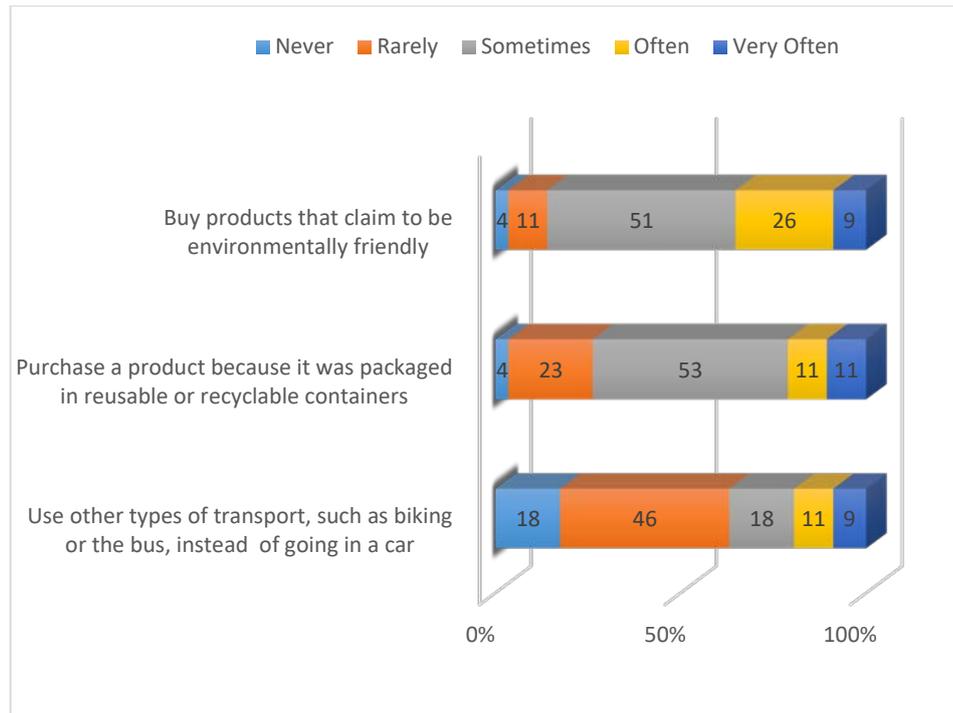


Figure 5-11 Percentage and distribution of PSTs' responses to statements on PSTs consumer action behaviour (n = 57)

Almost half of the PST respondents (46%) indicated that they rarely opt for alternative transport means. From these findings, there are indications that PSTs seem to feel less concerned in their commitments to reduce fossil fuel use through the use of transport. This finding relates to the focus group discussion with Year 1 PSTs, during which PSTs indicated that any consideration to walk to university might be for reasons associated with financial saving and health, rather than their concern for the environment. Their comments included:

Probably, it saves money in a way ..., fitness as well (PST9)

I think the idea of [asking students to pay for parking] from next year to stop the carbon footprint because that actually makes me [want to walk] it sucks, but it is a good idea (PST5)

PSTs were observed to be generally positive about consumer action like buying products that claim to be environmentally friendly or purchasing a product because it was packaged in reusable containers. However, when it came to the decision of taking other transport they were less keen. This might reflect their values and the convenience associated with going in one's car.

5.5.4 PSTs' eco-management behaviour

Based on PSTs' responses to the two environmentally-related activities that sought to assess eco-management behaviours, about 63% of the PSTs (Figure 5.12) reported that they often, very often, or at least sometimes bring their own shopping bags for shopping. On the other hand, 37% of PSTs rarely or never bring their own shopping bags for shopping. Comparatively, just about half of the PSTs (54%) reported that they often, very often, or at least sometimes conserve water at home. Almost half of the PSTs (46%) rarely or never conserve water when showering. Overall, the PSTs were more willing to bring a bag for their shopping than to conserve water when showering. This perhaps could be as a result of the public nature of one, the use of personal shopping bags, which could potentially create an atmosphere of public approval around the shopper, compared to the unseen act of conserving water while showering. Another reason for the low appeal for water conservation seems to align with the findings of PSTs' environmental worldviews in this study (Section 5.3.3) wherein the PSTs see Earth's resources as infinite and as such, do not bother about conserving water.

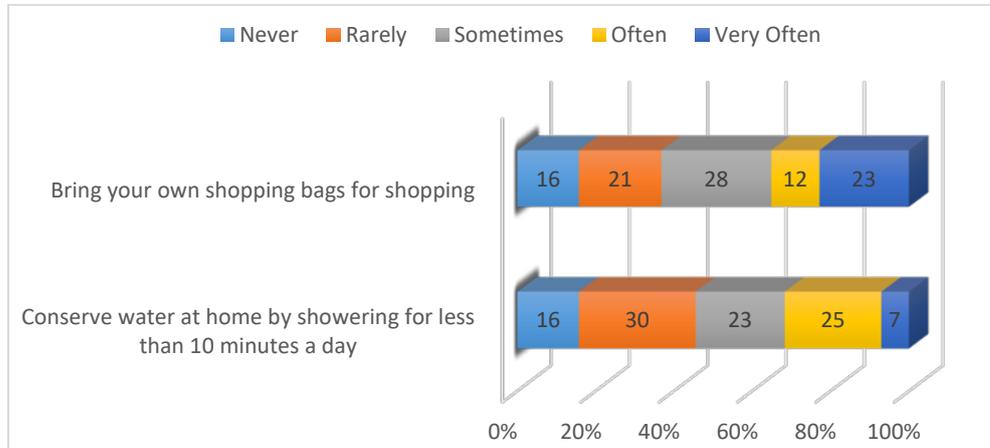


Figure 5-12 Percentage and distribution of PSTs' responses to statements on pre-service teachers' eco-management behaviour (n=57)

5.5.5 PSTs' persuasive behaviour

An analysis of PSTs' responses, when asked questions which sought to assess how frequently they used persuasive environmental behaviours, indicated that the PSTs' were very disposed to encouraging people at their homes to recycle glass, paper or

food scraps. Almost 90% of the PSTs indicated that they often, very often or at least sometimes encourage people at their homes to recycle (Figure 5-13). However, the proportion of PSTs (65%) that either often or very often encourage people in their homes to recycle was higher than those who sometimes (25%) engage in this behaviour. A contrasting trend was nonetheless observed when asked if they try to persuade people to stop doing activities that could harm the environment. The proportion of PSTs (25%) that either often or very often engage in this behaviour was lower than those who sometimes do it (41%) (Figure 5-13). This finding shows an indication that PSTs seem to engage more in persuasive activities that seem to involve people of immediate influence. These include family members who could be easily encouraged to participate in simple ‘soft environmentalism’ activities like recycling, etc. On the other hand, a contrast was observed when PSTs were asked if they try to persuade people to stop doing activities that could harm the environment (Figure 5-13). This could either indicate that PSTs don’t particularly feel comfortable persuading people about ‘hard environmentalism’ or that the PSTs are not sure of which specific activity could harm the environment.

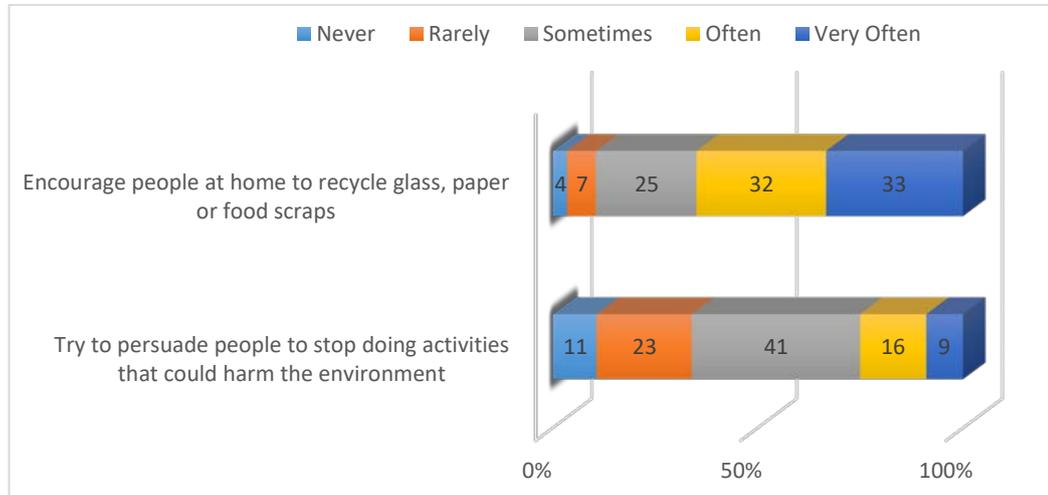


Figure 5-13 Percentage and distribution of PSTs’ responses to statements on pre-service teachers’ persuasive behaviour (n=57)

Furthermore, another possibility for the varied PSTs’ responses to the two statements on persuasive behaviour might have been influenced by the sentence construction. In this case, it may be because one is presented in a positively directed

manner and hence, is more easily embraced, as against the more confrontational approach that seeks to persuade people to stop, perhaps, a habitual action considered harmful to the environment.

5.5.6 Other environmental behaviours

PSTs were also questioned about some other pro-environmental behaviours, for instance, giving to charity, spending time outdoors in the natural environment and participation in organised tree planting (Figure 5-14). Among these three, the PSTs reported being most involved in giving (money, old clothes, books etc.) to charity. This could be interpreted as PSTs' way of reacting to social justice and equity issues in the community, as findings from this study reveal that PSTs expressed the most concern for child poverty among the specified environmental and sustainability issues (Section 5.4). Also, from an environmental perspective, PSTs' behaviour of engaging in charitable activities, could indicate their willingness to contribute to environmental protection by avoiding the degradation that would have resulted should these materials have been disposed as trash instead of given out to charity. A majority of the PSTs reported spending time in the natural environment in activities that include camping, picnicking, and hiking, as up to 80% of the PSTs often, very often or at least sometimes, engage in such activities (Figure 5-14).

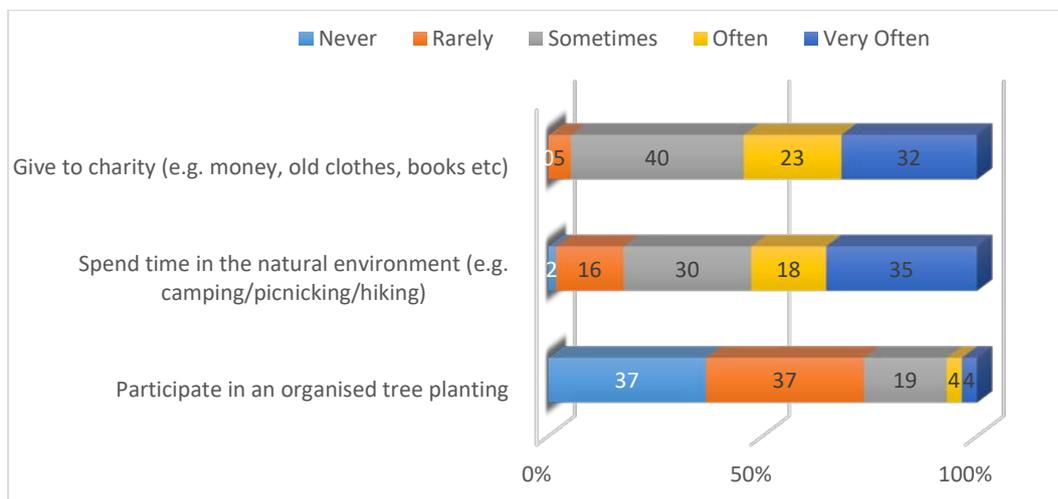


Figure 5-14 Percentage and distribution of PSTs' responses to statements on other pro-environmental behaviours

(n=57)

On the contrary, PSTs seem not to be disposed to participating in organised tree planting despite the existence of some tree planting programmes in the local community. In fact, 74% of PSTs rarely or never engaged in such activity. This finding could be connected to PSTs' unwillingness to be seen as activists (Section 5.5.1) and may therefore not likely participate in such public organised programmes as tree planting.

On the whole, as shown in Table 5-9, mean scores associated with PSTs' responses to the environmental behaviour items reveal that PSTs were generally more disposed towards encouraging people at home to recycle glass, paper or food scraps, giving to charity and spending time in the natural environment and less disposed to using other types of transport, such as biking or the bus, instead of going in a car or participating in an organised tree planting activity.

However, the high standard deviations associated with these mean scores largely shows that the responses were dispersed around the mean thus suggesting a lack of consensus among the PSTs regarding carrying out the specified ERBs.

Table 5-9 Means and standard deviations of PSTs' responses to environmental behaviour questions (n=57)

	Mean	SD
Encourage people at home to recycle glass, paper or food scraps	3.84	1.082
Give to charity (e.g. money, old clothes, books etc.)	3.81	0.953
Spend time in the natural environment (e.g. camping/picnicking/hiking)	3.68	1.167
Buy products that claim to be environmentally friendly	3.26	0.897
Bring your own shopping bags for shopping	3.05	1.381
Purchase a product because it was packaged in reusable or recyclable containers	3.02	0.954
Try to persuade people to stop doing activities that could harm the environment	2.89	1.09

Conserve water at home by showering for less than 10 minutes a day	2.77	1.195
Use other types of transport, such as biking or the bus, instead of going in a car	2.47	1.167
Participate in an organised tree planting	2.00	1.018

5.5.7 Section summary

Analysis of PSTs' responses to the intention to act statements indicated that PSTs were willing to make adjustments regarding issues that concern community giving and protecting endangered species but were not willing to be seen as activists or modify entrenched lifestyles.

Based on PSTs' self reported environmental behaviour, findings indicated that the most common environmental behaviour PSTs engage in is giving to charity and encouraging people at home to recycle glass, paper or food scraps and. Previous findings have shown that the majority of PSTs showed high concerns for child poverty (Section 5.4) and willingness to donate a day's pay per year to feed a poor child in their community (Section 5.5.1). Therefore engaging in giving to charity could be interpreted as PSTs' means of reacting to social justice and equity issues in the community. Furthermore, it appears that PSTs find encouraging people at home to recycle glass, paper or food scraps a simple task to do and as such carry out such activity more often. PSTs were, however, less disposed to using other types of transport, such as biking or the bus; instead of going in a car. This might reflect their values and the convenience associated with going in one's car. They were also less disposed to participating in an organised tree planting activity. This could possibly be associated with PSTs' unwillingness to be seen as activists (Section 5.5.1) and may therefore be less keen to participate in such public organised programmes.

5.6 Relationships between environmental literacy components

To explore relationships between environmental literacy components, Pearson product moment correlation coefficient and Path analysis were used as in Section 4. 6. Findings from each analysis are reported below.

5.6.1 Correlations between environmental literacy components

This section presents findings from the analysis of relationships between the components of PSTs' environmental literacy employed in the study (environmental knowledge, concern, affect, intention to act and behaviour). All calculated correlation coefficients were taken as the extent to which data points of two different components (e.g., behaviour and affect) tend to fall along a straight line (Sedgwick, 2012). A correlation of 0 was taken as an indication of no correlation between the environmental literacy components. Meanwhile, a correlation of -1 or 1, indicates that there is a perfect negative or positive correlation between the environmental literacy components. Correlation coefficients lower than 0.3 were taken to indicate weak relationships between the environmental literacy components.

5.6.2 Environmental knowledge

Environmental knowledge scores were not significantly correlated with scores for any of the environmental literacy components scores, except for environmental affect which, interestingly, significantly correlated negatively with it ($r=-.440$, $p<0.01$) (Table 5-9). This finding seems to suggest that environmental knowledge did not influence, in the positive direction, the environmental affect of the PSTs.

5.6.3 Environmental concern

Environmental concern scores were significantly correlated with environmental affect scores ($r=.544$, $p=.000$), intention to act scores ($r=.467$, $p=.000$), as well as with environmental behaviour scores ($r=.455$, $p=.000$) (Table 5-10).

5.6.4 Environmental affect

Environmental affect scores were significantly correlated with environmental concern scores ($r=.544$, $p=.000$), intention to act scores ($r=.584$, $p=.000$) and environmental behaviour scores ($r=.510$, $p=.000$). Overall, the highest correlation coefficient in the study was observed to be between environmental affect scores and intention to act scores ($r=.584$, $p=.000$) (Table 5-10).

5.6.5 Intention to act

Intention to act scores were significantly correlated with environmental affect scores ($r = .584$, $p = .000$), environmental concern scores ($r = .467$, $p = .000$) and environmental behaviour scores ($r = .453$, $p = .000$) (Table 5-10).

Table 5-10 Correlation coefficient between environmental literacy components (EA=environmental affect, EC=environmental concern, ITA=Intention to act, EB=environmental behaviour, EK=environmental knowledge).

EL Components		Correlations				
		EA	EC	ITA	EB	EK
EA	Pearson					
	Correlation	1				
	Sig. (2-tailed)					
	N	53				
EC	Pearson					
	Correlation	.544**	1			
	Sig. (2-tailed)	.000				
	N	53	57			
ITA	Pearson					
	Correlation	.584**	.467**	1		
	Sig. (2-tailed)	.000	.000			
	N	53	57	57		
EB	Pearson					
	Correlation	.510**	.455**	.453**	1	
	Sig. (2-tailed)	.000	.000	.000		
	N	52	56	56	56	
EK	Pearson					
	Correlation	-.440**	-.288	-.136	-.298	1
	Sig. (2-tailed)	.001	.033	.322	.029	
	N	53	55	55	54	55

** . Correlation is significant at the 0.01 level (2-tailed).

5.6.6 Environmental behaviour

Environmental behaviour scores were significantly correlated with environmental affect scores ($r = .510$, $p = .000$), environmental concern scores ($r = .455$, $p = .000$) and intention to act scores ($r = .453$, $p = .000$) (Table 5-10).

In summary, findings from Pearson product moment correlation coefficient analysis indicated that PSTs' environmental knowledge did not correlate significantly with any of the environmental literacy components, except environmental affect which has a negative correlation ($r = -.440$, $p < 0.01$). The strongest positive correlation

was found between environmental affect scores and intention to act scores ($r = 0.584$, $p < 0.01$), and affect, concern, intention to act and behaviour were all correlated.

5.6.7 Path Analysis with multiple regression

Similar to Year 1 PSTs, path analysis was used to examine the direct and indirect hypothesised relationships among the environmental literacy components. The hypothesised model again had two layers of multiple regression. The first layer had intention to act as the criterion with environmental affect, environmental concern and environmental knowledge as the predictors. Accordingly, the model hypothesises a start from environmental affect, environmental concern and environmental knowledge and an end in intention to act for the first layer. The second layer had environmental behaviour as the criterion with environmental affect, environmental concern, environmental knowledge and intention to act as the predictors.

Findings from the first layer of the model reveal that only PSTs' environmental affect could directly predict PSTs' intention to act. The R^2 (coefficient of determination) value indicates that the model can explain 37% of the variation in PSTs' Intention to Act (Table 5-11, Table 5-12 and Figure 5-15).

Table 5-11 First layer multiple regression for the hypothesised model

(EA=environmental affect, EC=environmental concern, ITA=Intention to act, EB=environmental behaviour, EK=environmental knowledge)

Model Summary					
Model	R	R Square			
1	.615 ^a	.378			
^a Predictors: (Constant), EK, EA, EC					
Coefficients					
Model		Unstandardized Coefficients		Standardized Coefficients	
		B	Std. Error	Beta	t
1	(Constant)	-12.641	6.038		-2.094
	EA	.571	.136	.605	4.188
	EC	.118	.139	.114	.852
	EK	.421	.282	.187	1.494
Sig.					
					.041
					.000
					.399
					.142
^a Dependent Variable: ITA					

Table 5-12 Second layer multiple regression for the hypothesised model

(EA=environmental affect, EC=environmental concern, ITA=Intention to act, EB=environmental behaviour, EK=environmental knowledge)

Model summary						
Model	R	R Square				
1	.547 ^a	.299				
^a Predictors: (Constant), EK, EA, EC, ITA						
Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.185	12.446		.015	.988
	EA	.515	.314	.298	1.643	.107
	EC	.281	.276	.149	1.016	.315
	ITA	.287	.284	.156	1.012	.317
	EK	-.391	.570	-.095	-.685	.497
^a Dependent Variable: EB						

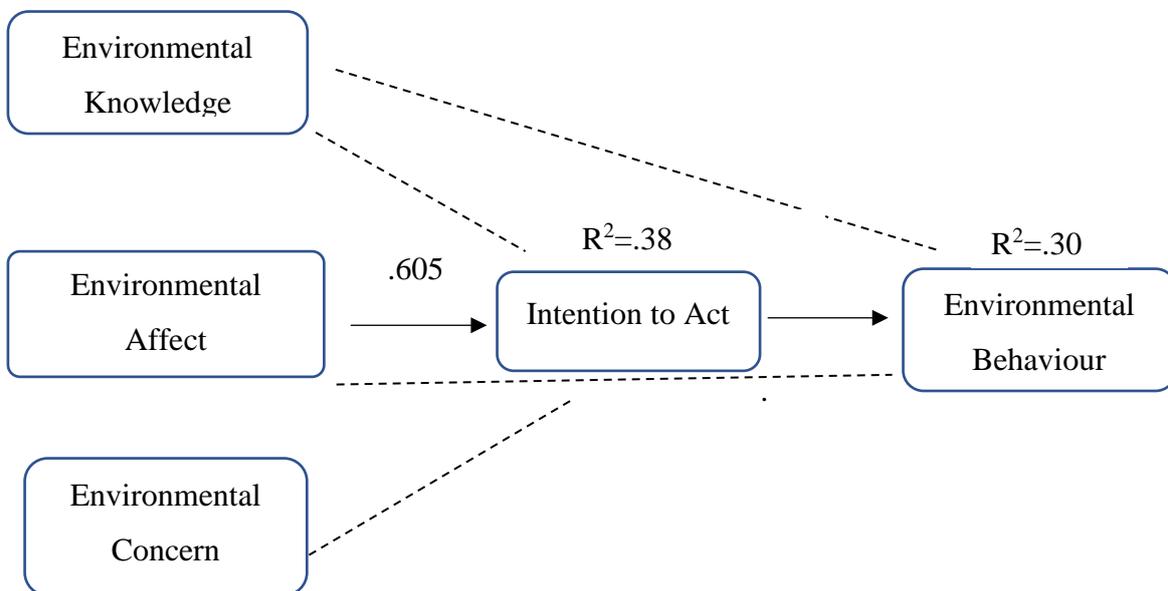


Figure 5-15 Path analytic model of environmental literacy components. Broken lines show non-significant paths at p=0.05 level (n=57)

Findings from the first layer reveal that environmental knowledge and environmental concern were not found to directly predict intention to act. Considering the second layer of the hypothesised model, only environmental affect was observed to predict environmental behaviour directly with an R^2 value indicating that the model can explain 35% of the variation in PSTs environmental behaviour (Figure 5-15)

5.6.8 Section Summary

As shown in Table 5-13, Pearson product moment correlation reveals moderate positive relationships among all the environmental literacy components except for the negative correlation between environmental knowledge and environmental affect. Path analysis however indicated that, in the backdrop of other environmental literacy components, only environmental affect could directly predict intention to act and environmental behaviour.

Table 5-13 Summary of relationships between environmental literacy components (where EK=environmental knowledge, EA=environmental affect, EC=environmental concern, ITA=Intention to act and EB=environmental behaviour).

EL Components	Relationships		
	Pearson Product Moment correlation	Path Analysis	
EK	-vely with EA	EA directly predicts ITA	EA directly predicts EB
EC	+vely with EA, ITA, EB		
EA	+vely with EC, ITA, EB		
ITA	+vely with EC, EA, EB		
EB	+vely with EC, EA, ITA		

Comparing findings from Year 3 with Year 1 PSTs, Pearson product moment correlation for Year 1 indicated that positive moderate correlations were found between environmental knowledge and other environmental literacy components upon completing the EE paper compared with no statistically significant correlation between environmental knowledge and these components prior to completing the EE paper. Whereas, for Year 3 PSTs, no statistically significant correlation was found between environmental knowledge and the other components except for the moderate negative correlation found between environmental knowledge and

environmental affect. Moreover, for Year 1 PSTs, path analysis indicated environmental concern and environmental affect as strong predictors of intention to act and intention to act as a strong predictor of environmental behaviour. Findings from Year 3 PSTs however showed that only environmental affect was found to be a strong predictor of intention to act and environmental behaviour.

5.7 Contribution of other factors on PSTs' Environmental Literacy.

The possibility of other influences on PSTs' environmental literacy was explored. PSTs were asked to indicate the level of contribution a variety of factors had on their environmental literacy (Questions 77-83, see Appendix A). These factors included completion of the EE paper taken in their first year, completion of other University papers, media, experiences with family and friends or any other experience. A 5-point Likert scale ranging from 1 (no contribution) to 5 (very strong contribution) was employed. The majority (95%) of PSTs report that the EE paper taken in their first year contributed the most to their environmental literacy. Ranked in order of contribution to PSTs' environmental literacy, the highest level of reported contribution was from the EE (TEPC 120-13) paper while the least contribution was from other experiences at the University (Figure 5-16).

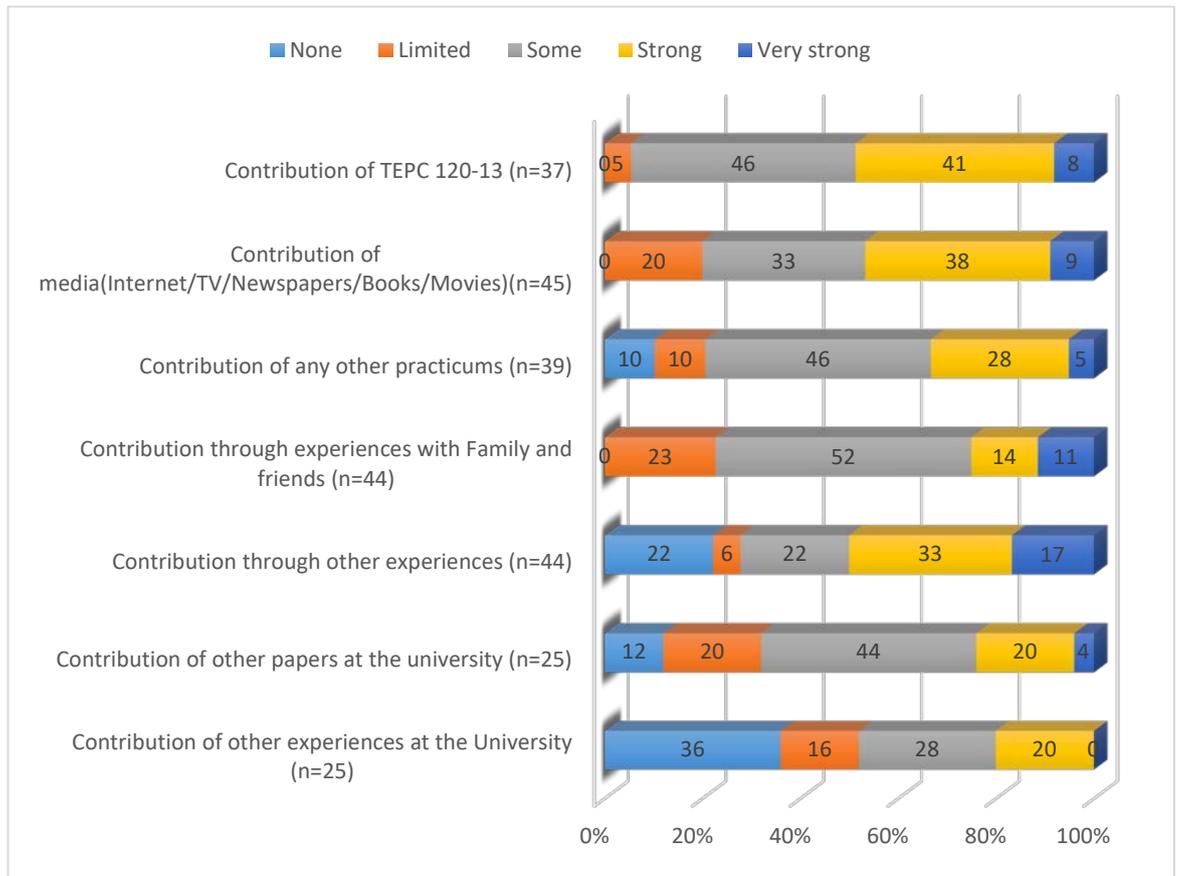


Figure 5-16 Percentage and distribution of PSTs' responses to statements on the contribution of other factors on PSTs Environmental Literacy

Table 5-14 Means and standard deviations of PSTs responses when asked for sources that contributed to their environmental literacy

Contributions to PST environmental literacy from:	Mean	SD
TEPC 120-13	3.51	0.73
Media (Internet/TV/Newspapers/Books/Movies)	3.36	0.91
Other experiences	3.17	1.43
Experiences with Family and friends	3.14	0.91
Any other practicums	3.08	1.01
Other papers at the university	2.84	1.03
Other experiences at the University	2.32	1.18

From PSTs' self-reported data, the EE paper contributed the most to the environmental literacy of PSTs during their teaching education training than any other paper they had completed at the University. For instance, while 95% of PSTs indicated that the EE paper contributed strongly, very strongly or at least in some

ways towards their environmental literacy, only 68% of the PSTs indicated that other papers at the University contributed towards their environmental literacy (Figure 5-16). Additionally, as shown on Table 5-14, among all the specified possible contributory factors to PSTs EL, contribution of the EE paper taken had the lowest standard deviation, indicating consensus among PSTs. The media and practicums as reported by PSTs contributed hugely towards their environmental literacy. Eighty percent of PSTs reported that the media and practicum contributed very strongly, strongly or the least in some ways towards their environmental literacy (Figure 5-16). On the other end of the spectrum, other papers and other experiences at the university according to the PSTs, contributed the least to their EL. This finding is somewhat disturbing as it indicates that if PSTs do not develop the needed EL to impact the future generation through the EE paper taken, there is the possibility of them not having any other opportunity to do so before they start their teaching career.

5.8 Pre-service teachers' preparedness to teach EE

In addition to PSTs' environmental literacy, this study sought to explore PSTs' preparedness to teach EE when they begin their teaching career. For effective implementation of EE in schools, teachers need to be well prepared regarding balanced curriculum and pedagogical content knowledge to be confident to incorporate EE into their classroom (Öztürk, Gökhan, & Teksöz, 2013). This section, therefore, reports on findings from the questionnaire administered to PSTs that examined their preparedness to teach EE. This assessment was based on:

- a) PSTs' reflection on their learning in the EE paper
- b) PSTs' beliefs about the influence of the EE paper and
- c) PSTs' confidence in teaching EE

5.8.1 PSTs' reflection on their learning

Similar to Year 1 PSTs, PSTs were asked to indicate whether they would have liked to have had more, less or about the same learning opportunities on six key areas of the EE paper taken in their first year (Questions 66-71, see Appendix A). From the analysis of PSTs' responses, the most commonly identified areas where PSTs would have liked to have had more learning was about helping students to

contribute to social and economic development of their community (60%) and taking students outside the classroom to learn in the environment (60%) (Figure 5-17). The least commonly identified area (49%) where PSTs would have liked to have had more learning was about integrating environment and sustainability in their teaching. Generally, for all the key areas highlighted, less than 10% of the PSTs wanted a reduction in aspects of coverage in the EE paper.

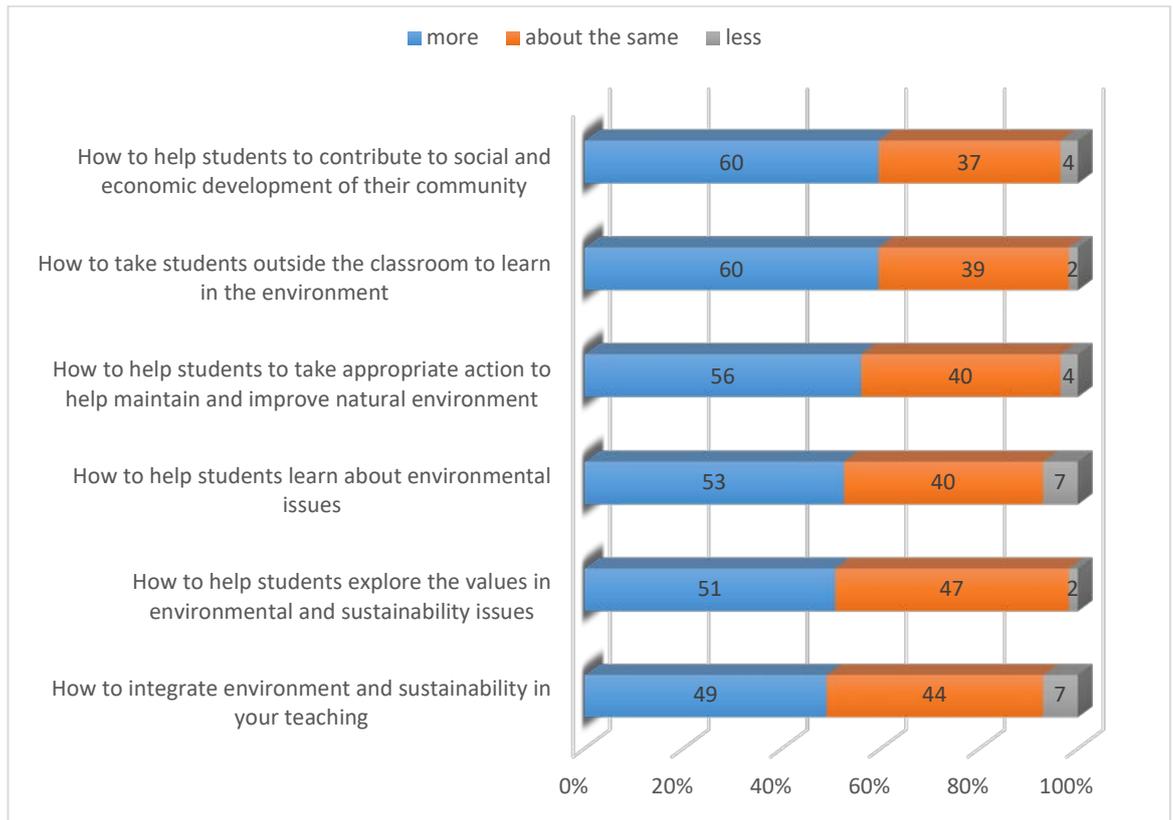


Figure 5-17 PSTs' reflection on whether they would have liked more, less or the same learning opportunities in the EE paper (n =57).

5.8.2 PSTs' confidence in teaching

PSTs were given a list of EE objectives (Question 56-61, see Appendix A) and asked to indicate how confident they were in teaching to achieve these objectives in primary schools. A 5-point Likert scale ranging from not at all confident (1) to very confident (5) was used. It is noteworthy to observe that none of the PSTs chose 'not at all confident' for all the EE objectives highlighted. The majority (93%) of PSTs reported being confident in taking students outside of the classroom to learn in the environment, while the second highest proportion (74%) of PSTs reported

being confident in helping students learn about environmental issues (Figure 5-18). The EE objectives with the least proportion of PSTs (55%) reporting being confident about was associated with teaching environmental and sustainability education in primary schools and helping students to contribute to social and economic development of their community.

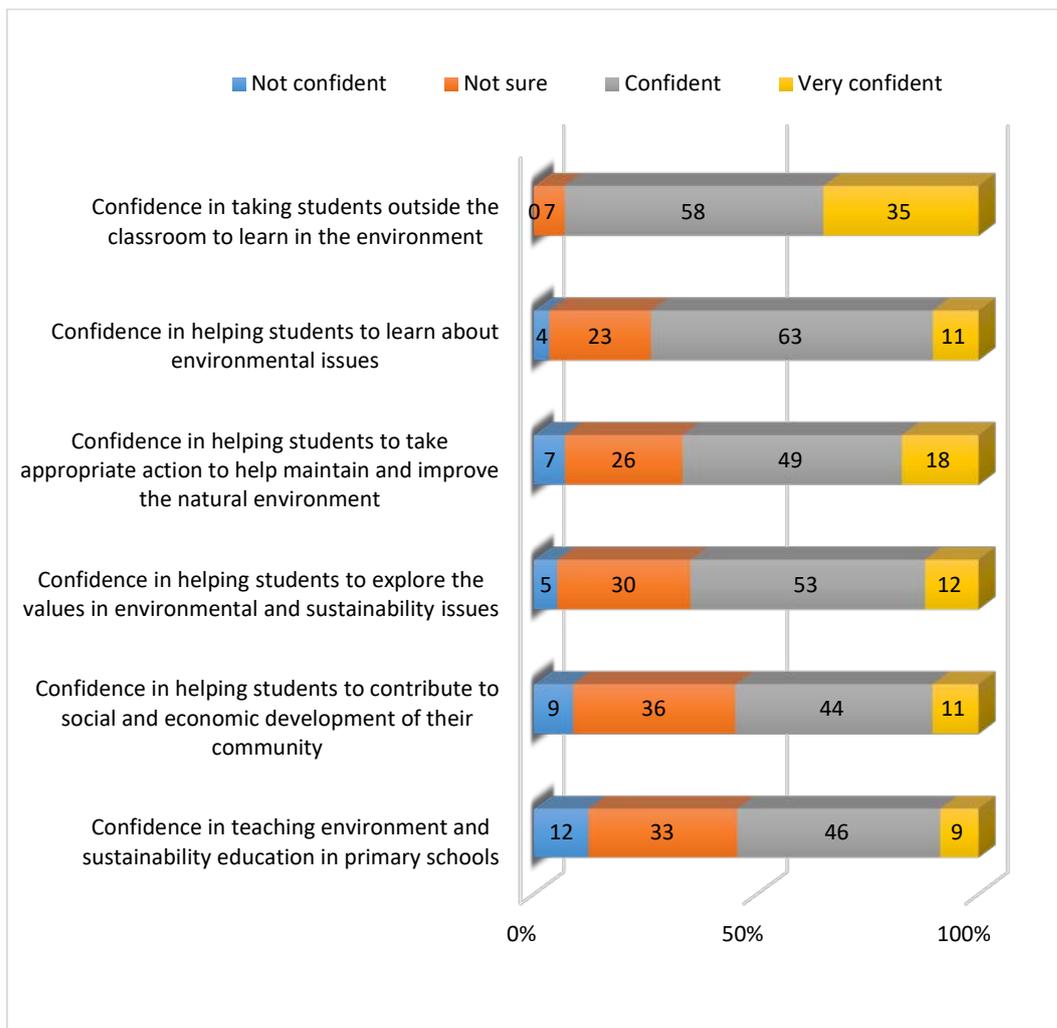


Figure 5-18 PSTs' confidence in teaching EE paper (n =57)

Similar to findings from Year 3s PSTs reflection on their learning (Section 5.8.1), PSTs seem to indicate their need for more learning in regards to helping students to contribute to social and economic development of their community. As such, it is not surprising to find out that PSTs felt less confident in achieving this objective in primary schools. On the contrary, it is somewhat surprising to find that PSTs felt less confident in teaching environmental and sustainability education in primary schools. In asking PSTs about their learning opportunities in the EE paper, the issue

of integrating environmental and sustainability education in teaching (method of teaching environmental and sustainability education in NZ primary schools) was the item least requested, although almost half (49%) still recommended this (Figure 5-17). This slight apparent contradiction may indicate that PSTs rely on means other than classroom learning to develop their EL. In support of this notion, earlier findings showed that media was the second highest contributor to PSTs' environmental literacy (section 7.1), with 80% of PSTs reporting the contribution of media to their EL. Relying on media as a source of environmental information might not be the most desirable as it might be misleading without providing PSTs with an accurate, indepth and sound EL.

Overall, according to PSTs' self-reported data, more than half of the proportion of PSTs felt confident and or very confident in teaching to achieve all the specified objectives in primary schools.

5.8.3 Section Summary

An analysis of PSTs' reflection on their learning in the EE paper indicated that less than 10% of the PSTs wanted a reduction in aspects of coverage in the EE paper for all the key areas highlighted. This could imply that PSTs feel that the aspects covered in the EE paper is adequate. A majority of PSTs would have however liked to have had more learning about helping students to contribute to social and economic development of their community and taking students outside the classroom to learn in the environment (Figure 5-17). The least commonly identified area where PSTs would have liked to have had more learning was about integrating environment and sustainability in their teaching.

In regards to PSTs' confidence in teaching EE in primary schools, findings from PSTs self-reported data indicated that a majority of PSTs felt less confident in helping students to contribute to social and economic development of their community and in integrating environmental and sustainability education in their teaching. On one hand, this finding is similar with findings from PSTs reflection on their learning (Figure 5-17) in which PSTs reported that they would have wanted more learning on how to help students to contribute to social and economic development of their community. On the other hand, it is somewhat surprising to

find out that PSTs felt less confident in integrating environmental and sustainability education in their teaching. This is because the least commonly identified area where PSTs would have liked to have had more learning was integrating environmental and sustainability education in their teaching. Reasons for this seem unclear, however, this slight apparent contradiction may indicate that PSTs rely on means other than classroom learning to develop their environmental literacy.

5.9 Case story

The case story in this section is provided to give an in-depth understanding of the extent to which ready-to-graduate pre-service teachers (Year 3 PSTs) feel prepared to teach environmental education based on their exposure to environmental education (EE) during their pre-service teacher education. After consulting a number of Year 3 PSTs who had taken the EE paper used as case study in this research two years ago, only Kate (a pseudonym) was enthusiastic about sharing her experience in the EE paper. Although a few of the Year 3 PSTs were willing to be interviewed, they however said their participation might not be productive, as they could not remember much about their learning in the EE paper. Kate was an exception, and she expressed a lot of clarity in respect to her knowledge about the EE paper taken two years ago. She said:

I can remember the lecture room location, it was quite full as it was a compulsory paper and there was a lot of us. I remember we had lectures that was quite late in the afternoon and we had a tutorial of 2 hours later on in the week.

Reflecting on her learning in the EE paper, fair trade was the topic she enjoyed the most, as she was interested and more passionate about it. Another aspect she appreciated was the effect of bee decline on food production. Kate said before taking the paper, she didn't really realize that bees were quite endangered but after the paper she felt a little bit more empowered about the issue of bee decline. Kate's learning about bee decline issues was consistent with PSTs' responses to the environmental knowledge questions asked (Section 5.2.3). For instance, the EK question most often answered correctly by PSTs was the question on effect of bee decline, as 90% of PSTs chose the correct answer. This resonated with findings

from the classroom observation wherein a great proportion of the EE paper was observed to be devoted to the effect of bee decline on food production. These considerations possibly explain the rationale behind PSTs still retaining the knowledge gained on bee decline even two years after completing the EE paper.

Other experiences at the university and other papers according to Kate contributed little or nothing towards her knowledge, attitude and behaviour about the environment and sustainability. This finding is similar to findings from PSTs' self-reported data on the factor that contributed the most to their EL during their teaching education training (Section 5.7). According to the PSTs' self-reported data, other papers and other experiences at the university contributed the least to their EL while the EE paper contributed the most. In the same manner, Kate further added that the EE paper had a somewhat positive impact on her knowledge, attitude, behaviour about the environment and sustainability.

Meanwhile, Kate mentioned that the practicum in an enviroschool contributed little or nothing towards her knowledge, attitude, behaviour about the environment and sustainability. This is in agreement with previous findings, given that participation in practicum ranked the fifth out of seven factors considered as contributory to the environmental literacy of the PSTs during their teaching education training (Section 5.7). Kate pointed out the lack of connectivity between the 'so-called' enviroschool and the environmental activity that was expected in such schools, based on her experience during the practicum. She reported that:

The school that we were at in first year where we did our first practicum, they were an enviroschool but it kind of became a bit of a running joke in our T-group that it was sort of like "oh! it's an enviroschool" where is the evidence of this environment ... but they had like many schools do, posters on their wall that they are silver enviroschool and they had this beautiful little garden ...

Findings from this interview again brings to the forefront two critical arguments related to environmental education in New Zealand. These are, first, the lack of clarity in the New Zealand curriculum of how environmental education could be incorporated in schools. These questions resonate with questions that emerged

during document analysis of existing policy documents (e.g the Ministry of Education's Guidelines for environmental education in New Zealand schools, 1999). Prior to the 1990s, the *New Zealand Curriculum Framework* did not make formal provisions for environmental education in the school curriculum. Instead, it permitted that the curriculum should accommodate diverse indigenous needs and priorities in such a manner that environmental concerns are not neglected. Even when the Guidelines were released in 1999, it only created a formal opportunity for schools that showed interest to incorporate environmental education into their school curriculum without making compulsory its inclusion in the apparently 'overcrowded' curriculum. Secondly, are mechanisms put in place to monitor the integration of EE in schools professing to be environmentally focused? Based on Kate's experience on the practicum in the enviroschool, she appears to perceive EE as completely outside the box and no concrete provision is really made for it in the New Zealand curriculum. She said:

I could not quite get a real clear link to how does this works in the classroom or in an education setting and that might be because there isn't anything in the NZ curriculum to try and link it in but then I remember our teacher saying to us this is in the curriculum but I say where? I know I don't remember that in there must be somewhere in the curriculum then I looked and there is really no where unless you try and link to the front end of the curriculum, which is great but that doesn't actually give you any clear guidelines of how do you do it in the classroom.

Kate's perception raises some concern about the clarity of the *New Zealand Curriculum* and presumably the lack of teaching along such directions during her teacher education programme.

Kate further asserted that based on her experience during the practicum in the enviroschool, it was apparent that there was confusion as to what an enviroschool should be doing or how they should incorporate environmental activities in the enviroschool's curriculum. More so, as there appeared to be lack of awareness among the whole school. According to Kate:

...if you talk to the students in the enviroschool they won't have any idea of what you are talking about unless maybe a small group of kids who are specifically dedicated to being environmentalists. In a school of 630 pupils, it wasn't really evident except the big poster on the wall that we are an enviroschool and that kind of reinforced that idea of the confusion of how you do it effectively in the classroom and without being tokenistic or without being surface level.

Reflecting on which environmentally-related activities she is regularly involved in, Kate claimed that the only environmental activity she has historically engaged in is recycling. She acknowledged that she was not sure if she carried out this action out of her concern for the environment, but she was sure it was more of a value developed while growing up. According to her:

Recycling in New Zealand became popular when I was about 12 years old so it was like quite a cool new thing to do so I thought it was fun to do it. It kind of became part of life, you have your recycling bin and you just put that in ...and then [after taking the EE paper] I realized that it was quite important so that we can reuse this material and it's also quite important to reduce the amount of rubbish going to the landfill...

Kate reflecting on the pedagogical approach used in the EE paper felt the pace of the lectures were somewhat too high for beginning students, as she said:

I suppose the lectures were kind of aimed maybe a little bit higher than where we were at in our sustainability journey. A lot of us or maybe it is just my experience for a while felt like I do not really understand the context to this as I do not have any prior knowledge of this really. So, kind of started quite high and then sort of through the tutorial our teachers try to help us make some connections but there was a lot of us who swim in the lost pattern for a while...

Kate also felt the way the paper outline was constructed made learning difficult, as there was so much to learn in the time available for the EE paper. She reported:

It was quite of a mismatch of lot of ideas put together that the flow-on through the paper was kind of maybe a little bit lacking so week to week (and I get that side that it's the easy way to organize the paper), we have a different topic but if you weren't quite finished with the previous topic or you didn't really understand that kind of waving of idea, it's quite difficult to do and you are like, am still so confused about the previous one we did and I suppose it was just more about learning to survive and get through with the assignment and move on rather than getting it really deep.

She strongly recommends a readjustment of some pedagogical approaches for more effectiveness. In her words:

I am not sure how it is done now, they might have already sort of reconsidered somethings but when we were taught, it kind of sounded like it needed to be just reconsidered. It was almost like, look it's another year we got to do the same thing over and over and let's just do it. Whereas I think they need to remember that there are people who are coming to learning the subject for the first time (most of us). Some of us had some experience of doing something at school but many of us had no idea of what is going on. So, it's like and maybe just the scaffolding through, especially the early stages and then you kind of have more understanding of the context of what's going on, then you can kind of go to high level but jumping straight and then going to... this is the four models or the four areas it's like what are you talking about?

These findings suggest that likely modifications or improvements in the pedagogical approach used in the EE paper may present opportunities for improvements in student learning experiences during the EE paper.

Kate feels she is probably not very prepared or confident to teach environmental and sustainability education to primary school students. She, however, said it will take a bit of personal research. She reported:

I am not entirely sure that I can feel like confident teaching environmental studies or leading children through that journey, even though I am about to

have my own classroom which is quite sad but I suppose it's just part of my own journey.

Although Kate hadn't started teaching, she has started envisaging some difficulties that might affect her integration of EE into her teaching. She reported that:

There is a huge focus on literacy, numeracy and you are lucky if yes some science, you have some social science, physical education and arts. It is difficult to find a space in your planning ... incorporating some sustainability and environmental on top of the school plan, it will be quite difficult and this is something I am not feeling overly confident about doing. I probably wouldn't and that's just how it is as a first year teacher, you have got a lot to fit in to just get right the basics and not going outside something in the direct learning area of the curriculum

Kate however, seems to be more passionate about some other subjects and would likely give that priority if any room for integration emerges in her future class. She reported that:

And to be honest I am more passionate about other areas that do not get recognition within the curriculum like the arts. I do want to integrate the art quite well and that does not mean we can't take issues that are related to sustainability but when you try to integrate literacy, numeracy arts, you already create a lot of pressure on yourself and the children.

Kate felt for her to be well equipped to teach EE, apart from some prior knowledge, which she had acquired, she felt probably a good thing would be some hands-on experience. She said:

...doing something physical even as a T-group, going through like a process of what you need to do in the classroom for instance when you are in the art paper when you do drama, often the teacher takes you through a process drama and then you've got like a structure to work with and you've got some personal experience to link back to on how you felt like a student and what some decisions you made in that context and maybe something like that will help you to successfully do it. It becomes more personal to you and not just

a piece of paper that was handed out on this is how you do it but we went through the steps ourselves.

On the whole, although Kate could be regarded as being naïve as a beginning teacher and might not have all the information needed to make some conclusions, especially during her practicum experience in an enviro school, the richness of Kate's story raises some issues. Apart from similarities in her responses to the questionnaire data from the Year 3 PST cohort, her perceptions of the challenges associated with the pedagogical approach used in the EE paper triangulated with tutors' interview data in this study.

Although Kate could not remember a lot of her learning in the EE paper, she was able to remember issues about bee decline (focused on in the EE paper) and how it influenced her. This further confirms previous findings that a majority of the Year 3 PSTs still retained their knowledge on bee decline two years after taking the EE paper.

Kate's responses indicated that other papers or experiences at university and even her practicum experience contributed little or nothing to her EL. Although caution must be exercised in generalizing this finding, Kate appeared to have had unpleasant experiences during her practicum experience, especially in implementation of EE in schools that are considered to promote EE.

Findings from this case story also raise questions about the clarity of the New Zealand curriculum with regard to how EE can be implemented in schools, and the role of teacher education programmes in helping would-be teachers to understand the curriculum better and implement it in their teaching. Kate recommended hands-on learning during the teacher education programme in order to be well equipped to teach future students. The time allocated for the EE paper, as highlighted in the case story in some ways had influenced the pedagogical approach used in the EE paper. The tutors had to cover a wide range of topics in the time available, which from Kate's responses seemed to make learning difficult for the PSTs. Although Kate did not feel confident to teach EE when she started teaching, she believed doing some personal research might help. However, based on the position of EE in

the New Zealand curriculum, Kate already envisaged some difficulties in implementing EE in her classroom, and even if the opportunity for integration arose, Kate's passion for arts might stand in the way of implementing EE.

5.10 Chapter Summary

This chapter examined the EL levels of ready-to-graduate PSTs (Year 3) and how they feel prepared to teach EE based on their exposure to EE during their teacher education programme. Overall, two years after taking the EE paper, Year 3 PSTs in this study seemed to have forgotten their learning. This inference was made on the relatively low level of knowledge of the natural environment, sustainability, and specific environmental and sustainability issues demonstrated by Year 3 PSTs as compared to their Year 1 counterparts who had just completed the EE paper. An exception, however, was a high level of knowledge on bee decline, an issue focused on extensively in the EE paper taken two years previously.

Despite Year 3 PSTs' low level of environmental knowledge, the majority of them showed positive environmental affect. Similar to their Year 1 PSTs, they demonstrated anthropocentric worldviews, and a majority of them agreed that there are no limits to the Earth's resources. This cohort of PSTs showed high levels of concern for all the environmental and sustainability issues highlighted in the questionnaire. Interestingly, they expressed the most concern for child poverty, endangered species, and racial discrimination (see Figure 5.9), which tallied with the concerns expressed by Year 1 PSTs before taking the EE paper. These findings indicate that the significant increases in Year 1 PSTs' concerns about bee decline and consumption and waste (aspects mainly focused on in the EE paper) was as a result of their learning in the EE paper and was short-lived.

Similar to their Year 1 counterparts, the same trend was observed in Year 3 PSTs' environmental behaviour. They were willing to make adjustments regarding issues related to community giving and protecting of endangered species but were not willing to be seen as activists or to modify entrenched lifestyles. The most common environmental behaviour PSTs engaged in was giving to charity and encouraging people at home to recycle glass, paper, or food scraps. Engaging in giving to charity

could be interpreted as PSTs' way of reacting to social justice and equity issues in the community. They were less disposed to other environmental-related activities that could be considered a threat to their convenience (e.g using other types of transport, such as biking or the bus instead of going in a car) nor participating in publicly organised programmes such as organised tree planting, which could possibly be associated with their unwillingness to be seen as activists.

Pearson product-moment correlations revealed moderate positive relationships among all the EL components except for a negative correlation between environmental knowledge and environmental affect. Path analysis, however, indicated that, of the other EL components, only environmental affect could directly predict intention to act and environmental behaviour.

PSTs' self-reported data indicated that the EE paper taken two years ago contributed the most to their EL, similar to their Year 1 counterparts. Other papers and other experiences at the university contributed least to their EL. This finding is somewhat disturbing as it indicates that if PSTs do not develop the needed EL during their teacher education programme, they may not have an in-depth opportunity to do so before they start their teaching career. Hence, they might not be able to help their future students develop their EL. In contrast to Year 1 PSTs, upon completing the EE paper, where 81% of them felt confident in teaching EE in primary schools, Year 3 PSTs felt least confident in teaching EE in primary schools (Figure 5.18). This finding of reduced confidence in teaching EE in primary school further buttresses indications that PSTs did not show evidence of their learning in the EE paper taken two years previously.

Findings from the case stories were consistent with PSTs' responses to the questions in the questionnaire, and hence are not repeated in this summary. However, some additional issues highlighted included:

- The ineffectiveness of some practicum experiences in further supporting PSTs to develop their EL and prepare them for integrating EE into their teaching. This could also imply a lack of role models in real-life job environments (e.g.,

Enviroschools) to express some of the EL developed during the teacher education programme.

- Pedagogical approaches used in the EE paper may not have completely presented opportunities for PSTs' to have a sound grasp of how to implement EE in their future classrooms.
- Ready-to-graduate PSTs seem to have already a mindset of an overcrowded curriculum which could impair the integration of EE into their teaching, especially if they get employed in schools that do not have expectations for the integration of EE into teaching.
- Personal interests of PSTs would play a role in whether they would seek for opportunities to integrate EE into their teaching or not.

The next chapter presents findings on the experiences of four beginning teachers with regard to how and whether their EL was applied to their practice in their first school.

Chapter Six: Findings - Beginning Teachers

6.1 Overview of the Chapter

This chapter presents findings of the research into beginning teachers' experience in teaching EE in New Zealand primary schools. Findings of the interviews of four beginning teachers who were part of the Year 3 PST cohort, and who had started their teaching career for at least 6 months are presented. Specifically, the chapter seeks to answer the fourth research question of this thesis: *Upon exit from university and integration into teaching workforce, what are the experiences of graduate teachers in applying their environmental literacy?* Interviews with these four beginning teachers are reported next as case stories.

6.2 Case stories

Four beginning teachers who had completed their Bachelor of teaching programme at the University in 2015 and had secured teaching positions in New Zealand primary schools were interviewed. These beginning teachers were part of the Year 3 cohort of PSTs examined in this study. They indicated their willingness to be followed up after securing employment and as such, the interviews were conducted a minimum of six months after they began their teaching career as a graduate. The aim was to find out about their experiences as beginning teachers, whether their EL was applicable to their practice in their first school, how prepared they felt to teach EfS and how they had been able to integrate EE into their teaching. All the four interviewees were teaching in state schools across New Zealand. State schools are the preferred choice for the vast majority of NZ children (85%) as schooling is free and parents only contribute to cover the cost of activities outside the core curriculum. These state schools are expected to teach the National curriculum (NZ Curriculum or Te Marautanga O Aotearoa) (Ministry of Education, 2016).

6.2.1 Tina

Tina was teaching in a state school in Wellington. The school comprises about 160 pupils and Tina had been employed there for over 6 months. Right from her university days, she had always shown a strong interest for EE. Tina was teaching in an enviroschool, the same school in which she had previously had her practicum experience, and Tina is currently the enviroschool coordinator for the school.

Despite finding it easy to integrate into the school due to some levels of familiarity, starting to teach was a different affair, which took Tina some time to acclimatize. She said:

I found it to be full on when I started, to be honest, but am trying to manage planning and assessment, it tells on you and the routine, but then things are starting to fall in place and I really like it.

Tina's school put emphasis on EE and there was an expectation that teachers include EE in their teaching. She reported:

We have a whole school outline for what kind of inquiry area we are expected to cover 6 weeks in each term. [We are first] looking at water conservation and then, living land space, in term 2 how we interact with the environment and ecological building, what we have around our school and how we can improve our school in terms of sustainability.

Tina had been able to integrate EE in her teaching. She said:

The first part of the year, we did water conservation and our next focus was how rain water goes down the drain, keeping our stormwater drain and that our river does not become polluted with rubbish ... so they learnt about it... that was really cool as they [the students] go around looking for rubbish in the drain. Our kids were really obsessed with it for a while by checking the drain for rubbish, and we have started a worm farm running with our school this year and we are using that for food waste rather than just throwing it out. I have taken my enviro group to the local habitat, we have done some planting along a stream that needs restoration and in a couple of weeks, we will be planting in the beach.

An important feature appeared to be the supportive role Tina's school management played in ensuring that EE is integrated. She reported that:

The management is really supportive, [they] find out what we need to do. They help the staff and me, so that we can do it together. I think the management team is really in support as I have been to a workshop at the

local school and I am in touch with the regional enviroschool coordinator. I think it has been really good.

Given the considerable management support and the focus of the school, even teachers who ordinarily would not have wanted to incorporate EE into their teaching would possibly do it. Tina reported that:

I think in the beginning of the year, every Friday morning block have different kids from all ages and showcase what they do from different kinds of learning, and we are thinking of what we can do, like veggie garden and we have a worm farm. But I remember I heard one of the teachers say, I don't want to do an enviro based thing and it's a little bit tricky... that's good. But with the management's support, they have said that's what we will be doing...

Having integrated EE in her teaching, Tina now felt more motivated to teach EE than she did when she graduated. A key reason for Tina's increased motivation was the resultant effect her teaching had on the kids. She reported:

More [I feel more motivated].I found that it's really an engaging way to teach the kids with the inquiry type topic to see where they are, and what they can do to change the world to be more sustainable, and aware of what they do. I feel like it is really relevant to them as they can see themselves making a change and helping in the bigger picture ... hands-on as well.

In addition to increased motivation, she felt more confident to teach environment and sustainability concepts/issues than she did when she had just recently graduated. She reported:

Yes, I feel more confident now. I feel more confident because one of the things we did in the beginning of the year was making water conservation. For the next 3 - 4 weeks [the kids] keep telling me how they tell their parents not to wash the car.

However, in taking students outside the classroom to learn in the environment, Tina did not feel confident, possibly because she hadn't attempted to do it. She suggested that:

I find that really tricky. I have only got 18 kids in my class and to manage eighteen 6-year-olds outside on my own... It's fine when we go to our school gully but I find it very difficult on my own. We do things inside as I find it really tricky to manage them outside. I will try to do it ...not letting that hinder me.

Reflecting on her learning in the EE paper, Tina does not think she had enough knowledge and skills as a beginning teacher. She largely attributed her knowledge and skills to the practicum experience in an enviroschool. She said:

No, I don't think so. I think if it wasn't for my enviroschool, I don't think I would be ready [to teach EE]. I think I got the majority from the practicum enviroschool because it's such a big interest of mine and I have been looking it up.

Thinking about the EE paper that she had taken at university, Tina said she really enjoyed it. Tina liked the holistic nature of the EE paper in that it teaches how to integrate EE into multiple disciplines, for instance, science, and social science particularly; she appreciated and enjoyed the opportunity to be creative in applying the assignment case study about bees to other aspects of environmental sustainability. Tina said:

I can remember doing the unit [assignment] about bees and the best thing was actually writing the unit and seeing how you can integrate science and social science and even reading and math into a unit so that people can see [that] teaching environmental sustainability is practical and possible in the class. You know we have got little time to do everything and you can make it a focus by integrating everything.

For Tina, completing the EE paper had some influence on her knowledge of environmental and sustainability issues. She was convinced that it was not necessary to have a stand-alone EE subject in primary school *per se*. The EE paper

had stimulated in her a level of curiosity and creativity that could help her come up with ways in which she could incorporate EE into her teaching. She said:

Yes, the [topic] 'in, for and about the environment' was new learning and all that, it kind of opened up the idea that you can teach about EE without it being alone. By linking it to the curriculum, it doesn't have to be a separate subject

Tina also thought the EE paper influenced her attitude and behaviour, especially reminding her of her family values and perhaps, made her appreciate them more:

Yes, I think it did [influenced my values]. It is good to have a reminder of what we do, the way we live and what we do. I think coming to university reminded me of some of the things my family does. I didn't do a lot of it in high school but some things my family do...I think it made me more aware of little things like recycling and more thinking right now about my teaching things I can bring into my classroom. Minimize power use ... lifestyle ... do your part.

Tina was of the opinion that before beginning teachers start their teaching it would be important for them to acknowledge that they can actually integrate EE into their teaching. Tina felt such acknowledgment would stir up motivation in the beginning teachers to find ways of incorporating EE into their teaching. She said:

I think the knowledge that EE can be integrated into all of your teaching or your inquiry topics. That it's not a separate subject and you don't have to put aside time just to teach that, and that topical idea that can be assessed and taught quite easily. When you get that, it makes you more enthusiastic and feel like you are more capable of doing something.

Tina was also of the opinion that moving the EE paper to the third year would be more appropriate. She mentioned two main reasons to support her position. First, the possibilities for losing EL gained during the teacher education programme are reduced. Second, it is the third year that the beginning teachers (PSTs) begin to prepare their minds for the teaching job, as the realities of the task ahead begins to dawn on them. She said:

Yes, especially if it was to talk more about unit planning and integrating it into daily or more regular teaching, because that is when you kind of start thinking about what are the kind of things you can do in your class. I don't really remember more about the first year.

Despite being very involved in her school's EE, the major challenge Tina considered hindering the execution of some projects was a lack of funding. She said:

A little thing I find with school is that budget and funding is a bit tricky to manage, especially when we want to set up a new project, finding money to do that could be quite tricky. It is going to cost money and it's a bit [of] a shame that things like that are put on hold because of money, and so we look for community support, like when we made our worm farm, we posted on community Facebook and got 10 people. People are willing to help but sometimes it is just money.

6.2.2 Rose

Rose taught in a state school in National Park. She had been teaching for about 6 months. Rose predominantly was teaching Years 5-8 with 27 kids in her class. Rose found it easy integrating into the school but saw the school as a different type of school, because unlike other state schools, the kids are placed in just two classrooms for four years. Rose taught in an enviroschool and the kids got the opportunity to go into the nearby national park weekly. The school has many environmental activities going on but there is really no emphasis toward teaching EE. Despite this lack of emphasis towards EE in the school, Rose believes the school is progressively working towards the goal of an enviroschool. She said:

We have a worm farm, we are a 'no rubbish' school, so the kids leave rubbish in their bags, and hence we have limited rubbish. We have a compost area which kids manage, recycle [waste]. We had an enviroschool visitor last week and we are looking at getting more and more towards that goal of being an enviroschool.

Rose has not been able to integrate EE into her teaching because of a number of factors. First is the 'overwhelming' pressure on her as a beginning teacher to do so

many things at the same time. Second, the school desires that she focus more on her time and behaviour management, as well as meeting the criteria for her registration. She reported that:

As a beginning teacher, everything is very overwhelming and there has been a focus for me [by the school] to improve my behaviour management with kids and make sure that I am focusing on my time management. [I am also focusing on] meeting the criteria for my registration so that's something that I have been doing. So, it [integrating EE into her teaching] has not been the focus as I have had all the other things to focus on.

Rose's school seems to decide the focus of their staff and it looks like the school has a plan for this but the time she has spent, there hasn't been any focus on EE. She further reported:

As far as my teaching ... this year we have not been able to do such things [learning in EE]. Last term we focused on sound where we use everyday occurrences to make music. Whatever the theme is [that the school decides on], is hoped to be integrated every couple of years.

Delving further to describe the school plan, Rose believed that when it's time for EE, the school would support her. She explained that "There is a 4-year teaching plan because [we are] having the same kid in two classrooms for 4 years. I feel that as I get to the enviro session [the session when EE would be a focus], I would be supported".

Although Rose hadn't integrated EE in her teaching, she felt confident to teach EE concepts given the right support and material. She said:

Absolutely, given the right support and having the right urge, [I feel confident to teach EE]. I am not yet uncomfortable teaching the subject because I know the subject and I can consult materials to find out any aspect I don't know.

She also felt confident to take children outside to learn in the environment as she had previously done that on several occasions. She reported:

Yes [I feel confident to take children outside to learn in the environment], because I am involved with going to the national park weekly. I have taken them out to all sorts of events as part of my leadership programme and I have managed that.

She feels as a beginning teacher, she did not have enough knowledge and skills. Rose also believed this experience of not having enough knowledge and skills as a beginning teacher is not limited to her alone. She reported:

No, I did not [have enough knowledge and skills]. I know I am not the only one. As a beginning teacher, I feel in regards to teaching, after completing a three-year degree programme and going into school, I [find out that] I know nothing ...I feel overwhelmed.

Thinking on the enviro paper, she could not remember a lot of her learning except the impression the teacher had on her, possibly as a role model who was passionate about the subject. Although she could not remember much of her learning in the EE paper, she, however, relied on the materials she had and would be willing to consult them whenever they will be needed. She said:

Considering that I had the EE paper in my first year, so, that is looking back over 4 years in the first semester, I can't say that I remember a lot but I remember my teacher. How passionate she was about the subject and that is something I pick up on, I remember that clearly. ... when it comes to the time of teaching, I do have all my books in a box that I can access in my house. When it comes to that time I think I should be able to teach it effectively because the knowledge is there, it will just take me some time to revise.

According to Rose, it is difficult to pinpoint the exact influence that the EE paper had on her knowledge, attitude, and behaviour. Possible reasons for this could be that she could not remember most of the things she learnt at the time of the interview.

6.2.3 Stella

Stella was teaching in a state school in Auckland with a student population of 486 students. She had been teaching for 6 months. She loved her teaching job and according to her ‘the staff and kids are friendly’. Integrating into the school was a lot easier because of the induction process she went through a week before the commencement of her teaching position at the school. Stella had her primary school education in an enviroschool where she did a lot of learning about the environment, worm farming, and global warming. Stella was teaching in an enviroschool, which had numerous environmental activities in place.

Stella reported that the school management did not put emphasis on the expectation of teachers to engage in EE. There, however, appeared to be environmentally-related routines, which the primary school children seem to be aware of, and servicing these activities appears more like a ritual without an accompanying platform for deep learning attached to it. She reported:

It’s not that there is a sort of push on that [to integrate EE in our teaching] but we have like an environmental team and each class rotates the responsibility of feeding the worm farm and the kids pour their waste in the bin. It’s there but it’s not that we do have to plan weekly as it just happens, the programmes are already in place.

Stella reported that she had not been able to integrate EE in her teaching but would do so the following term. According to Stella, her school was planning for an environmental activity the following term:

I haven't really done much. I think I haven't done much specifically on environmental aspects. We do inquiry teaching ... and I have not done that kind of [environmental] teaching. I am actually going to do some next term, actually about popcorn. We found that you can actually just plant popcorn seed and we are actually going to do the whole process and it's going to be cool.

She felt that what frustrates her efforts to integrate EE into her teaching is the availability of time. She said “Not enough time, you want to try and do everything

but you don't have enough time and that's the only thing [that frustrates or limits my effort to integrate EE in my teaching]”.

However, when asked what she would like to integrate if she had some more time, her response, ‘drama’, indicated that she seems to have passions for other things than EE. Although Stella hadn’t integrated EE into her teaching, she expressed being motivated to teach EE more now than when she graduated and claimed that she felt confident to take students outside to learn in the environment. The latter is not so surprising as Stella had already indicated that her school engage in some environmental activities.

Although Stella felt she doesn’t have enough knowledge teach EE, Stella said she would research herself to refresh her learning in the EE paper. She recounted that “There is that knowledge lag but I would do my own research to be sure I can do my own teaching. I need to remind myself”.

Thinking about the EE paper, she wished she could remember more but what stood out for her was the field trip. She reported that “I remember going on the field trip to the environmental garden and that was quite remarkable...because doing something and seeing that is quite memorable. I wish I remembered a bit more”.

Stella felt completing the EE paper served as a reminder to her, having gone to an enviroschool for her own primary education and being involved in some prior learning about environmental issues. She said “I think it [the EE paper] sort of reminded me of it all and brings it back to the forefront of your mind”.

In respect to her attitude and behaviour, she felt completing the EE paper had not really influenced her, since she had always cared for the environment, even before completing the EE paper. She said “Not really because I have always been quite caring towards the environment so it [the EE paper] didn't really change my position towards the environment”

Stella is of the opinion that before future teachers begin their teaching career, it would be important for them to understand how to integrate EE in their teaching:

How to integrate EE into the individual subjects in school, so how you could use the learning experience for your writing to remind them that it does not have to be literacy numeracy focus and that it can be done [integrated] rather than keeping it in a separate area [as a separate subject].

She felt it would be quite good for beginning teachers to have the EE paper in both the first and the third years of their teacher education programme because of two reasons. While the EE paper at the first year introduces the PSTs to the basics of EE, a subsequent refresher in Year 3 would rejuvenate their memories on the EL garnered during the EE paper. Additionally, Stella believed a subsequent refresher in Year 3 would help the PSTs to maintain the level of motivation needed to incorporate EE into their teaching as they take up teaching positions. According to her:

It is quite good in Year 1 as it gives the basis, but it would be nice to have like a refresher in Year 3 to remind you and refresh the whole idea. Besides, it will motivate you as well.

6.2.4 Emma

Emma was teaching in a big state school and had been there for one year. Her school was one of the largest primary schools in Hamilton with a roll of over 700 pupils. The school has a solid paper recycling system and a large selection of gardens. She liked it there and felt it was challenging but rewarding. Integrating into the school for her was tricky as it was a large school. She said:

It has been both easy and hard. They have a large number of staff so there are many opportunities to integrate socially. However, they move at a fast pace and a lot of the staff have been there for many years.

There was no emphasis toward EE in Emma's school. Emma felt the school had other priorities and as such, there were no expectations for beginning teachers to integrate EE into their teaching. It seemed that the focus of the school was mainly on the core learning areas of the NZ curriculum. She reported that there were: no expectations [to integrate EE into our teaching], the focus [of the school] is on

reading, writing and maths with other secondary focuses mainly being in the area of social sciences, health and physical education.

Given that there were no expectations for beginning teachers to integrate EE into their teaching, it is not surprising to know that Emma had not been able to integrate EE into her teaching. However, she had been involved in supporting the children in her class in some environmentally-related activities. She said, “I have tried in places by teaching some of the cultural significances of some trees through our class theme”.

What Emma saw as limitations that frustrate her effort are a crowded curriculum and achievement data driving a narrow curriculum. Emma mentioned that the reality of integrating environment and sustainability in her teaching was more difficult than she envisaged. Emma further stated that she understands the reality of the demands of the job more now and as such feels about the same level of motivation to integrate EE as she did when she graduated.

As a beginning teacher, Emma felt she did not have enough knowledge/skills nor felt confident to teach EE. She did not feel confident to help students learn about environmental and sustainability issues despite previously mentioning that she has supported the children to do some environmental activities. She also attributed her lack of confidence in teaching to not having done it. She said:

I do not feel confident enough to teach it, I would have to relearn the concepts I wanted to cover [if I were to teach today]. I don't feel confident to help students learn about environmental and sustainability issues simply because I haven't done it before.

She, however, believes she has some skills that might assist her to take her children outside the classroom to learn. She recounted:

I feel more confident to take students outside the classroom to learn in the environment but mainly because of my understanding of class management in that situation.

Emma could not recall much about aspects of the EE paper but she could remember vividly two aspects. First, the best aspect for her was the field trip to the gardens. The second aspect that left her with an impression was the overwhelming approach used in the EE paper, especially for those without prior knowledge of EE. Thinking about the EE paper, she said:

The best part... I can't remember much now but I do remember the trip to the gardens. The less interesting part is that so much of it [the teaching] was overwhelming particularly when we hadn't learnt about them [the topics discussed] before.

Emma affirmed that taking the EE paper made her know a little bit more but not much in regards to the influence of the EE paper on her knowledge of EE. However, she does not feel the EE paper had much influence on her attitude and behaviour. She reported "I was always interested in recycling and so I have maintained that but otherwise probably not really." For Emma, she strongly felt that for beginning teachers to be successful in their teaching, they need to understand and be able to implement the curriculum. She said "Good curriculum knowledge and experience implementing the teaching of it [is important] before beginning their teaching".

6.3 Summary of the case stories

All the beginning teachers in this study taught in enviroschools. Of the four beginning teachers, Tina was the only one who reported to have been able to integrate EE into her teaching. Interestingly, only Tina was in a school whose management had expectations for its teachers to integrate EE into their teaching. Evidence from the case stories, therefore, indicates that beginning teachers' school leaders could play a significant role in determining whether EE is integrated into their teaching or not. Equally, the extent to which EE is integrated is also influenced by the school leaders' approach. For instance, Rose stated that her school management expected that teachers integrate EE into their teaching every couple of years. Beginning teachers in schools where there were no expectations of integrating EE into teaching did not integrate it into their teaching. Hence, school leaders' expectations emerged strongly as a factor that either motivates or discourages the integration of EE into teaching.

All four schools had activities that could be termed ‘environmental’ (recycling, worm farming) in place in their schools. The findings of this study cannot be certain that these activities are backed up with in-depth teaching and as such could be regarded as ‘rituals.’ Environmental ‘rituals’ identified in this study, without deliberate education aimed at developing the EL of students cannot be regarded as achieving the goal of EE in developing environmentally literate citizens. Further study is needed to actually ascertain if learning accompanies the ‘rituals’ identified in this study.

Evidence from this study suggests the role of beginning teachers’ interest in integrating EE into their teaching. Tina’s school management emphasised the integration of EE into teaching, and she was also the only one of the four beginning teachers who expressed strong interest in the environment. This could further explain why she was able to integrate EE into her teaching. These findings show that EE integration into teaching becomes a reality when school leaders’ expectations on the integration of EE and beginning teachers’ personal interests coincide. For instance, Stella asserted that rather than integrating EE, she would be more willing to integrate drama (which, like EE, is expected to be taught using an integration approach), as she was more passionate about drama. This finding concurs with the case story of Year 3 PST (Section 5.9) Kate, who felt she would be more willing to integrate some other areas that do not get recognition within the curriculum, like the arts, into her teaching if she had the time.

Availability of time and the realities associated with integrating EE into teaching were also seen as challenges for beginning teachers by other respondents. Stella felt that the limitations on integrating EE into her teaching had to do with time, while for Emma, the reality of integrating EE in her teaching was more difficult than she initially envisaged. She added that, within the limit of available time, she was being faced with increasing pressure to deliver despite a crowded curriculum and achievement data driving a narrowing curriculum.

Another issue that emerged from the case stories was the effectiveness of the teacher education programme that the beginning teachers had been exposed to. All four interviewed beginning teachers felt they did not have enough knowledge and

skills in EE before they began their teaching career. This finding is not surprising because evidence from Year 3 PSTs, as discussed previously, indicated that these beginning teachers did not seem to have retained their learning from the EE paper studied more than two years ago. Similar to findings from Kate (Section 5.9), the pedagogical approaches used in the EE paper seem insufficient in preparing the beginning teacher for how to integrate EE into their teaching. Overall, most of the PSTs could not remember much of their learning in the EE paper. Stella felt it would be good to have the EE paper in both the first and third years of the teacher education programme. According to her, the EE paper in the first year introduces PSTs to the basics of EE, while a subsequent refresher in Year 3 could refresh their memories, which could help maintain the level of motivation needed to incorporate EE into their teaching as they take up teaching positions. This confirms evidence from this study that the time between taking the EE paper and the start of their teaching career seems too long and might have had an impact on beginning teachers' EL and their motivation to teach EE. Without exception, all the interviewed beginning teachers felt that what was most important for future beginning teachers to understand about EE before beginning their teaching was how to integrate EE into their teaching. The next chapter discusses these findings in relation to the EE literature, and also presents the conclusions, limitations, and recommendations of this study.

Chapter Seven: Discussion, conclusions and recommendations

7.1 Chapter Overview

This final chapter presents the discussion and conclusions of the research, research implications, limitations, as well as recommendations for further research. This chapter focuses on the main findings from this study that used a case study strategy within an interpretivism paradigm to explore the environmental literacy (EL) of pre-service teachers (PSTs) and their preparedness to teach environmental education (EE) based on their teacher education programme in EE. Specifically, this chapter focuses on findings from Chapters four, five, and six, along with how they relate to existing EE literature on the development of PSTs' EL and their preparedness to teach EE in primary schools. As mentioned earlier, EE is not mandatory in *The New Zealand Curriculum*. Although the Ministry of Education intends that EE should be included in all schools, it is left to each school to determine the extent of its inclusion, if any, in their own school wide programme (Chapman, 2011). The need for teachers to be well trained in EE, in order to be able to influence their future students' EL (Álvarez-García et al., 2015; Esa, 2010; Goldman et al., 2014) as well as overcoming challenges that might be associated with implementing EE in schools is clear.

As in most countries, primary school teachers in New Zealand are expected to integrate EE into other subjects. Therefore, it becomes imperative that teachers be adequately trained during their teacher education programme to develop their EL and confidence needed to integrate EE into their teaching. This research was therefore designed to (1) evaluate the EL of PSTs during their teacher education programme, as well as their preparedness to teach EE upon graduation; (2) explore the graduates' implementation of EE in New Zealand primary schools based on their EL developed and retained during their teacher education programme. To achieve these research aims, a cross-sectional approach was employed to collect data from two cohorts of PSTs, and beginning teachers. This was done in three phases. In the first phase, Year 1 PSTs' EL was examined using a pre-test and post-test design to evaluate the development of their EL upon exposure to EE. The second phase involved evaluating ready-to-graduate, Year 3 PSTs' EL and their

preparedness to teach EE based on their exposure to EE, two years previously. The third phase with beginning teachers was to assess whether the EL acquired during their teacher education programme is retained and ultimately applied in their teaching.

7.2 Discussion

This section focuses on the main findings from Chapters four, five, and six in a way that relates to existing EE literature on the development of PSTs' EL and their preparedness to teach EE in primary schools. The section has subsections structured according to the research questions guiding this study. Subsections 7.2.1 to 7.2.3, address research sub-questions 1-3:

1. What is the immediate impact of completing a first-year core paper in EE on the EL of PSTs (Year 1)?
2. What are the EL levels of ready-to-graduate PSTs (Year 3) and how prepared do they feel to teach EE based on their exposure to EE during their pre-service teacher education?
3. What relationships exist between components of EL among PSTs?

To answer these questions, data were collected from the participants at two different points in their teacher education programme, that is, (a) Year 1 PSTs, who had just completed the EE paper and (b) Year 3 PSTs after two years of completing the EE paper. A subsequent subsection, 7.2.4, addresses research sub-question 4:

4. Upon exit from university and integration into teaching workforce, what are the experiences of graduate teachers in applying their EL?

7.2.1 Impact of completing a first-year core paper in EE on development and retention of PSTs' EL

This subsection discusses findings as they relate to PSTs' environmental knowledge, environmental affect, environmental concern, and environmental behaviour. The relationships between these EL components in the data are discussed next, followed by the influence of different factors on the development of PSTs' EL.

7.2.1.1 Environmental knowledge

PSTs' knowledge of the natural environment, sustainability, and specific environmental and sustainability issues was examined. Year 1 PSTs' self-rating of their knowledge of the natural environment, as well as their responses to the open-ended question on the importance of the natural environment, present evidence of an increase in their knowledge upon completing the EE paper. In particular, before taking the EE paper, the Year 1 PSTs viewed the natural environment mainly as an 'object', while upon completing the EE paper a shift towards viewing the natural environment from a 'relational' perspective was observed (see Section 4.2.1). In addition, their learning in the EE paper seems to have broadened their conception about the importance of the natural environment. For example, upon completing the EE paper, PSTs were able to relate the importance of the natural environment to new concepts (not present in the pre-test responses) such as ecosystem and biodiversity taught in the EE paper. Previous studies (Pe'er et al., 2007; Tal, 2010) have also shown that prior to taking an EE paper, beginning teachers had limited knowledge of the natural environment, but increases in their knowledge were observed upon exposure to an EE paper. Evidence from this study and findings from existing literature therefore attest to the potentials of EE in increasing environmental knowledge of PSTs. However, two years after taking the EE paper, responses of Year 3 PSTs in this study indicated that their understanding of the natural environment now resembled a more limited understanding of the natural environment similar to that of their Year 1 counterparts prior to them taking the EE paper. This indicates that the Year 3 PSTs had not retained the knowledge gained in the EE paper. This in some ways implies that these potential teachers who are about to begin their teaching career do not seem to have adequate knowledge of the importance of the natural environment and this may limit their effectiveness in teaching in this area for their future students.

One shared feature among Year 1 and the Year 3 PSTs who had previously taken the EE paper was that a majority maintained a perception that the environment exists for what it does for humans (see Sections 4.2.1 and 5.2.1), thus they held an anthropocentric view of the natural environment. Their learning in the EE paper did not seem to influence this viewpoint of the natural environment. This resonates with findings from previous studies (Ahi, Balci, & Alisinanoğlu, 2017; Loughland et al.,

2002; Moseley, Desjean-Perrotta, & Utley, 2010; Pointon, 2014; Shepardson, 2005). Worthy of note, however, is the study of Liu and Lin (2014) that reported an anthropocentric worldview among surveyed university students in Taiwan. Even then, a critical look at the ideas of those students about nature and the human-nature relationship reflected that they had some mixed worldview tendencies. For example, the students recognized humans as part of nature but still felt humans should play a dominating role, although according to them, such a role could be replaced by other living species. Also, survey respondents in the Liu and Lin (2014) study advocated the need for humans to take responsibility for securing natural resources and a viable environment for all living species, 'especially humans.' It could then be argued that most of the respondents in previous studies, as well as this present study, reflect a utilitarian value with elements of anthropocentrism. It is somewhat understandable, given they are humans themselves and humans appear to be more prominent in the ecosystem, depending on resources from nature. It might, however, become worrisome if an individual does not hold other values of nature since an individual's values could determine an attitude of care towards the environment or not. More so, in the context of this study, since teachers have great influence on their students, their values can be easily transferred to their future students either directly or indirectly.

Findings from PSTs' self-rating of their understanding of sustainability indicated that PSTs had limited knowledge of sustainability prior to taking the EE paper and that their learning in the EE paper may have considerably increased their knowledge. Specifically, prior to taking the EE paper, 27% of PSTs rated their understanding of sustainability as either poor or fair, but upon completing the EE paper, only 2% of PSTs still rated their understanding of sustainability as either poor or fair. Analysis of PSTs' responses to an open-ended question asking what sustainability meant to them substantiated PSTs' self-reported knowledge ratings. Prior to taking the EE paper, PSTs demonstrated limited knowledge of sustainability, in that, they did not capture the three core aspects of sustainability (Nolet, 2009) in their response to the question asked. However, upon completing the EE paper, more PSTs were able to relate their understanding of sustainability to the three aspects: environment, economic and socio-cultural as taught in the EE paper taken. This

improved understanding of sustainability, upon exposure to EE, resonates with the findings of a recent study (Piasentin & Roberts, 2017).

Two years after taking the EE paper, the Year 3 PSTs were not able to relate their understanding of sustainability to its three aspects. In particular, among the Year 3 PSTs, only a few linked the definition of sustainability to its socio-cultural aspects while the economic aspect was completely left out. For example, only 16% of the responses (5 out of 32) reflected some socio-cultural elements of sustainability. This resonates with the findings of Summers et al. (2004). The Year 3 PSTs were also observed to demonstrate a more simplistic understanding of sustainability, as compared to their Year 1 counterparts who had just completed the EE paper, based on their responses to the open-ended questions. Interestingly, this Year 3 cohort of PSTs seems to be aware of their level of knowledge of sustainability, as indicated by their conservative self-rating (See Section 5.2.2). The Year 3 PSTs in this study seemed not to have retained their learning on the core aspects of sustainability at the time of the survey, two years after learning about them in the EE paper. Furthermore, based on a previously published classification of sustainability (Summers et al., 2004) used in this study (Section 4.2.2), PSTs' understandings of sustainability were most aligned to its nature (environment, economic, social), with the most inclination towards the environment. These findings are similar to those reported by Birdsall (2014), Walshe (2008) and Summers et al. (2004). The tendencies of PSTs in this study and other previous studies to align their understanding of sustainability more towards its environmental aspect has been suggested to be influenced by the departmental location of the EE paper itself. Fisher and McAdams (2015) argued that students usually view sustainability through the lens of the academic division where their coursework is located. For instance, students in the business or economics area might explain sustainability more with respect to its economic element. The EE paper in this study was located in a generic Faculty of Education so this may not have been a factor in itself. However, the paper name *Environmental and Sustainability Education* does foreground the environmental aspect more than the others and this may have had an influence. Interestingly, the PSTs' often referred to the EE paper as the 'enviro paper'. Evidence from this study thus indicates that designers of teacher education programmes should carefully consider issues around the position of EE in their

programme as well as its goals. This is because if an aspect of sustainability is foregrounded more than the others, then, such programmes cannot be regarded as achieving the goals of EE. For a balanced teacher education programme in EE all its dimensions need to be equally grounded.

As mentioned previously, findings from this study indicate that there was a general increase in knowledge of PSTs on specific topics covered in the EE paper. Analysis of PSTs' responses to the open ended questions on natural environment (see Section 4.2.1) and sustainability (Section 4.2.2) gives evidence of increased knowledge of PSTs, especially on the topics focused on in the EE paper. Analysis of Year 1 PSTs' questionnaires data on objective knowledge related to specific environmental and sustainability issues showed significant increases in environmental knowledge mean scores associated with the question on effect of bee decline, a topic discussed extensively in the EE paper (see Section 4.2.1). There was no significant increase observed in PSTs' knowledge of the other topics nor on the local issue included, water pollution. In a similar vein, Year 3 PSTs who had completed the EE paper two years previously also demonstrated good understanding of the effect of bee decline on food production (see Section 5.2.1). As reported in Section 5.9, two years after taking the EE paper, the interviewed PSTs could not recollect much of their learning in the EE paper, except for bee decline. Increased knowledge of students and PSTs on issues related to specific course content has also been previously reported in the literature (Liu et al., 2015; Tuncer Teksoz, Boone, Tuzun, & Oztekin, 2014; Zsóka et al., 2013).

While the EE paper in this study seems to have increased the environmental knowledge of PSTs immediately after exposure, as seen among the Year 1 cohorts, two years on, only a third of the PSTs could be regarded as having an acceptable level of environmental knowledge, based on the NEEFT and Roper scale (See Section 5.2.3). In a similar study, Yavetz et al. (2009) with a pre/post-test design, PSTs' environmental knowledge scores significantly increased after three years of studies, but their overall environmental knowledge was still regarded as somewhat low. While in this study, PSTs were evaluated after they had a one semester (12 weeks) long exposure to an EE paper during their teaching education programme, it is not stated in the Yavetz et al. (2009) study, the duration, frequency and intensity

of the exposure of the PSTs to the EE course. Neither was it made known if all the PSTs in the study took a compulsory EE paper. As such, it is unclear if the significant increase reported was largely due to an intervention or not. The low proportion of Year 3 PSTs that could be regarded as having an acceptable level of environmental knowledge in this study is an indication that the Year 3 PSTs did not seem to retain some of their learning from the EE paper taken two years previously. A previous study (Hsu et al. 2015) indicated the effects of an EE paper were still maintained two months after the conclusion of the course. However, in this study, retention after two years appeared much less. This observation presents implications and considerations for the positioning, frequency, and duration of EE paper in teacher education programme that will be discussed later.

Based on the evidence discussed above, indicating increased knowledge especially on the aspects focused on in the EE paper, as well as inability to retain the knowledge gained over a period of two years, a case can be made for more in-depth focus on some specific environmental and sustainability issues that could widen and strengthen students' EL. However, then the question arises as to how much content can one (or possibly more) EE paper cover that would suffice in effectively developing the EL of these PSTs, in such a way that they are adequately prepared to teach their future students. There are two schools of thought on the most suitable approach to answering this question, with one advocating for some predefined criteria, standards that could regulate the content of EE paper (Hsu & Roth, 1998; Roth, 1992; Simmons, 1995a). Others, influenced by a more critical standpoint, disagree with this approach of a need for predefined criteria as it tends towards a more positivist way of inquiry. These theorists believe individual transformation of learners can be achieved in different ways irrespective of the inclusiveness of a defined curriculum targeted at knowledge acquisition (Mezirow, 1990; Taylor, 2008). This school of thought which advocates individual transformation, emphasizes the need for learners in EE courses to be encouraged to develop their own curiosity, discuss their own views while critiquing these views as well as societal views about these environmental issues, and eventually develop their worldviews about the environment and sustainability (Tal, 2010). Regardless of the positions of these two schools of thought, what is crucial is achieving the goals of EE (IUCN, 1970), which although recognising the role of knowledge in developing

EL, stipulates that knowledge alone does not however suffice as it also needs development of the affective and behaviour components (Goldman et al., 2014). The next section discusses findings in this study related to PSTs' environmental affect.

7.2.1.2 Environmental affect

This EL component in the current study consisted of three subscales, namely: locus of control, personal responsibility, and environmental worldview. On the whole, high mean scores of PSTs on these three subscales were observed prior to, upon completing the EE paper (Year 1 PSTs), as well as two years after taking the EE paper (Year 3 PSTs). Specifically, on a cohort basis, Year 1 PSTs already demonstrated positive environmental affect prior to taking the EE paper, leaving little room for significant improvement as a result of their learning in the EE paper. Although slight overall increases in PSTs' mean scores (pre-test mean-3.76; post-test mean- 3.79) were observed upon completing the EE paper, the changes were not significant. Two years after taking the EE paper, Year 3 PSTs also displayed indications of positive orientation towards the environment for the three subscales. Generally positive environmental affect among all the PSTs observed in this study is consistent with previously published studies (Alp et al., 2008; Aminrad et al., 2013; Boubonari et al., 2013; Chu et al., 2007; Yavetz et al., 2009).

Among the three subscales, the highest observed shift was associated with Year 1 PSTs' personal responsibility (pre-test mean-3.70; post-test mean-3.80), indicating that, after completing the EE paper, there was some further realization of their contribution to environmental problems and solutions in their communities. PSTs' learning in the EE paper seems to have influenced their perception of being able to contribute to the solutions of environmental problems in their communities as well as acknowledging being part of the problem. This resonates with the findings of Erdogan and Ok (2011), but contrasts with the findings of Tuncer Teksoz et al. (2014) where PSTs did not see themselves as contributing to environmental problems. Responses from Year 3 PSTs, however, indicated that they felt more responsible for the environmental problems in their communities (mean-3.95) than for solutions (mean-3.60). This may indicate a waning of commitment to addressing environmental problems in the two years since undertaking the EE paper.

Despite the seemingly greater commitment of Year 1 PSTs about contributing to the solutions of environmental problems in their community, mean scores related to their internal locus of control remained unchanged, prior to and upon completing the EE paper (See Section 4.3.1). There was evidence from the focus group discussion that PSTs believed that they could make a difference, but that, there was still the need for some ‘powerful others’ such as the government to help out, and their learning in the EE paper did not seem to influence their position. This links to the study by Esa (2010) where only a small percentage of the students agreed that contributions by individuals to the environment were enough. Year 1 PSTs in this study could be regarded as having a mixed perspective concerning the role of the government and theirs as individuals. In contrast, PSTs in another study (Tuncer Teksoz et al., 2014) seem to give more support to government initiatives as the first avenue for addressing environmental problems, with individual responsibility regarded as less popular. This might be associated with prevailing cultural values of the country the study was carried out. A similar trend with the Year 1 PSTs was observed among Year 3 PSTs, in relation to their locus of control.

As discussed in Sections 4.3.3, PSTs’ environmental worldviews were explored using the NEP scale, measuring three dimensions: humanity over nature, balance of nature and limits of growth. Year 1 PSTs expressed pro-environmental worldviews to all of these dimensions but one; limits of growth (see Section 4.3.3). Precisely, an equal proportion of Year 1 PSTs in both the pre-test and post-test (89%) agreed with the statement that plants and animals have as much right as humans to exist. Similarly, Year 3 PSTs expressed strong pro-environmental worldviews in their response (88% agreed or strongly agreed with the statement). Moreover, two-thirds of the proportion of Year 1 PSTs in both the pre-test and post-test disagreed with the statement that humans have the right to modify the natural environment to suit their needs similar with previous studies (Al-Dajeh, 2012; Öztürk et al., 2013; Tuncer Teksoz et al., 2014). A third of PSTs in this study however remained undecided or neutral regarding interrelationships between human and nature, even after completing the EE paper. This is consistent with findings from PSTs’ perceptions of human-nature relationships as discussed in Section 7.2.1., where PSTs expressed an anthropocentric view about the environment. Their learning in the EE paper did not seem to influence this position,

and it could be argued that this trend became more pronounced two years after taking the EE paper.

An important pattern observed in the analyzed data of PSTs' responses relates to an exhibition of less pro-environmental worldviews regarding the limits of the earth, before taking the EE paper, after completing the EE paper and even two years after taking the EE paper (see Figure 4-12 and Figure 5-8). The majority of PSTs in this study (Year 1 Pre-test - 66%, Post-test - 65%; Year 3 -71%) perceived that the Earth has plenty of resources, if we just learn how to develop them. This contrasts with findings of Al-Dajeh (2012) where 96% of the respondents expressed a pro-environmental worldview by disagreeing with a similar statement. It is unclear why PSTs in this study felt the Earth has limitless resources, but then, it might show their lack of knowledge in this area, as westerners (e.g. New Zealanders) are more likely to have a perception that resources don't run out due to its availability. As such, this stance might be linked to the cultural environment of this study where it appears that resources are in abundance due to easier access to them. Alternatively, given the overall positive environmental affect expressed by PSTs in this study, it might be that the PSTs understood the statement from a different perspective linked to their responsibility and possible consequences of their behaviours. As such, they possibly could have thought that they could play a role in helping to develop these resources.

Summarily, it is noteworthy to mention that regardless of Year 3 PSTs' showing evidence of retention of the knowledge gained, if it was gained, they still demonstrated positive environmental affect to most of the environmental affect statements. This is in line with findings of previous studies (Aminrad et al., 2013; Chu et al., 2007; Liu & Lin, 2014; Timur et al., 2014) which suggest that having a low level of environmental knowledge does not necessarily imply less affective dispositions towards the environment.

7.2.1.3 Environmental concern

The level of PSTs' concern for seven environmental and sustainability issues (air pollution, water pollution, child poverty, racial discrimination, bee decline, endangered species, consumption and waste) was examined in this study. Findings

suggest that both cohorts of PSTs showed high levels of concern for all the specified issues prior to taking the EE paper, upon completing the EE paper (Year 1 PSTs), as well as two years after taking the EE paper (Year 3 PSTs). Specifically, among the environmental and sustainability issues highlighted, the Year 1 PSTs, before taking the EE paper, expressed the most concern for child poverty (mean 4.72) and racial discrimination (mean 4.42). The least concern expressed was associated with bee decline (mean 3.91). After completing the EE paper, significant increases were associated with post-test concern mean scores for bee decline (pre-test mean 3.91; post-test mean 4.3). As previously discussed, the effect of bee decline on food production was a central topic in the EE paper taken by PSTs. It is apparent from these findings that their learning in the EE paper might have contributed to their increased concern for bee decline. Interestingly, upon completing the EE paper, reduced concern was associated with other areas not focused on in the EE paper such as child poverty, racial discrimination, and air pollution. Although reasons for the significant decreases in the areas not focused on in the EE paper seem unclear, it could be argued that the more knowledge an individual has about an issue, the more concern the individual expresses towards the issue. This resonates with previous studies (Tuncer Teksoz et al., 2009; Tuncer Teksoz et al., 2014; Vlaardingerbroek & Taylor, 2007). These findings, however, challenge the position of Hsu (2009) that it is not about the impact of formal education *per se* but real life experiences that play the most significant roles in influencing EL.

Two years after taking the EE paper, Year 3 PSTs expressed the most concern for child poverty and racial discrimination (see Section 5.4). The issue of lack of knowledge retention observed two years after taking the EE paper, as previously discussed (Section 7.2.1), seemed to re-surface in the observed PSTs' level of concern. Specifically, prior to taking the EE paper, concern for child poverty and racial discrimination were highest while bee decline was the lowest. PSTs' level of concern for child poverty and racial discrimination might have been influenced by the egalitarian stance of New Zealand with policies put in place to ensure that no group especially Māori and Pasifika, are marginalized. Despite this, studies (Bécares, Cormack, & Harris, 2013; Harris et al., 2012; Paine, Harris, Cormack, & Stanley, 2016) have indicated that these groups still experience elements of racial discrimination and this could have been responsible for the concern of PSTs about

this sensitive issue. Closely related is child poverty. Boston (2014) reported that poverty rates are higher among Māori and Pasifika children as compared to their Pakeha / European counterpart. According to a research report on New Zealanders' Attitudes to Child Poverty (released July 2014), 80% of the respondents agreed that child poverty is a problem in New Zealand, and as such PSTs in this study might be aware of this issue. The media, as well, might have played a significant role in raising the awareness of New Zealanders about this prevailing sustainability issue (Vlaardingerbroek & Taylor, 2007).

Based on the above premise, it seems logical that PSTs, by default, prior to taking the EE paper, might tend to naturally demonstrate a high level of concern for these locally prevalent and publicized issues. This is consistent with previous studies (Ashmann & Franzen, 2017; Tuncer Teksoz et al., 2014; Vlaardingerbroek & Taylor, 2007). PSTs' concern for racial discrimination and child poverty might well be associated with their professional life as these are issues that readily confront teachers. Conversely, although water pollution is regarded as a local issue, findings from this study show that PSTs did not seem to be too concerned about it. This lack of concern may be linked to their lack of knowledge about the issue (see Section 4.2.3) or because it does not have a direct relevance to them as teachers. Upon completing the EE paper, the significant increase in concern for bee decline might be explained by the extensive learning on the issue in the EE paper taken, and a corresponding decreased concern for other issues not focused on in the EE paper. However, findings from this study indicate that the high level of concern probably stimulated by the EE paper was short-lived, and only temporarily supplanted their initial concerns before taking the EE paper. The re-emergence of the initial concern may have been stimulated by no further formal learning. This finding suggests that for EE to achieve its goal of developing PST EL and having it sustained, there is a need for continuous exposure to EE. To support this assertion, previous studies have shown that longer-term interventions are more likely to achieve sustained outcomes (Boubonari et al., 2013; G. Tuncer Teksoz et al., 2014).

7.2.1.4 Environmental behaviour

PSTs' environmental behaviour in this study was examined based on a combination of their intention to act in an environmentally responsible manner and their self-

reported engagement in some specified environmentally responsible behaviour. The specific behaviours highlighted in this study relate to consumer action, eco-management, persuasion, nature-related leisure, environmental activism, and community giving.

In general, PSTs were more willing to act in regards to protecting endangered species and actions that involve financial commitments. They were on the other hand not willing to act when it could affect their lifestyle nor were they willing to be involved in activities associated with environmental activism (see Section 4.5.1). These findings in some ways indicate PSTs' values. On a cohort basis, prior to taking the EE paper, Year 1 PSTs already demonstrated high levels of willingness to act towards three of the five intention to act statements, hence a big shift was unlikely to be seen upon completing the EE paper. These statements were associated with endangered species, child poverty, and consumer action. There was, however, room for enhanced intentions to act on the remaining two statements connected to environmental activism and lifestyle changes because of the low mean 'intention to act' scores for these statements before taking the EE paper (see Section 4.5.1). Upon completing the EE paper, however, changes towards more willingness to act in all the specified areas were not observed, regardless of the pre-test mean scores (see Figure 4-9). Interestingly, a similar pattern was observed among the Year 3 cohorts two years after taking the EE paper (see Figure 5-8) in that they were willing to protect endangered species and take actions that involve financial commitments. They were, however, reluctant to sacrifice their convenience for the sake of the environment nor were they willing to be seen as environmental activists. These findings are similar to previous studies (Alkahrer & Goldman, 2017; Boubonari et al., 2013; Erdogan & Ok, 2011; Esa, 2010; Goldman et al., 2006; Liu et al., 2015). Also, these findings suggest that PSTs are willing to act only when it is convenient for them and as such they may not get involved in environmentally-responsible behaviour (ERB) if they perceive an action would stretch them beyond their comfort zone.

PSTs' self-reported environmental behaviour largely corresponded with their intention to act which affirms the theory of reasoned action (Fishbein & Ajzen, 1975), that the best predictor of behaviour is the intention to perform such

behaviour. Overall, prior to taking the EE paper, PSTs' self-reported data showed that they moderately engaged in all the specified behaviours (mean value ≥ 3.2) except for environmental activism which had the lowest mean of 2.25. Over two-thirds of Year 1 PSTs reported that they rarely or never participate in an organized tree planting and this trend remained relatively unchanged after completing the EE paper. This finding supports the stance that PSTs least engaged in activities that involve collective actions. Similar findings have been reported in previous studies (Alkahr & Goldman, 2017; Boubonari et al., 2013; Erdogan & Ok, 2011; Esa, 2010; Goldman et al., 2006; Liu et al., 2015). PSTs' unwillingness to participate in such actions could be due to inadequate knowledge of the environment (Boubonari et al., 2013) or possibly because they are unaware of their civic rights as citizens. It could also be that they are not convinced about the impact of carrying out such activities on the environment (Fien, 2002), which also relates to their locus of control. Adding a new perspective, a case could be made that in New Zealand, as in other western countries, individuals respect each other's rights and views. As such, PSTs might have felt that carrying out such persuasive activities could be manipulative in nature. This links to findings from this study indicating that the majority (73%) of Year 1 PSTs upon completing the EE paper, often or very often encourage people to recycle, while only 41% of PSTs reported that they often or very often persuade people to stop activities that could harm the environment (see Figure 4-17).

PSTs' willingness to take actions that involve financial commitment as well as their unwillingness to act when it tended towards affecting their lifestyles was evident in their self-reported environmental behaviour, associated with consumer action (see Section 4.5.2.1). Of the three items in this category, the majority of PSTs (71%) reported to have engaged, at least sometimes, in two of the items that revolved around purchasing environmentally friendly products even if they are more expensive. However, when some level of inconvenience could be perceived, as with the third item involving the use of public transport instead of going in a car, consistently in the pre-and post-test, half of the PSTs reported to rarely or never engage in such behaviour. Findings from the focus group discussion also reinforce PSTs' seldom use of public transport. In instances when an alternative means of transport was used, reasons for such were not necessarily associated with protecting

the environment. This finding is consistent with previous research (Esa, 2010; Yeung, 2004) and it indicates that sometimes, knowing about the prevailing environmental and sustainability issues and even having some affective dispositions towards the environment does not always lead to acting in ways that could be regarded as environmentally responsible. It implies then that there are other factors responsible for behavioural changes in individuals. However, the findings here contrast with the findings of Kibert (2000), where the students were willing to give up their convenience or entrenched lifestyles for the sake of protecting the environment. Kibert (2000) did not provide any explanation for the reasons behind her findings and so it is not possible to consider how the students might be different from those of this study.

It is worthwhile to note that PSTs in this study did not only express concern for child poverty (see Section 7.2.1.3) but were willing to donate as much as a day's pay per year to feed a poor child in their community (see Section 5.5.1). Their self-reported environmental behaviour shows that they were already giving towards charity. This contradicts findings from Boubonari et al. (2013) and Negev et al. (2008) where PSTs were reported to only take actions that had less financial commitment. In this study, engaging in giving to charity could also be interpreted as PSTs' means of reacting to social justice and equity issues in the community. This behaviour could be associated with PSTs' concern for child poverty and racial discrimination as discussed earlier.

Among all the environmental activities specified in the questionnaire, the highest mean scores before taking the EE paper and upon completing the EE paper were associated with spending time in the natural environment. Although the reasons for PSTs' engagement in such activity is unclear, spending time in the environment is typical of New Zealanders as they express connection with nature (Morgan, Pritchard, & Piggott, 2002). This connection may however not necessarily be associated with an appreciation for nature or its intrinsic value; rather, it could be for the benefit that could be derived from the environment (Section 4.2.1). Two years after taking the EE paper, Year 3 PSTs demonstrated similar patterns to their Year 1 counterparts, with respect to most and least frequently engaged behaviours (see Table 5-9).

On the whole, a slight overall increase in Year 1 PSTs' environmental behaviour mean scores was observed upon completing the EE paper. Also, environmental behaviour mean scores for the Year 3 PSTs were lower than was observed for the Year 1 PSTs who had just completed the EE paper. Notably, these differences were not significant. Measuring the direct impact of the EE paper on PSTs' environmental behaviour is challenging given that environmental behaviour is a complex phenomenon influenced by a number of variables (Fishbein & Ajzen, 1995) and see below. Also, personal factors (encompassing an individual's attitude toward the environment) and social norms might either lead to a person performing or not performing a particular environmental action (Jelle Boeve-de Pauw & Peter Van Petegem, 2017). Another challenge might be the approach employed in this study to measure environmental behaviour of PSTs, which is in line with a number of previous studies (Hines et al., 1987; McBeth & Volk, 2009; Roth, 1992; Simmons, 1995a), but seems wider than the scope of the EE paper used as the case study. Hence, it might be unrealistic to expect significant changes related to the actual impact of the EE paper on PSTs' environmental behaviour. This is elaborated upon in Section 7.5.

On a final note, evidence from interviews with tutors of PSTs provided a deeper understanding of the EE paper from their standpoint which confirms some of the findings from PSTs' data and challenges to adequately equipping PSTs to teach EE to their future students. Particularly, the tutors agreed that EE plays a role in developing environmental knowledge, but given the nature of the EE paper used as case study, developing environmental affect and behaviour does not seem practicable as the scope of the EE paper does not seem to cover the affective and behaviour component of EL. The tutors, however, acknowledged the need for more focus on this component of EL. As opined by (Jensen, 2002), most pedagogical approaches used in schools are not action-oriented.

All the three tutors interviewed felt PSTs were not prepared to teach EE in primary schools due to a number of reasons among which is the positioning of the EE paper. The EE paper seems too early because the PSTs still had about two years before they begin their teaching career. They suggested the need for another paper which could serve as a refresher in the third year or some kind of continuous EE

programme through the course of PSTs' education. The tutors identified constraint on time as a barrier to the successful preparation of PSTs during their teacher education programme similar to the findings of (Evans, Whitehouse, & Gooch, 2012; Hill & Dymont, 2016; Lasen et al., 2017) They also yearn for a change in existing curriculum and pedagogical approach used in the teaching of EE to help the PSTs to be more critical in their thinking and able to meet the challenge of integrating EE into teaching in primary schools.

7.2.2 Relationship between EL components

To examine the relationships between the EL components in this study prior to, upon completing and two years after taking the EE paper, Pearson product moment correlation and path analysis were employed. Prior to taking the EE paper, findings for Year 1 PSTs from correlation analysis using Pearson product moment correlation at a significance level of $p=0.05$ (see Section 4.6.1) showed that the strongest correlation was between intention to act and environmental concern ($p=0.610$). Upon completing the EE paper, the strongest correlation for the Year 1s was observed between intention to act and environmental behaviour ($p=0.540$). These findings align with previously published literature which affirms that intention to act is a powerful predictor of environmentally responsible behaviour (Ajzen & Fishbein, 1975; Hsu & Roth, 1998). In contrast with this study, Alp et al. (2008) reported a poor correlation between the students' intention to act in an environmentally responsible manner and their actual self-reported environmental behaviour. Two years after taking the EE paper, the strongest correlation was observed between PSTs' intention to act and environmental affect (see Table 5-10). The correlational analysis in this study presents some findings that further give credence to initial assertions about the role of formal education in providing knowledge which serves as an entry point for the other EL components. Before taking the EE paper, Year 1 PSTs' environmental knowledge did not correlate with any of the EL components. Upon completing the EE paper, however, low to moderate relationships between environmental knowledge and other EL components were observed for the Year 1 PSTs. Among the correlations observed, the strongest was found between PSTs' environmental knowledge and environmental affect ($p=0.470$) in line with the findings of previous studies (Esa, 2010; Pe'er et al., 2007; Teksoz et al., 2012; Yavetz et al., 2009). Some other studies

(Aminrad et al., 2013; Liu et al., 2015; Timur, Timur, & Yilmaz, 2013), however, found a weak but positive correlation between knowledge and affect. Since the direction of the Pearson correlation coefficient is more important than its size, a case could be made that upon completing the EE paper, PSTs' increased knowledge also influenced their more positive environmental affect. The studies of Bradley et al.'s (1999) and Mangas & Martinez's (1997) also support this relationship between knowledge and affect after exposure to an EE paper.

Furthermore, upon completing the EE paper, a moderate correlation between environmental knowledge and environmental behaviour ($p=0.336$) was observed. While theoretical models of behaviour change postulate that strong correlations are not expected between knowledge and behaviour, it is necessary to provide individuals with a knowledge base in order to make informed decisions that could ultimately lead to making sacrifices for the protection of the environment. Equally, Azjen (1988, p.134) opined that knowledge is a pre-condition for behaviour: "At the most basic level of explanation, behaviour is assumed to be a function of salient information, or beliefs, relevant to the behaviour." The moderate positive correlation observed in this study agrees with previous studies (Chu et al., 2007; Esa, 2010; Fah & Sirisena, 2014; Liu et al., 2015; Paço & Lavrador, 2017; Pe'er et al., 2007).

A notable finding was that, upon completing the EE paper, environmental concern did not significantly correlate with any of the EE components. Significant decreases in PSTs' environmental concern to some issues were observed upon completing the EE paper (see Section 7.2.1.3), and this would have affected the result of the correlation analysis. Previous research findings (Hutchinson, 1997; Strife, 2012) have stated that a decline in environmental concern might be due to feelings of helplessness, fear, and pessimism about environmental issues, but in this study, there is evidence that that might not be the case. As discussed in Section 7.2.1.3, the decrease in PSTs' concern for water pollution, air pollution, endangered species, child poverty, and racial discrimination was more likely due to little or no focus of the EE paper on such issues. Two years after taking the EE paper, moderate correlations were found among the EL components except for environmental knowledge which had a negative correlation. This suggests a decline in PSTs'

environmental knowledge and a possibility that environmental knowledge gathered from other sources may be potentially confounding this relationship.

Findings from path analysis before and upon completing the EE paper for Year 1 PSTs consistently indicated that intention to act was a strong predictor of environmental behaviour. Also, environmental concern and environmental affect were strong predictors of Year 1 PSTs' intention to act. This resonates with the Liu et al. (2015) study that reported intention to act as highly related to the environmental affect domain of EL. For Year 3 PSTs, only environmental affect could directly predict intention to act and environmental behaviour. The r^2 value showed that environmental affect could explain up to 30% of the variation in Year 3 PSTs' environmental behaviour. This is large in comparison with the findings of Fah and Sirisena (2014) where environmental affect was reported to explain just 5% of the variation in the students' environmental behaviour. This finding indicates that, for EE to achieve its goal of equipping PSTs with the needed EL that transforms into ERB, the focus of teacher education programmes needs to transcend beyond head knowledge, rather, it must also be oriented towards the 'heart' (affect, concern) of PSTs. This supports Orr's (1992) claim that the crisis of sustainability does not appear to lie in the domain of 'knowing', rather, in the domain of 'other ways of knowing' which according to him includes realm of vision, intuition, revelation, empathy, or even common sense. Although this study did not directly explore the highlighted 'other ways of knowing', findings from this study affirms the impact of the affective components on the development of EL over that of the knowledge component.

7.2.3 Influence of EE paper on PSTs' EL and confidence to teach EE

Among other possible factors (see Section 4.6.4) that might have influenced PSTs' EL during their teacher education programme, the EE paper was consistently ranked highest by Year 1 PSTs, upon completing the EE paper, and Year 3 PSTs, two years after taking the EE paper (see Sections 4.6.4 and 5.74). This agrees with the findings of Abramovich and Loria (2015). Other experiences or papers taken at the university contributed least to PSTs' EL. This is somewhat disconcerting as it suggests that if PSTs do not partake in the EE paper before they start their teaching career, they might not have the opportunity of developing the needed EL to impact

the future generations. This finding may well support the observed decline in Year 3 PSTs' EL, two years after taking the EE paper. As the EE paper might be the only option left to develop PSTs' EL before they begin their teaching career, this study further expounds on the need for a long-term, continuous exposure to EE in PSTs' teacher education programme for the development and retention of their EL. Although some previous studies reported television programmes (Pe'er et al., 2007), internet (Al-Dajeh, 2012) and media (Alp et al., 2008) as major contributors to students' EL, a critical review of these studies indicates that their participants were not exposed to a dedicated EE unit and as such the students had to source environmental information from multiple means, which at times may not be accurate. Findings from PISA 2006 (OECD, 2009) placed greater importance on the environmental information received from schools, as compared to other sources.

The EE paper in this study appeared to achieve its goals. As shown in Section 4.7.1, significant increases were observed in the post-test mean scores for Year 1 PSTs' understanding on all the four teaching and learning outcomes of the EE paper. But then, the question is, does the EE paper achieve the goals of EE in developing EL, which is expressed in observable environmentally responsible behaviour? (Roth, 1992). Findings from PSTs' self-reported beliefs of the influence of the EE paper on their EL shows that the most influence was on their knowledge, while the least influence was on their behaviour (see Section 4.7.3). If the fundamental objective of EE is to encourage environmentally responsible behaviour, then this study proposes that EE goals might not have been explicitly achieved in the EE paper. Reasons for this assertion may be the lack of emphasis on the behaviour components of the EL framework in the EE paper coupled with lack of tutors' expectations that the EE paper would influence PSTs' behaviour. These findings call for a rethink of what EE in teacher education programmes is intended to achieve. Findings from this study also echo earlier research on EE programmes where the PST tutors mostly emphasized theoretical knowledge in the EE paper taught (Mintz & Tal, 2014). It could be argued that the approaches being used by tutors are more inclined to teaching 'about the environment,' a little bit of 'in the environment' but not 'for the environment.' There is the need for teacher education programmes preparing teachers in EE to embrace EE principles that places emphasis on behavioural change.

It is worth noting that, when examined against the outlined objectives of the EE paper, Year 1 PSTs' confidence to teach in primary schools significantly increased (see Section 4.7.4) after taking the EE paper, except for confidence in taking students outside the classroom to learn in the environment. For their Year 3 counterparts, a majority of PSTs felt less confident in helping students to contribute to the social and economic development of their community and in integrating environmental and sustainability education in their teaching (Section 5.8.2). This finding might well indicate the enthusiasm for teaching about environmental and sustainability issues among the Year 1 PSTs in line with their self-perceived EL upon completing the EE paper. Findings here are similar to a study in Australia (Kennelly, Taylor, & Maxwell, 2008) which reported increased confidence of PSTs after exposure to a dedicated unit on EE. Comparably, another study in Turkey (Tekkaya, Cakiroglu, & Ozkan, 2004) reported that the majority of the PSTs felt confident about teaching despite holding misconceptions concerning basic science concepts. Confidence is an important teacher attribute (Kennelly et al., 2008) but may not be regarded as a reliable indicator of competence (Appleton, 1995).

7.2.4 Experiences of beginning teachers in applying EL into teaching

Apart from assessing PSTs' EL and their preparedness to teach EE, this study also examined the experiences of beginning teachers in applying EL into their teaching, particularly in relation to the factors that influenced the implementation of EE in their classrooms. As discussed in Section 6.3, among the four beginning teachers interviewed, only one of them could be regarded to have applied the EL gained in her teaching. Six major factors were identified in this study as influencing the implementation of EE in beginning teachers' classrooms. These are school leaders' emphasis and priorities, issues with how to integrate EE into teaching, lack of time/overcrowded curriculum, lack of knowledge of EE, beginning teachers' interests and the potentially ritualistic nature of EE in schools.

Emphasis and priorities of school leaders were observed to be the most influential factor determining whether the beginning teachers in this study implemented EE in their classrooms or not. For instance, of all the four interviewees, Tina, the only beginning teacher who had been able to integrate EE into her teaching, was also the

only one who reported that her school management had expectations that teachers include EE in their teaching. Principals, as school leaders have an unswerving influence on teachers' attitudes, professional development, and implementation of educational reform (Leithwood, 2007). Hence, for any school programme to be successful, school leaders' support is vital. Evans et al. (2012) reported that four primary schools in Australia embraced a whole school approach to EE largely because the principals in their schools demonstrated active facilitation and support for their teachers. Similar findings have also been reported in previous literature (Eames, Barker, Wilson-Hill, & Law, 2010; Evans et al., 2012; Hill & Dymont, 2016).

Reasons for principals not keen to support the implementation of EE might be due to their limited knowledge of EE and the influence of sustainable schools on the children and community at large (Kadji-Beltran, Zachariou, & Stevenson, 2013). It might also be that these school leaders consider the time and money that an implementation of EE in their schools might involve (Evans et al., 2012). Investigating further on school leaders' influence on the implementation of EE in NZ primary schools is beyond the scope of this study. Closely linked to the emphasis of school leaders are the schools' priorities which seem to reflect in schools' expectations from teachers. For example, Rose, in this study, recounted that her school desired that she focusses on time and behaviour management, as well as meeting the criteria for her registration. Emma, on the other hand, stated that there were no expectations in her school to integrate EE into her teaching. The primary focus of her school was on reading, writing, and mathematics. Similar findings of school priorities on student performance in literacy and numeracy, which could be regarded as high stakes in national tests have been earlier reported (Lasen et al., 2017).

Issues with how to integrate EE into teaching were also observed to be one of the factors impeding the implementation of EE in beginning teachers' classrooms. Findings from this study suggest that the beginning teachers and the Year 3 PSTs needed more understanding in regards to approaches to integrating EE successfully into their teaching. Specifically, when the beginning teachers were asked what they felt future teachers would need to know before beginning their teaching career;

three out of four of them highlighted the need to understand how to integrate EE into their teaching. A similar need was expressed by teachers in the study of Hill and Dymont (2016). Some teachers perceive EE as an add-on (Hill & Dymont, 2016) and would be willing to integrate it into their teaching if they felt it was relevant to their subject matter, as reported in Yueh, Cowie, Barker, and Jones (2010). As noted by Summers et al. (2005), “while the theoretical arguments for interdisciplinary implementation are strong . . . such approaches are problematic” (p. 624). This is because any subject expected to be taught using an interdisciplinary approach can be easily ignored due to other subjects demanding more attention, lack of teachers’ adequate knowledge on the subject, or lack of knowledge of how to synthesize and integrate such subject into other areas.

Another factor observed to affect the implementation of EE in beginning teachers’ classrooms was the lack of time paired with an overcrowded curriculum. According to Stella, she does ‘not [have] enough time to do everything’ while Emma added that, within the limit of available time, she is being faced with increasing pressure to deliver despite a crowded curriculum. This finding is similar to previous studies (Evans et al., 2012; Hill & Dymont, 2016; Lasen et al., 2017). These findings also suggest that a beginning teacher, in trying to meet the demands of their profession, while addressing the core learning areas of the curriculum, can become overwhelmed. Thus, there may be little or no time for integrating EE into their teaching. In addition, the seemingly non-prescriptive approach recommended by policy documents for the integration of EE in the NZ Curriculum framework could act as a leeway for entirely excluding it from the curriculum, especially when mechanisms are not in place to monitor its integration. This factor, lack of time, relates to the previously discussed issues on how to integrate EE in teaching, and thereby calls for the need for teachers to be well equipped with strategies for successful integration of EE into their teaching, despite the marginalized position it holds in the school curriculum.

All the interviewees in this study felt they did not have enough knowledge and skills to teach EE as beginning teachers. As discussed previously, this is not so surprising because these beginning teachers were part of the Year 3 PST cohort. Findings from this study had already shown indications that they did not retain the EL gained in

their teacher education programme, two years after completing the EE paper. Previous studies have also reported on the lack of knowledge and skills to teach EE as beginning teachers (Evans et al., 2012; Lasen et al., 2017). However, in the study of Stevenson, Carrier, and Peterson (2014), lack of environmental knowledge was not reported as a barrier to implementing EE in teaching. In this study, it was observed that despite beginning teachers stating that they did not garner enough knowledge during the EE paper, they still claimed they were confident to teach EE, should the need arise. Specifically, Stella and Emma stated that they would be willing to do more research on their own whenever they needed to teach EE. This confirms that teachers rely on other sources for getting information on EE (Al-Dajeh, 2012; Pe'er et al., 2007).

Beginning teachers' interests and values were also observed to influence the implementation of EE in their classrooms. Findings from this study propose that if beginning teachers are not passionate about EE, there is a reduced likelihood that it would be integrated into their teaching, even if an opportunity for integration eventually arises (Hill, 2016; McKeown-Ice, 2000; Stevenson et al., 2014). Of the four beginning teachers, only Tina expressed strong interest for EE. This could possibly further explain why she has been able to integrate EE into her teaching when she was employed in a school that had expectations for teachers to integrate EE into their teaching. Even when the schools' focus does not support the implementation of EE, beginning teachers who are personally motivated to integrate EE into their teaching may go an extra length in being innovative, seeking out opportunities to incorporate EE into other learning-related activities. It could be argued that the willingness to promote EE in schools or not are associated with teachers' personal values and what they care about (Sund & Wickman, 2008). Supporting the role beginning teachers' interest and values play in implementing EE in their teaching, Stella affirmed that if she had the time, rather than integrate EE, she would be more willing to integrate drama (which like EE, is expected to be taught using an integration approach), as she was more passionate about drama. This finding agrees with the case story of Year 3 PST Kate (see Section 5.9), who felt she would be more willing to integrate some other areas (over EE) that do not get recognition within the curriculum, like the arts, into her teaching if she had the time.

A novel factor observed in this study that has been recognized to influence the implementation of EE in schools is referred to as the “ritualistic nature of EE in schools.” This refers to a potentially limited sense of implementation of EE because of environmental activities such as worm farming, recycling already put in place in schools without it being backed up with intentional learning. In this study, all the four schools had these sorts of activities in place, routinely serviced by some groups of students. Specifically, Stella pointed out there was no push for integration of EE in teaching in her school but there was an environmental team, and each class rotated the responsibility of feeding worms and emptying waste bins. These activities were, however, not obviously under the aegis of teaching or learning. According to her, servicing these activities just happen as the programme is already in place. This study suggests that although such activities are encouraged, their purpose is defeated if they are not backed up by some sort of deliberative learning. Additionally, EE is more comprehensive than such activities, and as such, EE goals might not be achieved if teachers have a mind-set that EE is being implemented because such activities are being done in their schools.

7.3 Conclusions

In light of the crucial role of teachers in realizing one of the goals of EE, that is, development of EL, it is essential that teacher education programmes are structured in such a way that teachers can develop their EL and confidence needed to integrate EE into their teaching. This study set out to explore the impact of completing an EE paper on New Zealand PSTs’ EL at two stages of their teacher education programme: Immediately after completing the EE paper and two years after taking the EE, paper. Relationships between components of EL among these PSTs were also examined. Furthermore, the study sought to explore the experiences of beginning teachers in applying their EL, upon integration into the teaching workforce. Based on the evidence obtained from the findings and discussion of this study, conclusions drawn are presented in relation to the research sub-questions.

Research Question 1: What is the immediate impact of completing a first-year core paper in environmental education on environmental literacy levels of pre-service teachers (PSTs) and preparedness to teach EE?

1. Evidence from this study shows that the EE paper completed by PSTs increased their knowledge of the natural environment and sustainability, especially on the topics focused on in the EE paper.
2. PSTs held anthropocentric views of the natural environment and their learning in the EE paper did not influence this stance.
3. PSTs' understanding of sustainability was more inclined to the environmental aspects. Evidence from this study shows that reasons for this inclination might have been associated with the foregrounding of the environmental aspect the most in the EE paper taken by PSTs.
4. PSTs demonstrated positive environmental affect prior to taking the EE paper and little change was observed upon completing the EE paper. Despite the reported positive environmental affect, PSTs retained anthropocentric stances on human-nature relationship and also perceived that there were no limits to growth in regard to the Earth's resources.
5. PSTs' environmental concern increased significantly in line with the most discussed issues in the EE paper, bee decline. A reduced environmental concern was observed on other environmental and sustainability issues not focused on in the EE paper.
6. The EE paper did not seem to influence PSTs' intention to act. Rather, PSTs' values seem to consistently reflect in their intention to act, prior to and upon completing the EE paper. PSTs were more willing to act regarding protecting endangered species and behaviour involving a financial commitment, but were unwilling to act when the behaviour affected their entrenched lifestyles or activities that tended towards environmental activism. Correspondingly, PSTs engaged more in behaviour that involved financial commitment and spending

time in the natural environment but least engaged in behaviour associated with environmental activism or with a form of inconvenience like using transport instead of going by car. PSTs also did not want to engage in behaviour that could be considered as persuasive, even if it would contribute towards the protection of the environment.

7. PSTs believed that the EE paper they completed contributed the most to their EL. This highlights the important role teacher education programmes in EE play in the development of PSTs' EL which if not adequately delivered might rob these PSTs of the opportunity to develop their EL.
8. According to PSTs' self-reported data about the influence of the EE paper on their EL. The EE paper influenced their environmental knowledge the most and had the least influence on their environmental behaviour. This finding confirmed other evidences from this study as well as the tutors' perception of the goal of the EE paper. According to them, the EE paper focused more on the knowledge dimension rather than on other EL components, which they felt was not realistic due to time constraints
9. PSTs felt confident to teach EE in primary schools upon completing the EE paper. This PSTs felt confident as a result of the EE paper taken but they still have about two years before they start their teaching career so it appears too early to make such claim.
10. Tutors of PSTs felt PSTs were not prepared to teach because the EE paper taken was too early in their teacher education programme. Also, the tutors felt a change to the existing EE curriculum and pedagogical approaches could enhance the successful preparation of the PSTs.

Research Question 2: What are the environmental literacy levels of ready-to-graduate pre-service teachers (Year 3) and how prepared do they feel to teach environmental education based on their exposure to environmental education during their pre-service teacher education?

A general decline in PSTs' EL was observed two years after taking the EE paper. Findings from this study indicate that the Year 3 PSTs could not show evidence of any EL that they may have gained from undertaking the equivalent paper two years previously.

1. Year 3 PSTs demonstrated simplistic level of environmental knowledge of all the topics discussed in the EE paper two years previously. In fact, Year 3 PSTs' environmental knowledge level was comparable to those of Year 1 PSTs before taking the EE paper.
2. Year 3 PSTs expressed pro-environmental attitude towards the environment on all the statements except for statements on human supremacy over nature and Earth's limitless resources. However, as compared to their Year 1 counterparts, they were less pro-environmental.
3. Two years after taking the EE paper, Year 3 PSTs' intention to act and environmental behaviour was comparable with their Year 1 counterparts (i.e., they were willing to act on issues related to protecting endangered species and behaviour involving financial commitments but unwilling to act on issues that affected their entrenched lifestyles or tended towards environmental activism).
4. PSTs felt confident to teach EE in schools despite indications that they seem not to have retained their learning in the EE paper. Evidence from Year 3 PSTs' self-reported data (see Section 5.8.2) shows that more than half of the PSTs felt confident to teach EE in primary schools.
5. Year 3 PSTs reported that they would have loved to learn more about how to integrate EE into their teaching during their teacher education programme.

The impact of the EE paper on Year 3 PSTs from the evidence gathered in this study seemed to have waned two years after taking the EE paper. This is worrisome because teachers play a vital role in developing the EL of their future

students. If these teachers themselves are not well prepared, then it is unlikely that they will be able to help their students develop the EL needed to contribute towards the resolution of the environmental and sustainability issues facing our world today.

Research Question 3. What relationships exist between components of environmental literacy (knowledge, affect, concern, and behaviour) among pre-service teachers?

1. Increased knowledge through taking the EE paper appeared to also enhance PSTs' other EL components. This conclusion was reached because before taking the EE paper, there was no correlational relationship between Year 1 PSTs' environmental knowledge and other EL components. Upon completing the paper, however, low to moderate relationships were observed between knowledge and the other EL components (see Sections 4.6 and 5.6). This presents indications that knowledge could be the entry point needed to instigate other EL components.
2. Environmental knowledge did not influence intention to act. Between both cohorts, as seen by findings from path analysis, environmental knowledge did not appear to influence intention to act. Prior to completing the EE paper, only environmental affect and concern were observed to be predictors of intention to act. The strength of prediction increased following the completion of the EE paper. Two years after taking the EE paper, only environmental affect appeared to influence intention to act.
3. Environmental affect and intention to act are predictors of environmental behaviour. Environmental affect was found to be a predictor of intention to act and the strength of prediction increased following the completion of the paper. Two years after, PSTs' environmental affect was still found to be a predictor of intention to act. Findings from this study also confirmed a relationship between intention to act and environmental behaviour, and the strength of prediction increased following the completion of the EE paper.

Two years after, however, the relationship between intention to act and environmental behaviour appears to have waned.

Research Question 4. Upon exit from university and integration into the teaching workforce, what are the experiences of beginning teachers in applying their environmental literacy?

The experiences of beginning teachers in this study are primarily influenced by two key drivers: the first relates to existing EE policies and practices in schools and the second is associated with personal attributes of PSTs.

1. Barriers such as school leaders' emphasis/priorities and lack of time/overcrowded curriculum encountered by beginning teachers in implementing EE in schools are exacerbated by the positioning of EE in *The New Zealand Curriculum*. Because EE is not compulsory at the school level or at individual level, school leaders are not compelled to expect their teachers to integrate it into their teaching. They would then naturally focus more on aspects emphasized in the curriculum. Teachers also have the choice not to integrate EE into their teaching.
2. Beginning teachers' perceptions of a lack of environmental knowledge (which was equally observed in this study among the Year 3 PSTs) and issues with how to integrate EE into teaching (an area which was not adequately covered in the EE paper) were important barriers to the successful implementation of EE in teaching by beginning teachers.
3. Beginning teachers' interest and passions play a vital role in the likelihood to integrate EE into their teaching, even if the opportunity for integration arises.

Overall, findings from this study have supported the conceptual framework proposed in Section 2.4 (Figure 7-1). Specifically, evidence from this study confirmed some of the relationships between the EL components after completing an EE paper (see Figure 7-1). Although the study confirmed the

impact of taking an EE paper on PSTs' environmental knowledge, especially on the areas focused on in the EE paper, the study, however, could not confirm a relationship between environmental knowledge and either participants' intention to act or their environmental behaviour. Notably, this study also identified some factors that were not envisaged in the original model (See Figure 7-1 versus Figure 7-2) which influence the integration of EE into teaching. These factors are EE policy and practice (school leaders' emphasis and priorities, issues with how to integrate EE into teaching, lack of time/overcrowded curriculum and the ritualistic nature of EE in schools), and teachers' personal factors (lack of knowledge of EE, beginning teachers' interests) (see Figure 7-2).

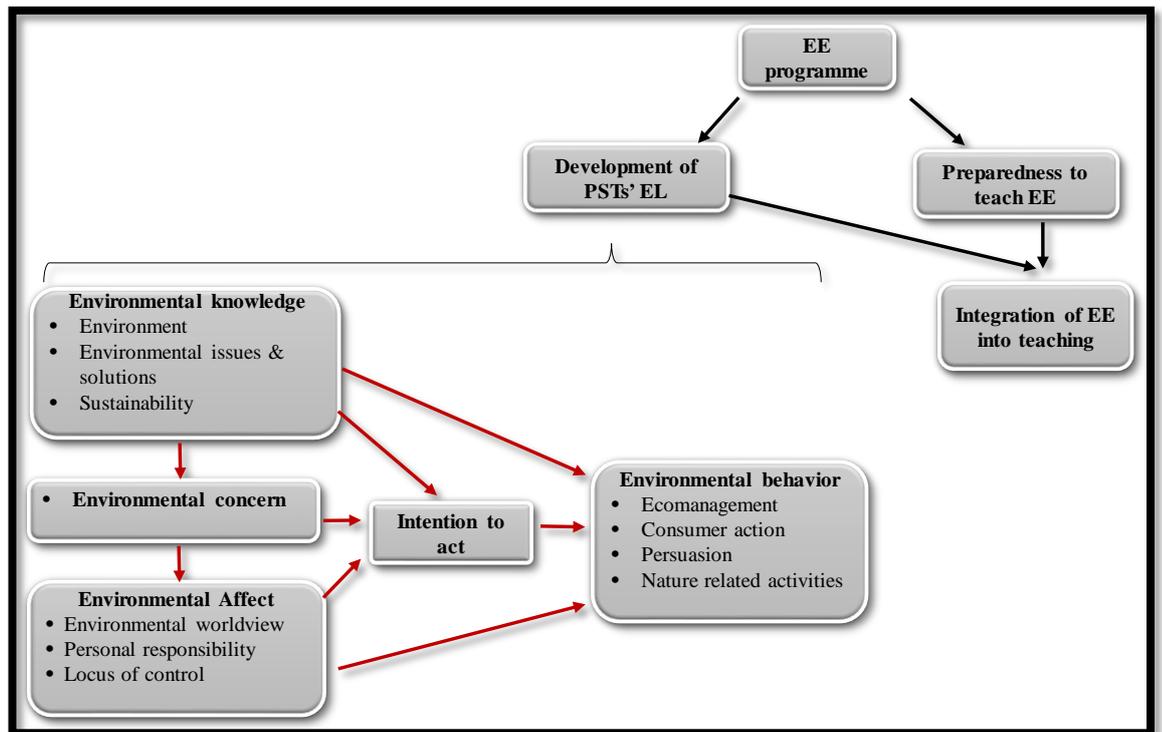


Figure 7-1 Initial theoretical framework for this study

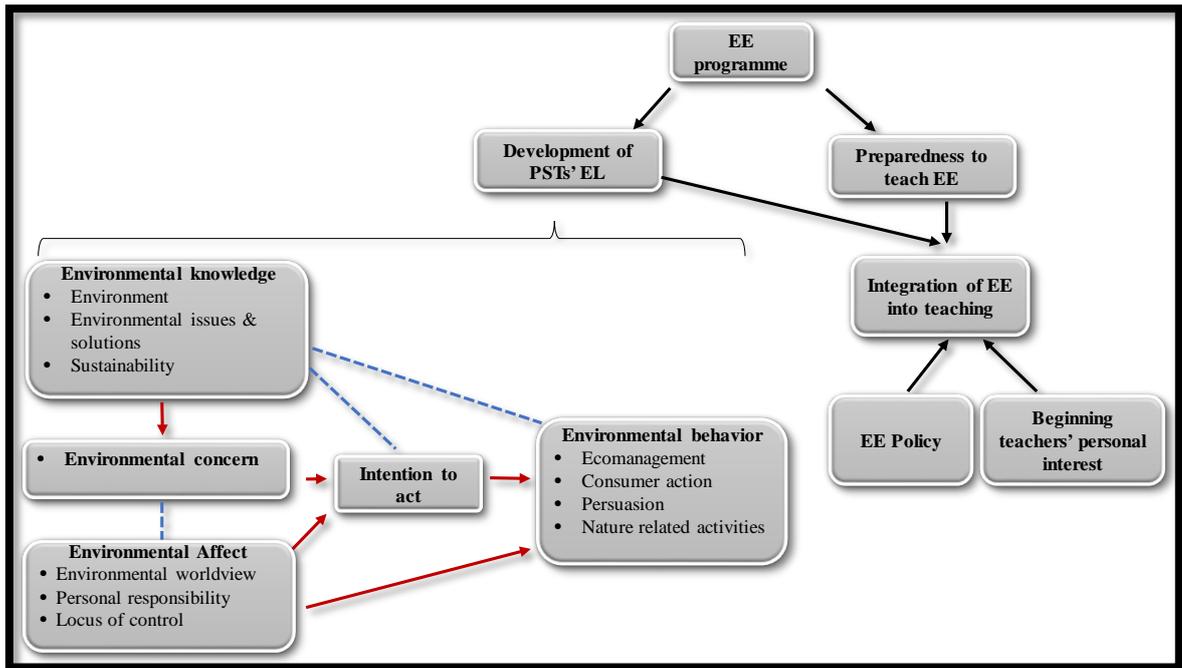


Figure 7-2 Validated theoretical framework for this study (Broken lines show no relationships)

7.4 Limitations of the study

Despite the strengths of this study and efforts to ensure the trustworthiness of the data, some limitations still existed and are presented below.

The extent to which the results of a study can be generalized determines the external validity (Fraenkel & Wallen, 2006). To make generalizations from samples to populations, the sample drawn from a population should accurately represent the population. In this study, the samples were drawn from PSTs enrolled in Bachelor of Teaching programme at one institution and as such cannot be considered representative of all the institutions in New Zealand offering EE for PSTs. Perhaps broadening the sample to include more institutions would have provided a clearer understanding of the impact of EE on PSTs' EL in New Zealand. The findings from this study cannot therefore be generalized to all PSTs in institutions offering EE in New Zealand, but provide a starting point for further studies in other institutions.

Because of the time available for this study, a further limitation was related to the inability to investigate the same group of Year 1 PSTs through to their Year 3. Therefore, the two cohorts of PSTs were treated as equivalent since they

presumably undertook the same intervention, relevant to this study. Suggestions for further research include conducting a longitudinal study with the same group of PSTs to more accurately explore the impact of completing an EE paper on their EL.

As a pre-test and post-test design study, the anonymous nature of the questionnaire used in this study made it impossible to match individual PSTs' pre-test and post-test responses. Hence, the impact of the EE paper on PSTs' EL was explored on a cohort basis. This was seen as a limitation, as being able to match PSTs' responses would have provided a platform for understanding shifts in individual PSTs' EL as a result of taking the EE paper. Also, where needed, it would have been easier to probe individual PSTs further on some of the surprising findings observed in the study, such as the significant decline in PSTs' concerns about environmental and sustainability issues not focused on in the EE paper. Another limitation closely related to the anonymous nature of the questionnaire related to the choice of analytical method for calculating the shifts in PSTs' pre-test and post-test scores. The independent sample t-test was used rather than a paired sample test, which would have been better for a pre-test and post-test design.

This study did not explore the impact of cultural factors on PSTs' EL. This was beyond the scope of this study because during the design of the study, it was anticipated that given the small number of other ethnic groups represented, there was a likelihood of low correlational relationship between ethnicity and the EL components. Cultural differences have, however, been recognized in literature as relevant in examining EL and as such, it is an important consideration for future research in this direction.

7.5 Recommendations

Based on the findings and conclusions from this study, this section outlines recommendations for teacher education programmes in EE and EE policy in New Zealand primary schools.

7.5.1 Teacher education programme

This study reinforces the crucial role teacher education programmes in EE play in developing the EL of PSTs. This supports the assertions of UNESCO (2005) that

“teacher-education institutions serve as key change agents in transforming education and society” (p. 11). Specifically, it could be argued that the outcome of teacher education programmes in EE, as reflected in the level of EL developed by PSTs, seems to be directly linked to the focus of the programmes. The curriculum design for teacher education programmes in EE therefore plays a huge role in determining whether or not the goal of EE in developing EL will be achieved. This study identified environmental affect and concern as strong predictors of intention to act (environmental behaviour). The observed increased environmental knowledge of PSTs, with little or no impact on their affect and behaviour, highlights the need for a re-orientation of the curriculum used for teacher education programmes in EE. There is a need to include environmental value-based education, in addition to content knowledge. A case could be made for more emphasis on the affective domain because the affective domain is concerned with developing individuals’ interest in environmental issues and building attitudes, worldviews, personal responsibility and commitments favourable to the conservation and protection of the environment. This is not the case with acquiring knowledge, as knowledge is more concerned with the facts about a subject without necessarily implying an interest in the subject or a positive feeling about it. In other words, as discussed in section 2.5.2, in the affective domain, the emphasis is on stimulating interest in a subject, feeling favourable towards it, and being motivated to undertake it. Hence, an emphasis on the affective domain in teacher education programmes could help PSTs not only to be aware of prevailing environmental and sustainability issues but also to become committed to solving them. Furthermore, fostering the ability of PSTs to learn through action in their teacher education programme would enhance the achievement of the goals of EE. According to a UNESCO (2012) report, for EE to achieve its goal in developing EL, EE must be distinguished through the following lenses:

An integrative lens – taking on a holistic perspective that allows for the integration of multiple aspects of sustainability (e.g. ecological, environmental, economic, socio-cultural; local, regional and global; past, present and future);

A critical lens – questioning predominant, taken-for-granted patterns that are or may be unsustainable (e.g. the idea of continuous economic growth, dependency on consumerism and associated lifestyles);

A transformative lens – moving from awareness to incorporating real change and transformation through empowerment and capacity building to lead to more sustainable lifestyles, values, communities and businesses;

A contextual lens – recognizing there is no one way of living or doing that is the most sustainable everywhere and forever. We can learn from each other, but places and people around the world are different and times will change. Therefore, sustainability needs to be re-calibrated as realities change (UNESCO, 2012, p. 13)

Furthermore, pedagogical approaches that would achieve the goals of EE in developing EL of PSTs should revolve around learners, ‘a learner-centered approach’, which sees PSTs as independent learners and encourages active development of knowledge through reflections and critical thinking rather than mere transfer of knowledge (Nolet, 2015). This type of learning should also be targeted towards ‘action-oriented learning’ in a way that engages learners in action and reflection on their experiences in regard to their intended learning process and personal development. Additionally, pedagogical approaches that would achieve the goals of EE should be aimed at empowering learners to query and change the ways they see and think about the world in order to deepen their understanding of it (Nolet, 2015; UNESCO, 2017).

Time allocated to the teaching of EE seems to be insufficient to address all aspects of the curriculum adequately. This study showed that PSTs’ knowledge was confined primarily to those aspects extensively focused on in the EE paper. A case could thus be made for more in-depth focus on a number of specific environmental and sustainability issues that could widen and strengthen PSTs’ EL. Moreover, adopting a more transformative approach to EE with pedagogical approaches that involve inquiry and critical thinking, empathy, and action skills might enhance transferability to other issues, making the best use of the time available (Varela-Losada, 2016). This is crucial in achieving the goal of EE because, in principle, EE

focuses on fostering the transfer of dispositions from issue to issue (IUCN, 1970), intended to develop learners' attitudes and behaviours (Goldman et al., 2014). Additionally, there is a need for an innovative pedagogical approach and practices to adequately prepare PSTs for the challenges they might encounter when they begin teaching. This is important because EE is not a mandatory requirement in the curriculum, and is expected to be taught using an integration approach. PSTs need to be well prepared on how to manage the challenges associated with the realities of being a new teacher and also successfully implement EE in their classrooms. For instance, pedagogical approaches that familiarize PSTs with the New Zealand curriculum and its implementation in their future classroom should be integrated into teacher education programmes.

Teacher education programmes need to ensure that a balanced approach to all components of sustainability is presented to PSTs during their preparation programme, regardless of the faculty in which the EE programme is presented. Sustainability rests on three core aspects: environmental, socio-cultural, and economic, and in order to provide adequate EE, all these aspects need to be equally emphasized. Otherwise, PSTs will have a limited understanding of sustainability, which will be transmitted to their future students.

The lack of evidence about the retention of the EL developed by PSTs two years after taking the EE paper raises concerns about the positioning and duration of EE during teacher education programmes. This study recommends options that provide PSTs with an opportunity for continuous exposure to EE during their teacher education programme. This could involve integration of EE across different subjects taken by PSTs throughout their teacher education programme, since EE is interdisciplinary.

7.5.2 EE policies and practices in New Zealand schools

Based on evidence from this study, existing EE policies and practices influenced the successful implementation of EE in primary schools the most. To change this, there needs to be a change in the present EE policies in New Zealand primary schools. Unless the New Zealand government gives EE mandatory status, it is unlikely that teachers will take it up to any great extent. It is therefore recommended

that EE is made mandatory in New Zealand schools, not as a separate curriculum area but using an integrated curriculum approach, given the interdisciplinary nature of EE. In addition, fundamental concepts of EE should be taught through the achievement objectives of the existing curricula.

There is also a need for more support of the implementation of EE in primary schools. Although recent guidelines for senior secondary school in New Zealand show an emphasis by the Ministry of Education on sustainability, there is a need to encourage EE in primary schools in practical ways by allocating funding and other resources for its successful implementation. This study also recommends some form of assessment standards or guidelines for EE in schools to monitor its implementation by teachers, in order to understand their challenges and provide assistance where necessary.

Finally, this study showed that PSTs do not seem to be adequately prepared to teach their future students in EE upon completing their teacher education programme. It is recommended that the Ministry of Education develop EE training for in-service teachers. Regardless of the training received during PSTs' teacher education programmes, policies around ongoing professional development for teachers in EE could further strengthen beginning teachers' confidence to integrate EE into their teaching successfully. Such policies could encourage collaborations among teachers within the EE space to create room for peer learning on how to successfully integrate EE into teaching, and combat the challenges associated with implementation of EE in primary schools.

7.5.3 Suggestions for further research

Findings from this study contribute to the continuing discussions on how to effectively prepare PSTs in teacher education in EE as well as their subsequent practices in primary schools. Evidence from this study therefore presents some suggestions for further research:

- A longitudinal study with the same group of PSTs is important to clearly understand the changes in PSTs' EL over time. The outcome of such study

could enhance the focus of teacher education in EE in successfully developing the EL of PSTs.

- A study that investigates EE in primary schools, with a focus on the environmental activities in place. Since evidence from this study indicates some ritualistic nature of EE in primary schools, such study could examine the perceptions of these schools about EE and the environmental activities in place. For instance, how do the schools see the environmental activities in place? What do the kids think about the environmental activities in place? Are the kids genuinely learning about sustainability and making a difference or not?
- Research is needed to explore the most appropriate pedagogical approaches that best develop all components of PSTs' EL during their teacher education programme in EE.

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Appendix A : Questionnaire (Post-test)

Dear Student,

I am conducting a study entitled “**Evaluation of Environmental literacy among New Zealand pre-service teachers**” in fulfilment of the award of a doctorate degree in Environmental Education. In connection with this, I would like to ask for your help to complete this survey. All responses will be treated as confidential, so do NOT put your name on this survey paper. All responses will be reported only as aggregated figures so no individual responses can be identified in my thesis or published articles. Please answer all questions as honestly as possible.

Thank you for your anticipated cooperation.

Deborah Bandele

1. What is your gender? (Tick one) Male Female Other
2. What is your age? _____ (in years)

Have you ever (please tick the response that applies):

3. Belonged to an environmental club or association? Yes No
4. Worked for money in a job related to the environment? Yes No
5. Volunteered to do environmental and sustainability related activity (for example, tree planting, litter clean up, Yes helping older people)?

Indicate your agreement or disagreement with the following statements by circling the appropriate number in the boxes below.

		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
6.	I believe I can contribute to the quality of the environment through my personal behaviour	1	2	3	4	5
7.	Even if I conserve water/ electricity or purchase environmentally-friendly products, it won't make a difference if others don't do the same	1	2	3	4	5
8.	It is more the government's responsibility to look after the environment than mine	1	2	3	4	5
9.	I feel I am responsible for any part I play in contributing to environmental problems in my community	1	2	3	4	5
10	I feel responsible for contributing to solutions to environmental problems in my community	1	2	3	4	5

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11	When humans interfere with the natural environment it often produces negative consequences.	1	2	3	4	5
12	Plants and animals have as much right as humans to exist	1	2	3	4	5
13	The Earth has plenty of natural resources if we just learn how to develop them.	1	2	3	4	5
14	The natural environment is strong enough to cope with the impacts of modern industrial nations.	1	2	3	4	5
15	Humans have the right to modify the natural environment to suit their needs.	1	2	3	4	5
16	Maintaining economic growth is more important than protecting the natural environment.	1	2	3	4	5
17	People should get access to an equal share of natural resources	1	2	3	4	5

Indicate how concerned you are about the following environmental and sustainability issues in New Zealand by circling the appropriate number in the boxes below.

Environmental and sustainability issues in New Zealand		Very Unconcerned	Unconcerned	Unsure	Concerned	Very concerned
18.	Water pollution	1	2	3	4	5
19.	Climate change	1	2	3	4	5
20.	Consumption and waste	1	2	3	4	5
21.	Endangered species	1	2	3	4	5
22.	Child poverty	1	2	3	4	5
23.	Racial discrimination	1	2	3	4	5
24.	Bee decline	1	2	3	4	5

Indicate your agreement or disagreement with the following statements by circling the appropriate number in the boxes below.

		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
25.	I would be willing to stop buying products from companies found guilty of polluting our streams, rivers and coastlines,	1	2	3	4	5

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	even though their products are cheaper					
26.	I would be willing to donate one day's pay per year to feed a poor child in my community	1	2	3	4	5
27.	I would be willing to support the protection of a New Zealand endangered species, even if it results in some restrictions on my activities	1	2	3	4	5
28.	I would be willing to not eat meat, as this is a sustainable lifestyle	1	2	3	4	5
29.	I would be willing to participate in a protest such as a march or rally on a sustainability issue	1	2	3	4	5

For the statements below, please indicate how frequently you do each of the following actions by circling the appropriate number in the boxes below.

		Never	Rarely	Sometimes	Often	Very often
30.	Purchase a product because it was packaged in reusable or recyclable containers	1	2	3	4	5
31.	Buy products that claim to be environmentally friendly	1	2	3	4	5
32.	Use other types of transport, such as biking or the bus, instead of going in a car	1	2	3	4	5
33.	Conserve water at home by showering for less than 10 minutes a day	1	2	3	4	5
34.	Bring your own shopping bags for shopping	1	2	3	4	5
35.	Encourage people at home to recycle glass, paper or food scraps	1	2	3	4	5
36.	Try to persuade people to stop doing activities that could harm the environment	1	2	3	4	5
37.	Give to charity (e.g. money, old clothes, books etc)	1	2	3	4	5
38.	Participate in an organised tree planting	1	2	3	4	5
39.	Spend time in the natural environment (e.g. camping/picnicking/hiking)	1	2	3	4	5

Please rate how informed you think you are about the following environmental and sustainability issues in New Zealand by circling the appropriate number in the boxes below.

		Very Uninformed	Uninformed	Not sure	Informed	Very informed
40.	Water Pollution	1	2	3	4	5
41.	Climate change	1	2	3	4	5
42.	Consumption and waste	1	2	3	4	5
43.	Endangered species	1	2	3	4	5
44.	Child poverty	1	2	3	4	5
45.	Racial discrimination	1	2	3	4	5
46.	Bee decline	1	2	3	4	5

For the following, please circle the letter beside the one response that best fits your understanding of the question:

47. Which of the following services do New Zealand native forest ecosystems NOT provide:

- (a) Oxygen production
- (b) Remove carbon from the atmosphere
- (c) Control erosion
- (d) Prevent invasion of introduced pest animals and plants
- (e) Don't know

48. Which of the following is an example of a sustainable approach:

- (a) People of the same ethnic backgrounds work better together

- (b) Consultation can create unnecessary delays in decision making
- (c) A range of cultural perspectives are important in making a decision
- (d) People should all speak English to make communication easier
- (e) Don't know

49. What would happen if all the bees in New Zealand disappeared?

- (a) Fruit production would be unaffected
- (b) Fruit and vegetable production would go down
- (c) Nothing
- (d) Honey would be produced by other insects
- (e) Don't know

50. Which of the water pollutants from dairy farming in New Zealand can be controlled by the farmers fencing off waterways and planting trees near the rivers on their land?

- (a) Nitrogen
- (b) Pesticides
- (c) Lead
- (d) Iron
- (e) Don't know

51. Of the following, which contributes the most to sustainability?

- (a) recycling products
- (b) reusing products
- (c) buying the newest products to increase economic development
- (d) reducing consumption of products
- (e) Don't know

Please indicate your level of understanding for each of the following teaching and learning outcomes by circling the appropriate number in the boxes below.

Understanding				
Very poor	Poor	Not sure	Good	Very good

52	The significance of the environment and associated issues	1	2	3	4	5
53	The interdependence of the ecological, social, cultural and economic dimensions of sustainability	1	2	3	4	5
54	People's demonstration of attitudes, values and perspective that influence behaviour towards the environment	1	2	3	4	5
55	The use of personal experience and reflections(e.g. field trips) in understanding local/global environmental issues	1	2	3	4	5

Indicate how confident you are, at this point, in teaching to achieve the following in primary schools? (Circle your response)

		Not at all confident	Not confident	Not sure	Confident	Very confident
56.	Teaching environment and sustainability education in primary schools	1	2	3	4	5
57.	Helping students to learn about environmental issues	1	2	3	4	5

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58.	Helping students to explore the values in environmental and sustainability issues	1	2	3	4	5
59.	Taking students outside the classroom to learn in the environment	1	2	3	4	5
60.	Helping students to contribute to social and economic development of their community	1	2	3	4	5
61.	Helping students to take appropriate action to help maintain and improve the natural environment	1	2	3	4	5

Please answer the following questions as thoughtfully as you can. The answers you give are anonymous and will only be reported in a combined way.

62. How would you rate your personal understanding of the importance of the natural environment in New Zealand?

(Please circle one option that best represents your understanding on the scale below)

Poor Understanding 1 2 3 4 5 6 7 8 9 10 Excellent
understanding

63. If you think the natural environment is important, why do you think it is important?

64. How would you rate your personal understanding of sustainability?
 (Please circle one option that best represents your understanding on the scale below)

Poor Understanding 1 2 3 4 5 6 7 8 9 10 Excellent understanding

65. What does sustainability mean to you?

Reflecting on your learning during the semester, please indicate whether you would have liked to have had more, less, or about the same, learning opportunities in the following areas: (Circle your response)

		More	Less	About the same
66.	How to integrate environment and sustainability education in your teaching	1	2	3
67.	How to help students learn about environmental issues	1	2	3
68.	How to help students to explore the values in environmental and sustainability issues	1	2	3
69.	How to take students outside the classroom to learn in the environment	1	2	3
70.	How to help students to contribute to social and economic development of their community	1	2	3
71.	How to help students to take appropriate action to help maintain	1	2	3

	and improve the natural environment			
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Please indicate the extent to which completing TEPC 120-15 (Environmental and Sustainability Education paper) has influenced you in the following areas.

Circle the appropriate number in the boxes below.

To what extent did completing TEPC 120-15 (Environmental and Sustainability Education paper)						
		Not at all	A little	Somewhat	Quite a lot	A great deal
72.	Influence your knowledge of environmental and sustainability issues?	1	2	3	4	5
73.	Influence your attitude towards the environment?	1	2	3	4	5
74.	Influence your willingness to act in a more environmentally responsible and sustainable way?	1	2	3	4	5
75.	Influence your environmental behaviour?	1	2	3	4	5
76.	Encourage you to teach environment and sustainability issues to your future students	1	2	3	4	5

What contribution do you believe the following has made to your current knowledge, attitudes and behaviour towards environment and sustainability issues in New Zealand? (Circle your response).

		Contribution				
		None	Limited	Some	Strong	Very strong
77	The TEPC 120-15 Environmental and Sustainability Education paper	1	2	3	4	5
78	Other Papers taken at the University (Please name them)	1	2	3	4	5
79	Field trip to Hamilton gardens(on-campus students)	1	2	3	4	5
80	Other experiences at University (Please describe these)	1	2	3	4	5

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81	Media (Internet/TV/Newspapers/Books/movies)	1	2	3	4	5
82	Experiences with family or friends	1	2	3	4	5
83	Other experiences (please explain)	1	2	3	4	5

Thank you very much for your participation.

Appendix B: Interview with PSTs' Tutors

1. People have differing views on what environment and sustainability education is all about, do you mind sharing with me your views about environment and sustainability education?
2. In teaching pre-service teachers about environment and sustainability, what do you think the Pre-service teachers need to learn? How should they learn it?
3. Can you tell me about your experience teaching the enviro paper this year (TEPC120-15)?
4. In your teaching of the enviro paper, can you share your experiences of what you think has worked and what hasn't worked in helping the students learn better?
5. What would you have done differently to help students learn better?
6. How important do you think it is that the pre-service teachers
 - i) gain knowledge about environmental and sustainability issues in TEPC120?
 - ii) help students consider their attitude about environmental and sustainability issues in TEPC120?
 - iii) learn how to take action about environment and sustainability issues
 How do you think the paper currently enables this? And how successful do you think that has been this year?
7. How do you see the relationship between the knowledge, attitude, and behaviour in relation to environmental and sustainability issues?
8. How have you assessed the learning outcomes in TEPC120-15?
9. Do you think the students measured up to your expectations in these assessments?
10. What do you think about the relationship between the lectures and workshops in terms of helping students learn?

Probe: What happens in case a student misses the lectures?
11. Do you think the paper could be improved to achieve the goals of developing the students' environmental and sustainability literacy?

Probe if needed- the knowledge of environmental and sustainability concepts and issues; the attitudinal dispositions, motivation, cognitive abilities, and skills, and the confidence and appropriate behaviours to apply such knowledge in order to make effective decisions in a range of environmental and sustainability contexts
12. How well do you think the PSTs are prepared to teach ESE after completing the paper?
13. Do you think that age or ethnicity might make learning different for students in ESE?
14. Do you think the mode of study can make learning different for students in ESE?

Specific Question: Do you they think the student learning opportunities are any different between the face to face class and the online class
15. Were there some challenges in delivering the enviro paper? If yes, what are they?

16. Is there anything else I have left out which you will like us to discuss? Any other suggestions?

Appendix C : Interview with Year 3 PST

1. Thinking back on your first year,
 - I. What do you remember about doing the Environmental and Sustainability Education paper (TEPC120-13)?
 - II. Do you think you learnt anything? If so, what?
 - III. How do you feel about that now?
2. Has your attitude towards any environmental and sustainability issues changed as a result of your learning in the enviro paper? Any specific issue?
 - a. Why has your attitude changed?
3. Have you changed anything you do for the environment and sustainability as a result of your learning in the enviro paper?

Probe: For example towards wastes, water, energy etc.?
4. Can you talk about any other paper(s) you took during your pre-service teacher education (also practicum experience) that you believe has contributed to your knowledge, attitude and behaviour towards the environment and sustainability?
5. Have you had other experiences outside the university that has directly or indirectly contributed to your knowledge of, attitude and behaviour towards the environment and sustainability?
6. How important do you think it is for primary school students to learn EfS?
 - a. From your learning in the enviro paper, how confident do you think you are to be able to teach EfS in school?
 - b. What ideas do you have about teaching EfS in primary school?
 - c. What else do you think you need as a teacher to teach EfS?
7. Do you have further suggestions on ways to improve learning opportunities in this paper?

Is there anything else you would like to add about learning experiences in this paper?

Appendix D: Interview with Beginning teachers for graduate teachers

1. What type of school are you teaching in – state schools (funded by the government), ‘state integrated’ schools or private school?
2. Roughly how many students attend the school?
3. How long have you worked there?
4. How do you like it?
5. How easy/hard has it been for you to integrate into the school?
6. Is there any emphasis toward environmental and sustainability education in the school?
7. Tell me about how ESE is supported in your school (management, colleagues, curriculum, practices such as recycling, worm farming, gardening, composting)
8. Is there an expectation in your school that you will include ESE in your teaching? Why/why not?
9. Have you been able to integrate EfS into your teaching? How have you done this?
10. What supports have you been given to do this? /Would you have liked to have done more?
11. What do you see as limitations/what frustrates your efforts?
12. Do you feel more or less motivated to teach ESE than you did when you graduated? Can you explain this?
13. As a beginning teacher, do you feel you had enough knowledge/skills
 - of environment and sustainability concepts/issues when you began teaching? Can you explain this
 - on how to integrate environment and sustainability in your teaching when you began teaching? Can you explain this?
 - on how to help students learn about environmental and sustainability issues when you began teaching? Can you explain this?
 - on how to help students explore the values in environmental and sustainability issues when you began teaching? Can you explain this?

- on how to take students outside the classroom to learn in the environment when you began teaching? Can you explain this?

14. Do you feel more or less confident now:

- to teach environment and sustainability concepts/issues than you did when you graduated? Can you explain this
- in taking students outside the classroom to learn in the environment than you did when you graduated? Can you explain this
- in helping students to take appropriate action to help maintain and improve the natural environment than you did when you graduated? Can you explain this

15. Have you been able to support young children to engage in sustainability practices? How?

16. Thinking about the enviro paper,

- What do you think were the best parts of this paper and why?
- Can you recall any aspects of the enviro paper that were of less interest to you? Can you explain why?

17. How has completing the enviro paper influenced :

- your knowledge of environmental and sustainability issues? Can you explain this?
- your willingness to act in a more environmentally responsible and sustainable way ? Can you explain this?
- your attitude towards the environment? Can you explain this?
- your behaviour towards the environment? Can you explain this?

18. What do you think would be important for future beginning teachers to understand about ESE before beginning their teaching?

Appendix E: Year 1 PSTs' Focus group discussion questions

1. Can you share with us any memorable part(s) of the enviro paper for you, good or bad?
2. Did you learn anything from doing the enviro paper? If so, what? How did the paper help you learn this?
3. Has your attitude towards any environmental and sustainability issues changed as a result of your learning in the enviro paper? Any specific issue?
 - a. Why has your attitude changed?
4. Have you changed anything you do for the environment and sustainability as a result of your learning in the enviro paper?

Probe: For example towards wastes, water, energy etc.?
5. One of the key focuses of the enviro paper was sustainability. What does it actually mean to you now?
6. Do you think the field trip experience was helpful for your thinking about the environment and sustainability? Why/Why not
7. How do you feel about the assignments? Were they helpful for your learning in this paper? Why/ Why not?
8. In your personal life, do you think you can make a difference that might contribute to the quality of the environment? In what ways?
9. Do you think you want to make a difference?
10. How important do you think it is for primary school students to learn about the environment and sustainability?
 - a. From your learning in the enviro paper, how confident do you think you are to be able to teach EfS in school?
 - b. What else do you think you need as a teacher to be able to do this?
11. Do you have further suggestions on ways to improve learning opportunities in this paper? Is there anything else you would like to add about learning experiences in this paper?

Appendix F: Year 1 PSTs' Informed Consent Letter

Dear Student,

I am writing to invite you to participate in a research study. This study seeks to evaluate environmental literacy among New Zealand pre-service teachers. The study is being conducted in partial fulfilment of my PhD degree under the supervision of Dr Chris Eames and Prof John Williams.

The purpose of the research is to explore how university study may help you to develop environmental literacy, with particular reference to the Environmental and Sustainability Education paper (TEPC120-15). Participation in this study is intended to give you an opportunity to reflect on your learning and the subsequent development of environmental literacy. Findings from this study could assist curriculum and programme developers to have a better understanding of environmental education in pre-service teacher education including ideas for improvement.

You are invited to participate in this study because you are enrolled in the Environmental and Sustainability Education paper (TEPC 120-15) in the Bachelor of Teaching programme at the University of Waikato. I would like to involve you in being part of a focus group discussion. The focus group discussion will take up to 45 minutes duration.

Data collected during the study may be used in writing my thesis, reports, publications or in presentations. I will not use your name, the name of your University or the names of other participants in any publications or presentations. Data that you provide will not be shown to your teachers in this paper and every effort will be made to ensure that your participation in the study will not impact on your academic progress. I will make sure that I store all the information I gather securely. You can decline to be involved in this group, and can withdraw from any participation in the group at any time without any consequence. If there is a withdrawal, I will destroy any data gathered from you where it can be identified as yours.

I would appreciate your consent to be involved as described. If you need any more details about the project, or issues arise for you during the project, please contact me, Deborah Bandele, odb1@students.waikato.ac.nz, 0211156591. If I am unable to resolve your concerns, you may contact my research supervisor, Dr Chris Eames, c.eames@waikato.ac.nz, 078384357.

Yours sincerely
Deborah Bandele

Appendix G: Consent letter for participating in focus group discussion by Year 1 PSTs.

Dear Student,

Focus group discussions and follow-up interviews are planned as part of a doctoral study which aims at evaluating the influence of teacher education on pre-service teachers' knowledge of, attitude and behaviour towards the environment. The focus group discussion aims at facilitating deliberations on pre-service teacher's perceptions of how their environmental knowledge, attitude and possibly behaviour have been further developed and/or retained since completing TEPC120-13 in their first year. On the other hand, the follow up interview seeks to appraise experiences of teachers as they begin their practice and to examine how or whether their environmental literacy was applicable to their practice in their first school.

Based on the aforementioned, I would kindly ask for your assistance in participating in either or both activities. Please make your intention known in response to the questions below:

1. I am willing to participate in the focus group discussion Yes No

2. I am willing to be visited in 2016 after I might have gotten a teaching position

Yes No

If yes to any of the above, kindly provide your e-mail in the space below

.....

Appendix H: Year 3 PSTs' Students' Informed Consent Letter

Date

Dear Student,

I am writing to invite you to participate in a research study. This study seeks to evaluate environmental literacy among New Zealand pre-service teachers. The study is being conducted in partial fulfilment of my PhD degree under the supervision of Dr Chris Eames and Prof John Williams.

The purpose of the research is to explore how university study impacts environmental literacy. Particularly, how successful completion of the Environmental and Sustainability Education paper (TEPC120) has helped you develop environmental literacy and your perception of how this had been retained and/or further developed since completing the paper. Participation in this study is intended to give you an opportunity to reflect on your learning, subsequent development and retention of environmental literacy. Findings from this study could assist curriculum and programme developers to have a better understanding of environmental education in pre-service teacher education including ideas for improvement.

You are invited to participate in this study because you are a final year student who had taken the Environmental and Sustainability Education paper (TEPC 120-13) in your first year in the Bachelor of Teaching programme at the University of Waikato. I would like to involve you in completing an anonymous questionnaire that will take between 15-20 minutes.

Data collected during the study may be used in writing my thesis, reports, publications or in presentations. I will not use your name, the name of your University or the names of other participants in any publications or presentations. Every effort will be made to ensure that your participation in the study will not impact on your academic progress. I will make sure that I store all the information I gather securely. You can decline to be involved in the research, and can withdraw from further participation in the study at any time without any consequence. If there is a withdrawal, I will destroy any data gathered from you where it can be identified as yours.

I would appreciate your consent to be involved as described. If you need any more details about the project, or issues arise for you during the project, please contact me, Deborah Bandele, odb1@students.waikato.ac.nz, 0211156591. If I am unable to resolve your concerns, you may contact my research supervisor, Dr Chris Eames, c.eames@waikato.ac.nz, 078384357.

Yours sincerely

Deborah Bandele

Appendix I: Confirmation of PhD enrolment upon ethical approval

Postgraduate Studies Office
Student and Academic Services Division
Wahanga Ratonga Matauranga Akonga
The University of Waikato
Private Bag 3105
Hamilton, 3240, New Zealand

Phone: +64 7 858 5086
Email: postgrad@waikato.ac.nz
Website: <http://www.waikato.ac.nz/sasd/postgraduate/>



02 May 2016

To whom it may concern,

Re: Confirmation of PhD enrolment with the University of Waikato

Please accept this letter as confirmation that Oluwaseun D Bandele, ID number 1241276, is currently enrolled in the PhD programme at the University of Waikato, with the Faculty of Education.

Deborah's thesis topic is recorded as "Evaluation of Environmental Literacy Among Pre-Service Teachers in New Zealand".

If you have any questions or would like clarification, please do not hesitate to contact me.

Yours sincerely,

Tanya Wakefield
Postgraduate Studies Office

cc: File 1241276



Appendix J: Paper Outline (Learning Outcome) for Year 3 PSTs

Faculty of Education

Te Kura Toi Tangata



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

TEPC120-13B (HAM)

Environmental and Sustainability Education

Paper Outline

Department of Policy, Cultural and Social Studies in Education

Tari mo nga Kaupapa, Tikanga me te Matauranga Noho Hapori

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Week	Principal Lecture	Tutorial Theme	Assessments and Readings
July 8-12	What is Sustainability?	<ul style="list-style-type: none"> • What is the environment and what is sustainability? • A sustainability inquiry 	Littleddyke, Taylor and Eames (2009) PCE (2002)
July 15-19	Environmental Sustainability	<ul style="list-style-type: none"> • Environmental systems • Biodiversity, interdependence and adaptation • Field trip preparation 	Littleddyke (2009)
July 22-26	Social sustainability	<ul style="list-style-type: none"> • Social justice and Intergenerational equity • Values and attitudes • Field trip and Assignment 1 preparation 	Mutch (2000)
July 29 – Aug 2	Economic sustainability	FIELD TRIP	Jackson (2009)
Aug 5-9	Cultural sustainability – an indigenous perspective	<ul style="list-style-type: none"> • Economic and cultural sustainability • Reflection on field trips • Assignment 1 tutorial 	Roberts, Norman, Minhinnick, Wihongi, and Kirkwood (1995).
Aug 12-16	Sustainability connections and ethics	<ul style="list-style-type: none"> • Sustainability connections • Assignment 1 tutorial • Assignment 2 preparation 	Assignment 1: Due 4pm Fri 16 August
August 19-23	MID SEMESTER TEACHING RECESS		
Aug 26-30	MID SEMESTER TEACHING RECESS		
Sept 2-6	Teaching and learning in EE/EfS	<ul style="list-style-type: none"> • Key ideas in environmental and sustainability education • Resources for key ideas – TKI, Guidelines • Assignment 2 tutorial 	Bolstad (2003) McLean (2003)
Sept 9-13	EE/EfS practices in NZ schools	<ul style="list-style-type: none"> • Pedagogies for EfS • Assignment 2 tutorial 	Wilson-Hill (2006)
Sept 16-20	EfS in schools	<ul style="list-style-type: none"> • EnviroSchools Network • Planning a lesson • Assignment 2 tutorial 	Eames & Cowie (2004) Cowie & Eames (2004) Assignment 2: Due 4pm Fri 20 Sept
Sept 23-27	No lecture	<ul style="list-style-type: none"> • Classroom activities in EfS • Assignment 3 preparation 	
Sept 30 – Oct 4	No lecture	<ul style="list-style-type: none"> • Assignment 3 tutorial 	
Oct 7-11	No lecture	<ul style="list-style-type: none"> • Assignment 3 tutorial 	Assignment 3: Due 4pm Fri 11 Oct

Introduction

This paper provides opportunities for students to develop the skills, attributes, and knowledge related to the University of Waikato, School of Education, B.Teaching graduate profile and the academic rationale and goals for its teacher education programmes, particularly those that relate to the purposes, principles, practices and issues related to education for sustainability. Students completing this paper also develop their professional knowledge, practice, values and relationships as outlined in the Graduating Teacher Standards: Aotearoa New Zealand. Specific standards identified in this paper are:

1. Graduating teachers know what to teach
2. Graduating teachers understand how contextual factors influence teaching and learning
3. Graduating teachers use professional knowledge to plan for safe, high quality teaching and learning environment
4. Graduating teachers develop positive relationships with learners and the members of learning communities

Learning Outcomes

To successfully complete this paper, students will:

1. Demonstrate an understanding of the significance of the environment and concepts that underpin sustainability;
2. Demonstrate an understanding of the interdependence of the ecological, social, cultural, and economic dimensions of sustainability issues;
3. Demonstrate an understanding that people, including themselves, have a range of attitudes, values and perspectives that influence their behavior toward sustainability issues;
4. Demonstrate how they have used their experience of, and reflection on, a field trip to gain an understanding of a local environmental issue;
5. Demonstrate an understanding of the key ideas of teaching and learning in environmental and sustainability education, in particular in New Zealand schools;
6. Demonstrate an understanding of how to teach primary school students in environmental and sustainability education.

Appendix K: Paper Outline (Learning Outcome) for Year 1 PSTs

Faculty of Education

Te Kura Toi Tangata



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

TEPC120-15B (HAM)

Environmental and Sustainability Education

Paper Outline

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Week	Principal Lecture	Tutorial Theme	Assessments and Readings
July 13-17	What is Sustainability?	<ul style="list-style-type: none"> • What is the environment and what is sustainability? • A sustainability inquiry 	Littleddyke, Taylor and Eames (2009) PCE (2002)
July 20-24	Environmental Sustainability	<ul style="list-style-type: none"> • Environmental systems • Biodiversity, interdependence and adaptation • Field trip preparation 	Littleddyke (2009)
July 27-31	Socio-cultural sustainability	<ul style="list-style-type: none"> • Social justice and intergenerational equity • Values and attitudes • Field trip preparation • Assignment 2 introduction 	Pedersen (2008) Roberts, Norman, Minhinnick, Wihongi, and Kirkwood (1995)
August 3-7	Economic sustainability	<ul style="list-style-type: none"> • Economic sustainability • Resources • Production and consumption 	Jackson (2009) Assignment 1: In tutorials
August 10-14	Sustainability connections and ethics	<ul style="list-style-type: none"> • No tutorial 	
August 17-21	No lecture	FIELD TRIP	
August 24-28	MID SEMESTER TEACHING RECESS		
August 31 – Sept 4			
September 7-11	Teaching and learning in ESE in NZ	<ul style="list-style-type: none"> • Key ideas in environmental and sustainability education • ESE in the NZ Curriculum • ESE in NZ schools 	Barker and Eames (2011) Bolstad (2005) McLean (2003)
September 14-18	ESE in schools - pedagogy and practice	<ul style="list-style-type: none"> • ESE pedagogies • Action Learning cycle • Approaches and activities • Useful resources 	Wilson-Hill (2006) www.efs.tki.org.nz Assignment 2: Due 4pm Mon 14 Sept.
September 21-25	ESE in schools – planning for learning	<ul style="list-style-type: none"> • Planning for learning in ESE • Integration in practice • Evaluating teaching and learning 	Eames & Cowie (2004) Cowie & Eames (2004)
September 28-Oct. 2	ESE in schools – where to from here for me?	<ul style="list-style-type: none"> • Revisiting a rationale for ESE • Examples of good ESE • Sustaining our involvement 	
October 5-9	No lecture	<ul style="list-style-type: none"> • Critiquing ESE teaching and learning (Assignment 3 support) 	
October 12-16	No lecture	<ul style="list-style-type: none"> • No tutorial 	Assignment 3: Due 4pm Tues 13 October

Introduction

Nau mai, haere mai, welcome to Environmental and Sustainability Education!

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