MONASH University

Connecting Biodiversity Field Studies with Classroom Curriculum: *Understanding Children's Learning and Teachers' Perspectives*

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Declaration

This thesis, except with the Research Graduate School Committee's approval, contains no material which has been accepted for the award of degree or diploma in any educational institution and, to the best of my knowledge and belief, it contains no material previously written by another person, except where due reference is made in the text of the thesis.

John Maxwell Caldow

Dedication

To Louis and Joe

"Together we have reached a turning point, a crucial moment of choice … we can decide what kind of future we will leave to our children and their grandchildren" (Suzuki, 1997, p. 1).

Photo: J. Caldow - 18/4/2012

When we first built our home in Upper Maffra West (1992), Meadow Argus butterflies (*Junonia villida*) were common in the fields around our house. I have only seen five Meadow Argus butterflies since the Victorian bushfires of 2007-2008. They are said to be common Australia wide, however in Upper Maffra West they seem to have declined in number. Butterflies may well be, like canaries were in Welsh coal mines, indicators of the health of the environment and our atmosphere. I believe, future generations will need to have the skills and knowledge to monitor biodiversity, ecosystems and how humans impact on them if we are to live sustainably in the years to come. I thus dedicate this thesis to all future generations. I hope we see the return of the Meadow Argus butterfly for all.

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Abstract

Climate change is a serious global environmental issue that demands action. In response, educators will need to develop coherent environmental and sustainability pedagogies that promote eco-literate citizenry. This thesis contributes to such a need and focuses on better understanding the learning link between the findings in the field and the classroom practices adopted by teachers for their students.

At its core, this thesis examined student and teacher perceptions of the value of biodiversity, based on field days *out* of the classroom and how they were connected with post-field studies *in* the classroom. The study aimed to better understand and thus improve the extent and quality of student learning in Education for Sustainability (EfS). The overarching question of my study investigates the extent that place and experiential pedagogies enhance Education for Sustainability when field and classroom contexts are connected.

Framed by the ethnographic and grounded theory methodology of Glaser and Strauss (1967), the study investigated the use of Somerville's (2008) post-colonial place pedagogy and Dewey's (1938) experiential learning for developing student eco-literacy across field and classroom contexts. Data collection methods included video recordings, student Mindmaps, student work samples and semi-structured interviews with primary students and their teachers.

Findings suggest students were embodied in a range of place-based and experiential activities during their field trip that extended their environmental knowledge. They were highly motivated to undertake follow-up environmental learning. The students' sustainability learning was further extended when teachers connected the content of the field programs with interdisciplinary classroom studies, using place-based and experiential pedagogies. Field experiences were shown to develop students' biophilia and environmental knowledge, particularly when expert facilitators delivered 'hands on' workshops including biodiversity, stories and Indigenous culture, and teachers integrated

field and class programs. Connecting field trips with classroom experiences holds great promise for deepening children's ecological literacy and collaborative partnerships could provide the opportunities to support student learning 'in' 'about' and 'for' our environment, through linking natural habitats, schools and the wider community, using experiential learning and place-based pedagogy.

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Chapter One
Looking for 'Another Path'

> As an elder, I am impelled by a sense of urgency that comes from the recognition that my generation has induced change and created problems that we bequeath to my children, grand-children and all generations to come. That is not right, but I believe it is not too late to take another path (Suzuki, 2010, p. 3).

1.1: Introduction

Like David Suzuki in the above quote, I too am impelled by a sense of urgency and concern that humankind is confronting an environmental crisis that must be understood if we are to live sustainably. Suzuki provides many reasons for our environmental crisis in his book *The Sacred Balance: Rediscovering Our Place in Nature* (1997, p. 212) where he states that humankind will encounter environmental dilemmas in ongoing ways into the future as populations increase and an economic paradigm of thinking dominates. This situation, according to Suzuki, is not sustainable in a finite world. We need to find another path.

For over two decades scientists have argued for the need to prepare future generations to be eco-literate for the challenges ahead, specifically through education (Coyle, 2004). Education has a vital role to play in what needs to be the "Century of the Environment", a title for the 21st century, as coined by Wilson (2002) to describe a predicted domination of environmental issues for humankind during this millennia. Such views can be applied to the whole of society and are outlined by Al Gore in his book *Earth in the Balance: Ecology and the Human Spirit* (1993). Gore's global plan, placing rescue of the environment as the central organising principle of civilisation, prioritises long term planning and thinking (Pratt, 1993). Education for sustainability must surely be an important part of our long-term planning for creating a sustainable future.

To find 'another path' I believe we need to understand further the contributions of education and the ways it might assist in addressing the challenge of producing eco-literate citizens capable of moving quickly towards sustainable living (Orr,

1994b). To be eco-literate is to have knowledge of basic ecological concepts, environmental sensitivity or appreciation, awareness of environmental issues and problems, and skills and behaviours to prevent and/or resolve those issues (Waite, 2011). This thesis is one small part in better understanding the role education can play in developing eco-literacy. This chapter provides a background of the study and outlines my own role as environmental teacher and educator.

1.2: The purpose and contribution of the study

As a teacher, and now environmental education field worker, I consider the role education can play in the transition towards sustainable living as vital. I have always believed that learning is key to unlocking a public awareness of the importance of the environment. Rickinson (2008, p. 10) cites Sterling (2001) who states, "the difference between a sustainable or chaotic future will be learning." The belief that learning is important in moving beyond discourses of crisis by exploring how we educate current and future generations (Somerville, Davies, Power, Gannon, & De Carteret, 2011), infers the crucial role education has to play. My beliefs and broader debates about the important role of education in environmental crisis discourse, have led me to this doctoral study. Both my personal experience, and the environmental movement generally, have been the motivators for my examination of the significance of field learning for reconnecting students and their teachers with the natural world, and for developing environmental knowledge.

At its core, the study aimed to investigate student learning and teacher perceptions about the value and connections of field days spent outside the classroom for environmental learning. To better understand the 'field to classroom process', my study investigated how environmental learning experiences are understood and taken up by students and teachers. The study is built on the contributions to place-pedagogy theories of Professor Margaret Somerville (2010) and the experiential learning theory of Professor John Dewey (1938), as both are meaningful pedagogies for building student ecological literacy in response to our environmental crisis.

1.3: Justification for the study

Education has an essential role to play in creating a universal environmental ethic, which, when combined with long-term thinking and decision making, will be needed for humankind to live sustainably (Wilson, 2002). Developing an eco-literate citizenry will be a major part of this transformation. In light of what scientists are warning, the need for environmental education is crucial, and it is unimaginable "how the people of all nations could move toward a more sustainable world without the contribution of educators from around the globe" (UNESCO, 2005, p. 10). Closer to home, the Australian Government (2009b) has identified the capacity of Education for Sustainability (EfS) as an essential element of education more broadly that will re-orient a shift towards sustainability. There is no greater justification for research than pending environmental disaster, and one of our most potent weapons for responding could be education.

As our environmental dilemmas are so multi-faceted, all areas of knowledge will need to be involved in educating the citizenry to move towards sustainability. All stakeholders will also need to come together to examine how we can collectively develop the knowledge, skills and attitudes to provide our student citizens with the tools they need to be actively engaged, scientifically informed, citizens and lifelong learners who can adapt to the challenges we face in our future. As Sobel suggests "the best educational system will shape adults who both love the earth and are smart and competent" (2008, p. 54). This will involve shaping students who are knowledgeable about biodiversity and our environment, and amazed by its systems and interconnected life forms; students who respect or even love earth and want to actively protect it. To learn about and connect with nature, we need to go into the field, which equally applies to student and adult citizens alike.

In a review of literature (Rickinson et al., 2004) note, there have been few studies to date, investigating the direct impact of fieldwork on students' explicit environmental knowledge. This PhD study set out to contribute to this gap in knowledge in an attempt to investigate and explore explicit learning across field and classroom contexts. A further key message of the Rickinson et al. (2004) review, is for researcher's to explore how local contexts can be used for environmental learning, and to explore the extent of integrated learning between

outdoor and classroom contexts. Existing research, describing how and to what extent teachers integrate field and classroom contexts in schools, is minimal. My research is designed to contribute to this gap in current knowledge.

1.4: Personal orientation towards the study

In thinking through the implications of 'finding another path', and in embarking upon my doctoral studies, I have reflected upon my own experiences that have shaped and impacted this study. I provide below my personal orientation to the study and discuss my experiences as a child and as a teacher, and then explain my current role as an environmental field educator and Program Director for the Bug Blitz[1] program, which is integral to this study. The three perspectives of child/student, teacher and field presenter are also reflected in the three participant groups that underpin the study. These three groups were selected and span my own environmental journey, which has involved a process of lifelong learning.

1.4.1: Childhood beginnings

After working in education for over 30 years, I would describe myself as an environmentally active teacher. In her journey as a beginning teacher, White (2002) refers to Schratz' (1993) analogy of climbing a mountain as a way of looking backwards so you can see forwards to where you want to go. I too look back on my journey as a naturalist educator, which began for me as a child playing in the wetlands and fields at the edge of my suburban childhood home, catching lizards, frogs and tadpoles. My parents both modelled and encouraged a love of nature, and as a primary student I was a member of the Tree Lover's League and the Gould Bird Lover's League. My father kept and bred a wide variety of aviary birds, which helped develop my interest in birds. I was also a hunter-gatherer who collected mushrooms, caught fish and eels, and trapped or shot rabbits along a local creek in the nearby countryside.

[1] Bug Blitz Trust: a not-for-profit environmental organisation principally concerned with biodiversity and environmental education.

I have a distinct memory from my childhood of watching images of a factory spewing thick smoke from its chimneys into the environment on a black and white television. I was about 8 or 9 years old, so it was the early 1970s and media was warning us of impending environmental problems. This raised my awareness of the impacts humanity was having on our planet, and I remember feeling concern about pollution.

By the time I graduated as a teacher in 1986, urban sprawl had already claimed the wetland I explored as a child; by then it had been a suburban road for 15 years. Long gone were the bull-rushes, frogs, tadpoles and water skinks I had cherished. In 1987 I was posted into country Victoria by the Department of Education to take up my first teaching position.

1.4.2: A classroom teacher

My journey as a primary teacher took me to the Gippsland region of Victoria, where I was posted to Lucknow Primary School. Gippsland has been where I have both worked and lived and is also the context for the participants in my study. Surrounded by the Great Dividing Range and the Gippsland Lakes, I have learnt much about the natural world in this particular region as a consequence of my transition from an urban to a rural lifestyle. As part of this transition I purchased 40 acres of bush land, built a mud brick house using recycled materials, and became what some refer to as a 'Tree changer.'[2]

Being a teacher in regional Victoria has allowed me to practice EfS in local habitats with my students, as natural environments surround the schools I have taught in, making access to such areas for study, easy. Across the road from a school I once taught, there is a large wetland reserve. My class and myself completed a frog survey in this wetland before it was restored. We planted 100s of trees as part of its restoration.

Having lived in the bush,[3] and after implementing hundreds of environmental field day programs, I have developed a strong belief that field experiences are an essential part of EfS. I agree with Rickinson et al. (2004) who, suggest that it is

[2] Tree changer: a person who has moved from an urban to a rural existence.
[3] Bush: colloquial Australian term for forest

time to reconsider field learning as a mandatory part of life sciences, physical sciences and EfS. For me, field locations are an essential context for environmental learning: like books are to reading, instruments are to music, and pools are for learning to swim, and ought to be considered as mandatory in our school curriculums. I suggest my findings will add weight to this argument.

Throughout my 21 years as a classroom teacher I had always been interested and active in teaching EfS, making sure I consistently included it in my class curriculum. Thinking back, the most memorable EfS experiences I have had as a teacher always involved some type of 'hands on' outdoor/field learning integrated with classroom and other learning contexts. Frogwatch[4] and Waterwatch[5] were two such environmental programs that brought my students and me into contact with local ecosystems, requiring us to collate and report the results we found to the program's stakeholders. Both of these programs required integrated field and classroom learning contexts to achieve their goals, but they did not require the integration of study to go across all subject disciplines.

Integrated learning, which draws on a range of inter-disciplinary subject areas, is a pedagogical approach I have applied in my classes. My interest in the Arts has also led me to search for, and explicitly make, connections between disciplines when exploring topics. As a classroom teacher, I subsequently developed holistic, integrated and theme-based learning experiences for my students and myself. Based on the effectiveness of these approaches, I concur with Scarce (1997), who argues that "If conceived with imagination and planned with attention to detail, field trips can be among the most intensive, in-depth, integrative, and rewarding of educational experiences for students and instructors alike" (p. 226). It is in this spirit that my study searches for the elements of field experiences that teachers and students value most for environmental learning. In this way, this research suggests some best practices for fieldwork, building upon existing research in this area (Carlson, 2008). This has implications for teachers considering planning similar styled field programs.

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[4] Frogwatch: a citizen science survey program monitoring frogs in Victoria, conducted in the early 1990s.

[5] Waterwatch: a program requiring students to collect, map and send local water samples to Dept. of Environment in an attempt to monitor salinity levels in various water types around Victoria (1989).

A holistic process of learning from the field to the classroom resembles a pedagogical approach known as 'experiential learning', which requires cognitive, behavioural and affective responses to the stimuli being studied. According to Kolb (1984a), experiential approaches involve combinations of concrete experiences, reflective observations, abstract conceptualising and actively experimenting with new knowledge. I enjoyed teaching in this way and was convinced that using holistic and experiential approaches were beneficial in developing deeper and broader student learning outcomes, across a range of curriculum areas. These beliefs were further developed after I left teaching and now inform my current role as biodiversity educator for the organisation Bug Blitz Trust.

1.4.3: An environmental educator and field presenter

After five years of school-based environmental projects supported by the Hugh Williamson Foundation[6] (HWF), I was offered a full-time position as Program Director of Bug Blitz Trust. On taking the job my perspective became more of an outsider to the classroom, working for a not for profit (n.f.p) environmental organisation but still as an educator. After previously teaching in schools, this new job provided me with the opportunity to focus on biodiversity and education for sustainability from a non-formal 'classroom' perspective, and from exclusively outdoor experiences in natural places.

According to Charles & Louv there are "strong indicators of an absence of direct experience with the natural world in many children's everyday lives" (Charles & Louv, 2009, p. 1). Others suggest our environment is under threat from climate change (Flannery, 2005; McKibben, 2010; Wilson, 2006). Field experiences may be one way to remedy a growing lack of opportunity for students to interact directly with nature, increase opportunities to study the ways climate change is impacting our biosphere and therefore provide solutions for how we might respond to minimise and adapt to the effects of a changing world. Field learning is more strongly embraced by teachers when practitioners use carefully-structured

[6] Hugh D. T. Williamson Foundation: a philanthropic foundation established to benefit the Victorian community.

learning activities and assessments linked to the school curriculum (Rickinson et al., 2004). According to Carlson (2008); the best results of being in the field will be achieved with local community groups, government authorities and schools working together. In my study, this involved a range of partner groups.

As a teacher, I was familiar with excursion planning, school curriculum assessment requirements, as well as working with community-based partners. Moving from teaching inside a school to working for Bug Blitz has provided opportunities for working with partners in field day provision and as a consequence, the influence of various partners on student learning became more pronounced. A range of different people and groups are a part of this process: students, field presenters, teachers, scientists, government bodies, local naturalists, artists, and philanthropists. One of my roles was to work collaboratively with these partners to plan and improve the outcomes of programs in field, school and community contexts as, although they may have different roles to play all are contributors to the social construction of knowledge.

Another review of research on outdoor learning in the United Kingdom suggests we need to develop ways to improve the quality of this form of education (Rickinson et al., 2004). My study responds to this gap in research by suggesting an important element for improving the quality of EfS is the development of the teaching skills of various partners and groups who deliver EfS. As a field-event planner and field presenter, I have worked with many partners who have subject expertise and qualifications in a range of sciences and other disciplines, however, more often than not, they have completed no formal education studies or professional development to prepare for teaching roles.

It is through this journey that I have discovered the greatest sense of purpose in my own life – to contribute to developing educational pedagogies that help build an eco-literate citizenry concerned with living sustainably on earth. When we learn about biodiversity and our environment, we are learning about what we are trying to conserve, our biosphere. According to Wilson (2002, p. 22) the question of the century for humankind is, “How best can we shift to a culture of permanence, both for ourselves and for the biosphere that sustains us?” Educators have a major role to play by improving eco-literacy, as this will help students to learn about and find solutions to Wilson’s question; a question we must all answer

given we find ourselves facing an environmental crisis unprecedented in human history. We therefore need to understand the root causes and effects of this crisis before exploring potential solutions. Being a teacher and field presenter has prepared me to play a role in helping to improve the quality of EfS and to develop student eco-literacy.

1.5: Aims and objectives of the study

The main aims of this research were to understand (a) how participatory single-day biodiversity field events are implemented, (b) to consider their value in developing student eco-literacy, and (c) how, and if, they are connected with follow-up classroom/school-based study with teachers. In order to achieve these aims consideration was given to how the environmental field days in this research transpired, the key learning concepts included by facilitators in the field, as well as the pedagogical approaches they applied during their workshops. Doing this allowed me to gain insights into any influence field presenters may have had on student learning. My study also investigated teacher perceptions of student learning in the field and classroom contexts, in an attempt to understand how an experiential learning framework and place-based pedagogies might be compatible with 'eco-literacy' learning in field and school contexts.

1.6: My research questions

The overarching research question serves to investigate the value of place-based and experiential learning, and how these concepts interact with different learning contexts and approaches to enhance environmental and sustainability learning. To this end my central question is:

> *To what extent do place and experiential pedagogies facilitate, enable and enhance Education for Sustainability when field and classroom contexts are connected?*

Building on this over-arching research question, the following five sub-questions were formulated as a way of framing the overall study. Or:

1. What do children learn in a one-day biodiversity field event?

2. What are the connections (if any) between environmental field day events and the classroom?
3. How do primary teachers perceive students' environmental learning experiences in the field, and in classroom contexts?
4. How, if at all, do primary school teachers connect field experiences with classroom learning?
5. What influences, if any, do field presenters have on children's environmental learning?

1.7: Interpreting field and classroom connections

In keeping with the purpose and aims of the study, I used an interpretive approach that explored the content and delivery of field-based facilitator workshops in relation to students and their teachers. I investigated student and teacher perceptions of the field experiences, and related classroom learning undertaken by the participants post-field. I used a range of different methods: video data was recorded at one field event, field notes were taken, semi-structured interviews were undertaken with primary students and teachers, a range of document samples of students' post-field work, and a total of 21 student Mindmaps were collected to document children's perceptions of learning.

Collecting video data of field workshops 'in action' allowed me to assess the key content implemented by a range of facilitators, the pedagogical approaches facilitators applied and the impact of their workshops on student learning. I collected document samples in the form of student Mindmaps (a graphic thinking organiser) to find correlations between key field concepts and students' reflections of learning experiences, and to find evidence of the types of post-field learning undertaken by students. Document samples were also used to comment on ways students used digital technology. The methodology and methods chosen for my research have provided a rich data set, encompassing field and post-field contexts, to explore the questions of my study.

1.8: Significance and timeliness of the research

Research involving field experiences for developing environmental learning are numerous (Ballantyne, Anderson, & Packer, 2010; Carlson, 2008; Green, 2011; Zarmati, 2009). However, there is minimal research that investigates the value of single-day field experiences for this same purpose, particularly within an Australian context, and my research therefore addresses a gap in knowledge, which I hope will contribute to greater understanding about this form of EfS and its implications for environmental and sustainability learning.

My study provides a general view of student's levels of motivation during and after field days. Earlier research (Carlson, 2008; A. Farmer & Watt, 1997; Powers, 2004) suggests special events such as field trips, excursions and camps are great motivators for learning, and connecting such experiences with classroom study improves learning outcomes. Carlson (2008) also argues that field trips can have minimal outcomes depending on the approach to the field trip and the consequent planning.

Economic pressures on families, governments, not-for-profits and schools to pay for special events like field trips gives those paying a right to justify and question the investment. This research examined the value of field and post field learning partnerships. At a time when there is various participation from non-profit and government organisations regarding EfS for schools, this research describes how two field days involving such partners transpired. My study has the capacity to assist in understanding the role and importance of stakeholders and partnerships as key elements that can support improved outcomes in EfS.

As it is hoped that this research will be useful to researcher and stakeholders in environmental programs around Australia I need to clarify how I am using the term 'environment'. At an international scale, the changes to biodiversity and our environment over the past two centuries, alert us of the importance of understanding more about the roles biodiversity plays in sustainable ecosystems. In this context, biodiversity represents the variety of life forms at molecular, organismic, population, species and ecosystem levels of biological systems (Wilcox, 1982, p. 639). I use the term '*our environment'* to represent what Wilson

(2002) refers to as our biosphere, the collective of living ecosystems that forms a thin layer around earth which is habitable for life.

It is recognised internationally that biodiversity conservation is essential for sustainable living. For me, it is 'bugs' that represent what we are trying to conserve – an intricate web of interconnected life we call biodiversity, and it is under threat (Flannery, 2005; Gladstone, Stanger, & Phelps, 2006; Suzuki, 1997; Wilson, 2002; Zemits, 2006). "Australia has lost 350 species of animals in its recent past" (Zemits, 2006, p. 99), so our track record for biodiversity conservation is questionable. Zemits' work examines 350 of the larger species that have been lost and has not included estimates involving invertebrates, estimated to be 99 per cent of all animals on earth. The truth according to museum scientists (Museum Victoria, 2000) is that, we have little idea of the number of invertebrate species that are threatened or have become extinct, and the consequences of the loss of a single species in an ecosystem is difficult to predict. Biodiversity focussed education programs play an important part in the conservation of species and ecosystems around the globe. Knowledge of biodiversity is an essential part of being eco-literate.

1.9: Thesis Overview

Chapter One provides a brief discussion about the reasons for our environmental crisis, suggesting they are trans-disciplinary. It signals a need for change through education. I have summarised the key research topics, the context and motivation for this study, and provide a general outline of the purposes and aims of my research, which investigates how an experiential learning framework and place-based pedagogies might be compatible with 'eco-literacy' learning, in field and school contexts. The chapter explores definitions of some important terms in my study, namely Education for Sustainability (EfS) and place-based pedagogy. My personal orientation to education has fuelled the reason for the study and my journey as a teacher has influenced my knowledge and love of biodiversity, and in turn, how I facilitate environmental field days. Gaps in current research that my study contributes to were identified, research questions introduced, and methods discussed.

Chapter Two is the first of two literature review chapters. It examines literature relating to the 'environmental crisis' such as the 'urban dilemma', feelings of detachment from nature, and explores why humanity has become so disconnected from our environment. Literature pertaining to the origins and importance of developing biophilia in students as a way to connect them with the natural world are discussed. The chapter also considers the digital world, both its positive and negative impacts, for connecting people with the natural world. It outlines existing research that considers eco-literacy to be the main goal of EfS, exploring the American nature writers as a source of inspiration and role models for building connections, knowledge, understanding and care for biodiversity and our environment. This chapter also reviews existing research investigating the value of field experiences and how connecting post-field classroom experiences has been used to develop eco-literacy.

Chapter Three is the second of the two literature review chapters, and investigates different pedagogical approaches currently used for EfS. Using a range of resources from books, journals, websites and theses, I review studies involving the concepts of learning 'in', about' and 'for' our environment, biodiversity education, integrated and experiential learning in EfS, and place-based pedagogy. Student and teacher perceptions of environmental field learning, the controversial nature of EfS, and studies relating to connecting field and class learning, are all investigated. Given the centrality of student perceptions of environmental learning, literature pertaining to student learning is examined. In addition to examining teacher perceptions of *teacher* professional development in EfS, the chapter finishes by asking the question: Is there a role for field learning in teacher professional development?

Chapter Four provides the building blocks for my research and functions as the framework for understanding the value of place-based field learning experiences, as well as how an experiential learning cycle can exist across field and classroom contexts. This chapter is concerned with the design and research approach that frames the overall study. It highlights the methods and methodology used to

understand the value of field learning, and how it connects with other learning contexts to improve student eco-literacy. The chapter outlines the ethical considerations of my study, as well as an overview of data collection. This includes a systematic analysis of the various forms of data that were collected: video data, semi-structured interviews, student Mindmaps, field notes and other student documents and artefacts. The final part of this chapter outlines the procedure and phases of research and data collection that were undertaken in my study. Grounded theory and ethnographical methodologies are discussed.

Chapter Five focuses on the analysis of my research data. This chapter begins with an analysis of student perspectives of field and classroom learning. In this section I explore what students' value about environmental field learning days and what they learnt. Embodied learning, facilitator influence and learning new information in the field are considered. The value of the field presenters content and approaches such as Aboriginal perspectives of the land, interacting with animals and the impact field days had on student motivation, are also discussed. Following this, teacher perceptions of student learning in field and classroom contexts are analysed. This section also provides a significant analysis of how field and classroom learning were connected with integrated learning post-field.

Chapter Six completes the thesis by synthesising the main findings of this research and exploring how my literature reviews relate to the key findings. Student field learning, the qualities and value of field days, ecosystem learning, student reflection/research/writing, partnerships in EfS, the extent of EfS in field and classroom contexts and the influence of field presenters are discussed. The thesis chapter concludes with discussion of the implications this study has in the field of EfS, the limitations of the research, and recommendations for future research in EfS. In conclusion, I outline the contributions my study makes to the existing body of research in EfS, and reflect on my own learning path to suggest a way forward.

1.10: Conclusion

The need for a better understanding of the role education can play to find 'another path' to sustainable living has never been greater. My study provides insights for educators undertaking biodiversity field studies with a focus on the holistic study of invertebrates. I will suggest ways environmental actions can be incorporated with field and classroom learning to actively engage students in learning 'in', 'about' and 'for' our environment.

How teachers go about the task of connecting studies to special events is most certainly not standardised and according to Salata and Ostergren (2010, p. 51) "Environmental education takes many forms, both in and out of the classroom." While there is growing research about a variety of forms of field trip experiences, there is little research about the value of single day rotational biodiversity field days to student learning and connections to the classroom. My research provides an outline of this form of EfS, through investigating its value for developing eco-literacy.

Chapter Two

Environmental Crisis: Issues, Debates and Responses

> Twelve millennia back may seem like the Age of Dinosaurs, but it was just yesterday by geological standards. Humanity was stirring then, some eight million people alive and many seeking new land… The construction of the first towns, in the Fertile Crescent, lay only a thousand years in the future (Wilson, 1994a, p. 234).

2.1: Introduction

The aim of this chapter is to highlight the relevant research literature as it relates to the current environmental crisis and associated causes and effects. With these considerations in mind, the chapter identifies and defines two distinctive discourses in environmental and sustainability education, understanding these terms in the context of this study and exploring issues related to the environmental crisis. These two fields of study, amongst other things, draw attention to the current plight of the world, including the imperative to take action towards planetary sustainability.

Embedded within these discourses are several key topics that educate about, and critique, the need for improved relations between humans and the living systems that support us, which include, biodiversity, ecological-literacy (eco-literacy), the urban dilemma and human detachment from nature. The chapter goes on to explore other key terms such as the Anthropocene, biophobia, biophilia and the digital world, and examines their contribution towards fostering student eco-literacy. Following this, the chapter reviews the contribution of the North American nature writers and their advancement of ecological stewardship and ethic of care. Finally, the chapter examines the research literature as it relates to field day experiences for environmental learning, including their integration with classroom studies.

2.2: Defining the environmental crisis: Issues, debates and responses

Edward O. Wilson's quote, at the beginning of this chapter, paints a picture of the rapid increase of human population from eight million to seven billion people in just 15,000 years, suggesting this as the ultimate cause of the environmental crisis. Similarly, in *The Future of Life,* Wilson (2002) suggests that the exponential growth of human populations during the twentieth century has decimated natural environments and used natural resources to excess. As far back as November 1992, a document signed by 1,600 senior scientists from seventy different countries "World Scientists' Warning to Humanity", was released to inform the world's citizens of the environmental crisis, outlining the urgent issues in the atmosphere, water resources, oceans, forests, biodiversity and human overpopulation.

The warning states, many current human practices put at risk the future of humanity and all other life forms, which if not checked, so may alter the world that it can no longer sustain life in the manner we know (Suzuki, 1997). It is difficult to find a short definition that thoroughly defines environmental crisis, probably because the problems causing it are so many and so widespread. Names such as, Bhopal, Chernobyl and the *Exxon Valdez,* according to Suzuki, remind us of the scale of disasters humankind is capable of impacting on ecosystems and biodiversity. More recent additions to this list are, the 2010 *Deepwater Horizon Oil Rig Fire,* which destroyed whole ecosystems in the Gulf of Mexico, and the 2011 *Fukushima Nuclear Disaster,* resulting in a damaged reactor leaking radioactive waste into the ocean, which continues to this day.

In a biodiversity context, Wilson (2002) states that levels of extinctions of plants and animals around the world continue to rise, threatening ecosystem sustainability. Habitat destruction, invasive species, pollution, human population and overharvesting are the main causes of biodiversity loss around the globe (2002). With 1.2 billion cars, some 80,000 passenger jet flights every day, and powering societies with polluting coal energy, we have filled our atmosphere with chemical by-products that are changing our climate, threatening the sustainability of ecological and biological systems on earth (Flannery, 2005).

In a later book, *The Creation,* Wilson (2006) contends that if all these environmental crises (collectively known as 'climate change') go unabated until 2050, up to a quarter of all plants and animals currently on earth could become extinct. Others in the scientific community (Flannery, 2005; Lovelock, 2006; McKibben, 2010) have predicted equally serious consequences of climate change like melting polar ice, rising sea levels, ocean acidification, increasing storm intensity and extreme weather patterns around the globe.

A conglomerate of interrelated environmental problems, caused by humanity, has culminated in an environmental crisis (May, 1972), which is currently dominated by climate change. It has been 45 years since May (1972) warned us of the consequences of rising human population, and more than two decades since Orr (1995) questioned universities and colleges' response to the environmental crisis, arguing academics, had underestimated the gravity of the crisis and avoided confronting it. Encouraging educators and educational institutions to rise to the challenge of acting on a key dimension of the environmental crisis, such as climate change, Orr raises important questions about the extent to which EfS might be practiced in schools, and how indeed, teachers can educate to create eco-literate citizens capable of living sustainably.

Through defining what current and future generations of people need to learn and do to avert the environmental crisis, Orr (1995) provides a challenging list of the environmental problems facing humanity. He argues, "future generations need to: stabilise greenhouse gases and world populations, rebuild and reorient economies to sustainable living by eliminating pollution and waste through recycling, conserve biodiversity, rainforests and soil, they must use only clean, renewable energy sources, whilst at the same time, repair the environmental damage done by 150 years of intense industrialisation" (p. 43). A recently published update of the 1992 article *World Scientists': Warning to Humanity*, which was signed by 1,600 scientists, *World Scientists' Warning to Humanity: A Second Notice,* is signed by 15,000 leading scientists who agree the environmental crisis is urgent (Ripple et al., 2017). An increasing number of scientists from around the world believe we must act now in all the ways we can to respond, in a new geophysical epoch named the Anthropocene which is claiming its formal recognition according to

Zalasiewicz, Williams, Steffen, and Crutzen (2010), for inclusion in the Geological Time Scale.

2.3: The Anthropocene

It was James Lovelock who proposed the Gaia theory in the 1970s, a theory which recognises Earth and all of its creatures as akin to a super-organism, where the animate and the inanimate interact to influence the forces of nature into a state of self-balance (Donahue, 2010). Donahue notes that the Gaia theory still has relevance in the age of the Anthropocene, a new epoch dominated by human kind (Monastersky, 2015). According to eminent scientist Edward O. Wilson (2017), the term Anthropocene was coined first in the 1980s and popularised by atmospheric chemist Paul Crutzon in 2000, in reference to a new geological phase in the Earth's history. This epoch is characterised by Somerville and Green (2015), as a space where human and natural forces have become so intertwined, one determines the fate of the other. For example, if we continue to overharvest fisheries, destroy marine ecosystems and ocean biodiversity around the globe, humanity will no longer be able to rely on the oceans as a stable food source in the future. For Wilson (2002), science and technology in large part brought us to this crisis, and now they must devise solutions that will help humanity through this emergency.

The Anthropocene presents challenges for education researchers according to Somerville (2017), who suggests the rise of post-humanist pedagogies focussing on humans as co-constituted with all other life forms and seeking to decentre human importance, offer new paradigms of thinking for educators. Multi-species and common world pedagogies have risen within these new paradigms as a way of responding to the co-joined issues of interspecies and intergenerational justice, within the context of education in the Anthropocene (Taylor & Pacini-Ketchabaw, 2015). Such pedagogies encourage us to acknowledge the importance of the other than human creatures in our common worlds, where nature and culture are integrated to promote embodied appreciation of the ways the more-than-human life forms and forces are co-shaped (2015). The authors' believe, such thinking may help children to enhance their connections and reciprocal relationships with

the natural world, thus de-emphasizing anthropocentric views of human as superior to and separate from nature.

The Anthropocene has according to Steffen et al. (2011), driven a need to consider effective planetary stewardship, where science defines boundaries for critical earth system processes in an attempt to maintain planetary stability, liveability and sustainability. For example, a boundary goal is set to restrict climate warming globally to less than two degrees Celsius by 2050. From post-humanist perspectives, Taylor and Pacini-Ketchabaw (2015) believe such views perpetuate anthropocentric views of humankind managing earth's resources and systems, as separate from nature and Godlike, where only science and technology are seen as capable of finding solutions to the multiple problems of the Anthropocene.

In writing about educational research in the Anthropocene, Somerville (2017) warns of the perils of advanced capitalism philosophy, which she believes promotes unsustainable materialism, consumption and separation between human culture and nature. Given the urgency and growing concern about the instability of earth's systems in Steffen et al. (2011) research, it is hard to imagine how we can transform our thinking totally using post-humanist paradigms as Somerville (2017) suggests, without also recognising that science and technology may offer solutions to problems like climate change.

Planetary stewardship can be undertaken for altruistic reasons and could be seen as a complimentary part of the eco-centric and post-humanist paradigms Somerville urges educators to examine during this new epoch. She sees the Anthropocene as a time for innovation and imagination in thinking, citing Einstein who suggested, " we cannot solve problems using the same kind of thinking that created them" (Nordic Environmental Social Science, 2013). The Anthropocene is provoking us to reorient the very ideologies that have driven advanced capitalism and the rise of human prosperity, however Cutter-Mackenzie (2009) believes we may have to adopt an eco-centric paradigm of thinking to move towards sustainable living.

The research reviewed so far argues that the environmental crises facing humanity in the Anthropocene, are so multifaceted and all encompassing that action needs

to be taken across all disciplines of knowledge, by ordinary people as well as through changes to government policy.

2.4: Understanding key terms and definitions in environmental and sustainability discourse

Given the context of this chapter, and more broadly the context of the thesis, this section sets out to define some of the key terms, definitions and movements that relate to the environmental crisis, and which underpin the study. The global terms Environmental Education (EE), Education for Sustainable Development (EfSD) and Education for Sustainability (EfS), all current and central to the thesis, are brought to light in the following discussion. Overlapping in considerable ways, they each belong to a direct imperative to address the state of the planet, and educate for a sustainable future.

2.4.1: Environmental education to education for sustainability

Debates about which terms are best used and applied in educational contexts to describe environmental learning are ongoing (Cutter-Mackenzie, 2009). In its most basic form EE includes learning 'in', 'about' and 'for' the environment, however a more recent framework suggests the purpose of EE is to: convey information, build understanding, improve skills and enable sustainable action (Monroe, Andrews, & Biedenweg, 2007). Many proponents of EE, the precursor to the terms EfSD and EfS, are resistant to these later terms. By way of example, Jickling and Wals (2008) advise, "Environmental Education is a well-established field that already examines the issues Education for Sustainable Development is supposed to examine." Criticisms of EE include its failure to teach children about basic economics and political processes. According to Elder (2003), the term EE can be indoctrinating, biased, based on disaster scenarios, with a propensity for advancing an anti-anthropocentric philosophy that humans are evil and destroying the world.

More broadly, EfSD is widely viewed across the contemporary literature as an improved version of EE, most visibly at national government policy levels

(Somerville & Green, 2015). Intensified concerns about climate change in 2005 caused some environmental educators to criticise the terms EfSD and EfS for focussing on economic development at the expense of the environment (Jickling & Wals, 2008). It is argued the term EfSD is contradictory and reflects Orwellian 'double think' by "comparing the sustaining of ecological processes with the sustaining of consumerism" (Jickling & Wals, 2008, p. 14). In this light, sustaining consumer growth and development can be perceived as contrary to sustaining the environment. Jickling and Wals conclude, stating that many people are conditioned to think sustainable development is essentially good, and they promote both simultaneously.

In Australia, governments have adapted the ideals and objectives of an EfSD approach to local conditions. In doing so, they have positioned education as a vehicle for change via practical actions for sustainability, and equipping people with the knowledge, skills and understanding to make decisions based on environmental, social and economic considerations of issues at local levels (Australian Government, 2009a). This movement has become known as Education for Sustainability (EfS).

While this thesis encompasses and straddles each of the EE, EfSD and EfS pillars, the term EfS is privileged throughout the thesis. The rationale for doing so is twofold: (a) it is based on the understanding that biodiversity and environment are interconnected with social and political considerations, and (b) it assumes that education should be transformative; in other words, an agent for change via action, as included in *Living Sustainably. The Australian Government's National Action Plan for Education for Sustainability* (2009b).

2.4.2: Biodiversity: definitions and other considerations

According to Steffen et al. (2011) in the 1950's, a 'Great Acceleration' in the speed of anthropogenic changes occurred as human population tripled, the world economy and trade skyrocketed, material consumption grew exponentially, the number of motor-vehicles multiplied and communications went into overdrive encompassing societies globally. With these factors driving urban sprawl, damming of rivers, over-harvesting of natural resources and habitat destruction

for agriculture, pressure on the vastly unknown biodiversity that sustains us began to increase (Wilson, 2002).In terms of how biodiversity is understood in this thesis, I turn to Wilson's definition of the biosphere:

> The totality of life, known as the biosphere to scientists and creation to theologians, is a membrane of organisms wrapped around Earth so thin it cannot be seen edgewise from a space shuttle, yet so internally complex that most species composing it remain undiscovered (Wilson, 2002, p. 3).

The term biodiversity was promoted by Paul Erlich and Thomas Lovejoy in the 1970s, who used biodiversity as a focal point from which to study a wide range of environmental issues from climate change to forest management (Stewart, 2011). Erlich and Lovejoy's definitions of biodiversity included the interactions between life and the interdependent cycles, processes and systems, which regulate the health of our planet's environment.

In general terms, biodiversity includes all animals plants, fungi, fish, humans and algae as well as all other living things within a biota or an ecosystem that provide humanity with medicines, materials for building, clothing, the soil for plants to grow, food and creates the very air we breath (Wilson, 1994a). In earlier work Wilson (1987) noted that, a large part of what we know as biodiversity consists of invertebrate life forms which he called "the little things that run the world" (p. 344), i.e. insects which pollinate the food plants we depend on for life. Elsewhere, biodiversity has been described in terms of the number of entities (e.g. how many genotypes, species, or ecosystems), their distribution, differences, functional traits, and their interactions (Lindemann-Matthies & Bose, 2008). Another definition by Wilcox (1982) suggests that biological diversity "is the variety of life forms... at all levels of biological systems (i.e., molecular, organismic, population, species and ecosystem)" (p. 639). A speeding up of Anthropogenic changes on Earth signal a bleak future for biodiversity and ecosystem health around the globe. The need to educate citizens, of the roles biodiversity plays in ecological and planetary sustainability, is gaining urgency.

2.4.2.1: *Biodiversity under threat*

Keeping the definitions of biodiversity above in mind, the wider body of research suggests that biodiversity is under threat (Wilson, 1994a). For example, Environment Australia (1998) highlights the extent to which threatened species are affected in Australia: five per cent of higher plants, sixteen per cent of amphibians, seven per cent of reptiles, nine per cent of freshwater fish, nine per cent of birds, and twenty-three per cent of marsupials are either vulnerable, threatened or extinct. Between 1950 and 2000, species extinctions rates have risen from around 5,000 to 30,000 extinct species (Steffen et al., 2011). Such numbers were calculated using a contrived mathematical formula and are probably vast underestimates of the real number of species extinctions, however what the variety of graphical data used in Steffen et al. review of research shows is, like many other human environmental impacts, like CO^2 levels in Earth's atmosphere and biodiversity extinction rates, have risen sharply since the 1950s.

The number of threatened, vulnerable and extinct species has continued to trend upwards in Australia between 1998 and 2016 (Cresswell & Murphy, 2017), however more accurate measurements of extinct and threatened species are limited by an inadequate amount of data, research and our limited knowledge.

2.4.2.2: *Our limited knowledge of biodiversity*

In *Letters to a Young Scientist,* Wilson (2013) details that over time and up until 2009, 1.9 million species had been given Latinised names, but a realistic estimate of the total number of species is 10 million. Wilson qualified these figures, noting that they do not include single-celled bacteria or Achaea, which are the least known of all organisms. If included, the number of different species on Earth is estimated to be around 100 million. Based on these figures, only two per cent of earth's species have been named, which raises the question: How can we know extinction rates if only a miniscule number of life forms have been identified?

Research exploring public understanding of the term biodiversity in Switzerland found that 60 per cent of surveyed participants had never heard of the term biodiversity (Lindemann-Matthies & Bose, 2008). According to other theorists, as a general population, our knowledge of biodiversity and eco-literacy is

questionable (Orr, 1992; Stewart, 2006; Theiss, 2009). A recent government survey in NSW (Office of Environment and Heritage, 2017), found that only 30 per cent of the respondents surveyed could demonstrate an understanding of the term biodiversity. Similarly, a study investigating knowledge of local biodiversity found student knowledge was minimal, with students more likely to value and want to conserve virtual exotic creatures like Pandas, as compared to local creatures (Ballouard, Brischoux, & Bonnet, 2011).

The reviewed literature indicates that human understanding e.g. knowledge, attitudes and taking actions for the environment, relating to biological diversity, are low and need to improve. With these considerations in mind, Wilson argues that limitations of knowledge are not a reason to presuppose we can disregard the consequences of declining biological diversity. In his words:

> Because scientists have yet to put names on most kinds of organisms, and because they entertain only a vague idea of how ecosystems work, it is reckless to suppose that biological diversity can be diminished indefinitely without threatening humanity itself (1994a, p. 331).

Understanding biodiversity has a role to play in helping to conserve the ecological systems on which our existence depends. Biodiversity surely must be considered one of the great subjects and quests of human knowledge and learning, particularly when we reconsider Wilson's (2013) proposition that we have only named two per cent of the 100 million life-forms estimated to exist on Earth. How biodiversity can be framed in educational terms, namely through biodiversity education, is explored more fully in Chapter Three.

2.4.3: Eco-literacy and its contribution to the environmental crisis?

Another key term within environmental discourse is eco-literacy, which has been defined as including attributes of knowing, caring and having practical competence in understanding how people and societies interact with the natural world, and how they might continue to do so sustainably in the future (Orr, 1992). There has been ongoing debate about eco-literacy definitions, some of which have received criticism for being too vague (McBride, Brewer, Berkowitz, & Borrie, 2013). In their investigation of the history, definitions and uses of the term eco-

literacy, McBride et al. address this inconsistency by suggesting that all frameworks for eco-literacy should include knowledge of four domains of environmental learning: basic ecological concepts, environmental sensitivity or appreciation, awareness of environmental issues and problems, and skills and behaviours to prevent and/or resolve those issues.

Building on the McBride et al. framework for assessing eco-literacy, Hollweg et al. (2011) provide a model that lists five essential domains of eco-literacy: **knowledge** and understanding of environmental concepts, problems and issues, **dispositions** like attitudes, motivation and concerns, **competencies** such as investigating issues, questioning and using evidence to form solutions for problems, **environmentally responsive behaviour** involving working as a member of a group to solve current and prevent future environmental problems, and finally, **contexts** including personal, social, physical and political (p. 3-1).

In the field, all students become observers of nature and look at life through a range of lenses. According to Stewart and Müller (2009), it is these observations and hypotheses that can lead to higher levels of eco-literacy. Recent research in the field of environmental education has identified building an ecologically literate population as the main goal for EfS (Cutter-Mackenzie, 2009; McBride et al., 2013). Similarly, Wooltorton (2006) contends that direct engagement with nature is an important part of eco-literacy. He argues, "developing eco-literacy will be vital in achieving advanced curriculum outcomes in social, environmental, scientific and critical literacy areas" (p. 26). Building on this contention, Cutter-Mackenzie (2003) suggests that ecological literacy is the missing paradigm in EfS. She concludes that many primary school teachers in Queensland have low levels of eco-literacy, suggesting this pattern is likely to be reflective across a wider Australian context.

According to Nicholls (2010), one of the main purposes of EfS, is to build environmental or eco-literacy, but he states our education systems are failing to adequately address low eco-literacy at all levels. Nicholls believes a growing ignorance of basic ecological connections contributes to poor decisions that jeopardise sustainability and the quality of life for all things.

The research literature discussed here strongly supports the proposition that the development of eco-literacy is a major aim of EfS. Part of eco-literacy is developing student environmental appreciation and sensitivity (McBride et al., 2013), which can also be thought of as developing the connections nature. Many people believe such connections have been eroded during the Anthropocene, a period in which we have replaced forests with cities.

2.5: The urban dilemma and children's detachment from nature: From parking lot to paradise

A key element of the environmental crisis debate is concerned with the increasing detachment of humans from the natural world, which some argue has resulted in a lack of knowledge, understanding and care for our biosphere (Nicholls, 2010). According to Orr (1994b), the expansion of human population and growth are significant causes of detachment from nature, and has led to the majority of Earth's population living in cities.

In the evolution of modern humans, it has taken 100,000 years to reach a population of one billion, and another two hundred years to reach seven billion (Wilson, 2002). Nicholls (2010) suggests that such rapid human population growth and urbanisation has not only increased pressures on ecosystems, but has led to a human disconnect from the environment, which has resulted in a lack of ecological knowledge and care for our biosphere.

Wilson's (2002) inference that rates of urbanisation are a contributing factor in human disconnection from nature is supported by population data from around the world. For example, Japan has around 80 per cent of their population living around major cities and towns (Barrett, Abe, Harako, & Ishikawa, 2002), and 80 per cent of the current United States population are also urban dwellers (Malkus & Meinhold, 2002). In an Australian context, government census data suggests that " … 66 per cent of the population … reside in greater capital cities" (Australian Bureau of Statistics, 2013, para. 8).

Thus with much of the world's populations being urbanised, our connections to nature have diminished. Living in urbanised places means humans no longer directly rely on the natural environments around them to hunt or gather food and

medicines (as our ancestors did) (Wilson, 2006). As a consequence of no longer being directly connected with natural environments, we have become detached from our 'original cradle', which Wilson describes as the land itself (2006). According to Orr, existing research recognises the critical effects of detachment from nature, which can lead to a lack of knowledge, concern, understanding and care for our environment (Orr, 1994b).

In his article, *Leave No Child Inside*, Louv (2007) argues that detachment from nature is not solely to do with urbanisation. He claims urban and rural parents cite television, computer, traffic, stranger danger and disappearing access to natural areas as reasons their children spend less time in nature than they did as children. Louv infers that disconnection from the environment is an issue for urban, suburban and rural populations alike, and therefore not exclusive to urbanised contexts.

Similarly, Gill (2007) argues that disconnection from nature is exacerbated by risk averse societies, which has led to childhood experiences previous generations of children enjoyed without question, now being considered reckless. One of Gill's main contentions is that overstating risk and liability issues have resulted in declining opportunities for children to have experiences in natural environments.

To advance human-nature connections, Sobel (2008) appeals for the establishment of more natural places where children can feel a sense of discovery and freedom to explore. This might involve building more urban parks and green spaces (Orr, 1994b), visiting regional landscapes (Semken & Butler, 2008), or possible expeditions into to more remote landscapes in order to develop field science skills and raise young people's environmental awareness (Stott, 2010). Despite the limited range of open habitat areas in large cities, and in urban contexts more generally, the contributions of urban agriculture, greening projects and human-made park lands assist in providing nature-based contexts for children's learning (Russ & Krasny, 2017). In particular, gardening habitats in public gardens and school grounds afford outstanding opportunities for children's engagement with ecological systems, processes and wildlife (Green, 2011). Other research (Bowker & Tearle, 2007) shows that gardens have positive impacts "on children's confidence, self-esteem, attitudes and learning."

In addition to these sites, informal education environments such as museums, sports centres, botanic gardens, environment centres, zoos, nature centres, aquariums etc., have been advanced as important contexts that develop children's eco-literacy (Bozdogan, 2012). It has been suggested that schools have often reinforced the growing gap between nature and children, which according to Louv (2009), has implications for learning and health, and is a result of declining opportunities for school visits to local 'outdoor' places. Louv states that such places provide examples of more natural ecosystems to study and foster a love of natural ecosystems.

Including more natural ecosystems in environmental field studies is important for urbanised students, few of whom perceive nature as a place for learning (Wals, 1994). Some students believe the contrast between urban and rural landscapes best illustrate the impacts of humans on the natural world. In reality, students are really comparing built-up urban environments to non-built-up rural areas, which they perceive as more natural environments. In reality, many rural landscapes in Australia have been massively altered by agriculture, forestry and mining in the last 150 years.

According to Orr (1994b) and Wilson (2006), experiences in both urban and rural contexts are relevant and necessary in helping humans to connect with the natural world. To do this we need to make choices about the contexts and opportunities we provide to help connect children with nature (Orr, 2000). A part of this is feeling connected with the non-human world, a feeling referred to as biophilia, which is explored more fully in the following section.

2.6: Biophobia and biophilia: Correlations to reconnecting with nature

In what follows, I investigate the opposing forces of biophobia and biophilia, including their correlation to, and implication for, EfS and the environmental crisis. These two opposing forces may have a significant influence on whether people feel connected with or disconnected from the natural world.

2.6.1: Biophobia

In his journal article *The coming biophilia revolution,* Orr (1994a) defines biophobia simply as "the culturally acquired urge to affiliate with technology, human artefacts, and society with human interests regarding the natural world" (p. 38). According to Orr, the word biophobia broadly includes "those who regard nature 'objectively' as nothing more than 'resources' to be used any way the favoured among the present generation see fit" (p. 38). Orr's claims imply biophobia is linked with growing urbanisation and technology, and that some societal values and norms encourage it. Furthermore, conservation biologists such as Simaika and Samways (2010), believe that biophobia is genetic in humans: our human ancestors needed to fear certain creatures (e.g. spiders, snakes, crocodiles etc.) for safety and survival, so biophobia is therefore a naturally inherited instinct, fixed in the human genome.

According to Matthews (2013), biophobia refers to (1) fear of parts of the biological world like paranoia about snakebite or shark attack, or (2) fear of ecological problems. Orr (1994b) contends that, a fear or aversion to nature is common amongst generations growing up with access to all kinds of digital technology and media, and living in urban and suburban environments where nature is permitted as 'controlled decoration'. Orr's line of thinking suggests that green spaces in urban environments are controlled and small in comparison to the scale of built-up spaces where nature has been mostly replaced by cement.

Through our human need to control our environment, we choose which creatures we will exclude from our homes, gardens and farms, having developed an impressive array of weaponry like pesticides to help. People routinely kill spiders, cockroaches and other creatures for various reasons, which are sometimes caused by phobias or fear of fauna. According to Wagener and Zettle (2011), there are ways of countering such phobias. For example, an Information Based Approach (IBA) to therapy for arachnophobia is based on the rationale that "one thing that can help alleviate and ease your anxiety and fears about spiders is to gain as much information and knowledge about arachnids as possible" (p. 82). The authors conclude that an Acceptance Based Approach (ABA) to the psychology of dealing with phobias such as arachnophobia shows more promise than other approaches in

helping people to cope with them. Furthermore, an ABA approach shifts the emphasis towards the ways in which people relate to unwanted experiences (2011), which will be crucial when dealing with issues of environmental crisis.

Biophobia can also take the form of people being scared by the weight and complexity of ecological problems, including pressure to solve such problems. Banavage (2013) suggests that creating feelings of fear or hopelessness can cause people to turn off from wanting to participate in environmental action because the gravity of environmental problems seems overwhelming, "We cannot motivate with fear" (p. 1). Along similar lines, Sobel (2008, p.147) also contends that: "Fear and anxiety of environmental problems have the potential to turn environmental education into a counter-productive activity". Sobel (2008) goes on to argue that an overemphasis on problems and disaster scenarios leads to students who, fear the natural world, are overwhelmed by the environmental crisis, and turn off thinking about it to avoid such feelings.

As biophobia can include concerns about complicated and wide reaching international issues like climate change, Banavage (2013) and McKnight (2010) and Sobel (2008) all caution care when introducing such concepts to young children. This notion is supported by other researchers, (see for example White & Stoecklin, 2006), who suggest we ought to be aware biophobia in children can increase if young students are introduced to ecological problems they are not developmentally ready to understand, or psychologically ready to deal with, without becoming fearful.

In line with these concerns, the field of EE has been criticised for emphasising disaster scenarios (Elder, 2003), which can result in feelings of fear and biophobia in students. A similar view is held by Mueller (2009), who believes the 'environmental crisis' is not scientifically conclusive and that "… when opportunity rather than fear begins to fuel eco-justice and environmentalism in schools, education is much more likely to become a force for responsibility and activism" (p. 1050). While there is merit in Mueller's belief that environmentalism or ecological sciences approach to EfS presents a hopeful view of the world to encourage less fear and more positive action, one shortcoming of this way of thinking is that it can understate the reality of the world's 'environmental crisis' and the pressing urgency of 'climate change' which is

becoming more scientifically conclusive as time goes by. According to the Australian Academy of Sciences report *The Science of Climate Change: Questions and Answers* (2014), if we do not change our ways and reduce CO^2 emission levels in our atmosphere, by 2100 global average temperatures may increase by three to six degrees Celsius, which could be catastrophic for biodiversity, including humans.

Biophobia or ecophobia (refers to ecological phobia and is used as a synonym of biophobia) in adult populations may prove to be a stumbling block to engaging the general community in environmentally responsive behaviour (Sobel, 2008). He asks the important question: If adults are negatively affected by environmental tragedies and challenged in dealing with information overload and complex issues, how might children respond? Such a question compels us to consider the role adults play in shaping children's thoughts, perceptions, environmental beliefs and behaviours. Furthermore, he argues that educators need to critically engage with environmental problems that are age appropriate for students so they do not create feelings of hopelessness and biophobia, while also emphasising that environmental dilemmas can no longer be ignored (Sobel, 2008). Biophobia or fear of environmental crisis like climate change, is a recent phenomenon in human history and so is probably not genetically imprinted in the human genome as Simaika and Samways (2010) suggest phobias of animals are.

The evidence of this review suggests there is a need to carefully and sensitively address issues like climate change and biophobia, for some predictions about our environmental future can be truly scary. Some scientists have predicted a confronting future: "Imagine we live on a planet. Not our cosy taken for granted earth, but a planet, a real one, with melting poles and dying forests and a heaving corrosive sea, raked by winds, strafed by storms, scorched by heat" (McKibben, 2010, p. 1). Such predictions can also be viewed as McKibben (2010) contends, as a motivator for global human action to address issues of environmental crisis.

It is cautioned by a range of researchers (Banavage, 2013; Elder, 2003; McKnight, 2010; Sobel, 2008; White & Stoecklin, 2006), that educators sensitively and developmentally incorporate environmental issues like climate change into their teaching with children so as to avoid counter-productive effects of fear and

hopelessness in the face of some confronting predictions of Earth's future. Biophobia, the research suggests, is a barrier to building connections with biodiversity and Earth.

2.6.2: Biophilia

In contrast to the term biophobia is biophilia, a term first used by Fromm (1964) to describe a psychological orientation of being attracted to all living things, or the passionate love of all life (as cited in Orr, 1994b). More recently, the term has been redefined by Wilson (1984) as the human propensity to affiliate with other life forms. Although Wilson believes biophilia to be innate, some conservation biologists dispute this hypothesis (Simaika & Samways, 2010). Regardless of whether biophilia is innate or not, Banavage (2013) has argued that people simply fear the unknown. He goes on to suggest that developing 'biophilia' rather than 'biophobia' is one way we can help people connect with nature.

According to McKnight (2010), there are particular ways to encourage children to avoid fear of environmental problems. McKnight (p. 10) cites Sobel's (1996) book *Beyond Ecophobia,* which argues that an effective way to engage children in environmental education and avoid ecophobia is to build children's interest and fascination with local biodiversity, so they can experience natural systems as living and dynamic. Sobel refers to Finger's (1993) study, which recommends that experiences 'in' nature are a necessary condition for developing biophilia and eco-literacy. Properly cultivated and validated by caring and knowledgeable adults, fascination with nature can mature into ecological literacy, which young people may continue to develop over their lives (Orr, 2000). Orr goes on to state the imperative of choosing between biophobia and biophilia, suggesting that science and technology have given us the power and knowledge to dominate, and even destroy our natural world.

Indigenous peoples' cultures around the world often focus on core aspects of biophilia; spiritual and cultural interconnectedness with the environment, use of art and mythology in cultural story constructions of local places, and direct experience with nature as a foundation (Cajete, 1999). Moreover, it is asserted by Lowan (2009), that we have much to learn from indigenous ways about educating

and knowledge of country as a way to build biophilia. According to Paton and Brearley (2009), Australian Aboriginal cultural knowledge goes beyond humans to include animals, the physical and spiritual worlds, as well as Earth's plants, cycles and stories. They suggest Aboriginal ways of being are to create respectful and reciprocal relationships with their elders and the land, where sharing knowledge is central. In both Australia and globally, Indigenous knowledge challenges the separation of culture and nature in Western thought (Somerville, 2015), suggesting the benefits of embodied learning where physical, cultural and spiritual perspectives are significantly represented in student learning, to develop biophilia.

We are at a point where we need to consciously choose to develop biophilia as a way to reconnect with nature (Orr, 2000). According to my review, an effective way of encouraging connections with nature is to go into the field to interact with biodiversity in local places (McKnight, 2010). This review further suggested that educators listen to and be guided by indigenous ways of connecting nature and culture to develop biophilia. Ironically, we are at a point where ancient knowledge and our primal instincts to affiliate with biodiversity are seen as ways to reconnect with nature, and yet we are so engulfed in the modernity of the digital age.

2.7: The digital world and its contribution to environmental learning

In addition to the considerations for environmental learning discussed thus far is the digital world, which has positive and negative implications for children's connection to the natural world (Louv, 2011). As Louv (2011) and Moseley, Herber, Brooks, and Schwarz (2010) suggest, digital learning presents us with the potential to both disconnect from, and connect to, the natural world. As a source of environmental information, a platform for sharing learning or for being environmentally active in social media, the digital world is a powerhouse of potential learning tools that might support the development of eco-literacy, and for connecting field experiences and classroom studies.

As the literature suggests, mobile digital technology is already being used to augment environmental learning in the field (Kravcik, Kaibel, Specht, & Terrenghi, 2004; Rogers et al., 2005), as highlighted in a study investigating the

use of mobile devices to collect data in the field and connect with classroom locations in real time (Kravcik et al., 2004). Digital software can even be used to go on a virtual field trip (Spicer & Stratford, 2001), however this presents some concern for those who believe in the need to visit real places to connect with nature.

In a review of different forms of ICT that have been used in EE, Fauville, Lantz-Andersson, and Säljö (2014) found that although game based learning like the Virtual Museum motivate students, however they can present ICT challenges for under-skilled teachers. A similar study comparing control and experimental groups of year six students trialling the E-Junior application (a virtual marine habitats simulation game) at the "*L'Oceanogràfic*" in Valencia, Spain, found no differences in learning performance between the control, who experienced traditional instruction, and the experimental group who played E-Junior (Wrzesien & Raya, 2010). The authors speculate that the novelty of using virtual tools and new virtual experiences distracted the small student sample from learning the information intended by the game design. Further, they found E-Junior engaged students, except for parts that involved long lecture style segments via an animated character in the game, which students considered too long and boring. It is however according to Fauville et al. (2014), through the implementation of ICT in EfS practice that students have access to a whole new range of digital tools never previously accessible, to develop environmental literacy.

Along similar lines, another study (Banavage, 2013), intimates that changes in a vastly urbanised and digitised world are forcing us to consider ways to help populations connect or reconnect with our natural world. There are also those who argue children should be kept away from TV and digital media (P. Edgar, 2009). However, as D. Edgar (2008) advises, trying to stop children engaging with digital technology and media is like "spitting into the wind" (p. 1). Embracing these considerations, Louv (2011) refers to a modern 'hybrid' human who is connected to both the digital world and the natural world in a balanced way. According to Louv, this view reflects a growing belief that the digital world presents serious contradictions for EfS in that, while it has potential to detach people from real experiences in nature, it also presents opportunities to engage in an exciting multi-media world for researching, sharing information and

integrating disciplines in ways that enhance environmental and sustainability learning.

More than half of all people on earth are Internet users ("Internet World Stats: Usuage and Population Statistics," 2017), which provides enormous capacity for sharing information. This growth of Internet users globally, will inevitably result in it becoming an important source of environmental information for students. In a study of the sources of environmental information, 45 per cent of Australian students surveyed indicated that television was the most important source. Significantly they considered its reliability lower than other sources like non-government organisations (Fien, Yencken, & Sykes, 2002). In Japan, 49 per cent of 15-16 year old students surveyed about their sources of environmental information in a similar study by Barrett et al. (2002), considered television as their most important place to get information.

Collectively these studies speak to the powerful role media plays as a knowledge source, including television, and the increasing impact and availability of digital media such as YouTube, as sources for information (D. Edgar, 2008). Almost a decade ago, studies reported television as the most-important media source used by children for gathering environmental information, but since then digital technology and online access has advanced exponentially. Social networking platforms like Facebook, blogs, E-mails and chat rooms for example, are now heavily used by a vast range of individuals and groups for communication, information gathering and sharing (Moseley et al., 2010), and it is possible now to engage in environmental action online.

In a similar vein has come the rise of online service learning in EfS research (2010), which purports that the online course a small number of pre-service teachers (3) completed in this study, provided experiences in three of the four tenets of eco-literacy: awareness, knowledge and problem solving/action strategy skills. The fourth tenet of eco-literacy, taking real action was not conclusively evidenced in the study, and all of the participants agreed the online EfS course lacked authentic direct experiences in outdoor places. Another perceived benefit of online service learning is the social-constructivist nature of learning experienced by students (2010), which provides participants the opportunity to

network and share learning with course facilitators and peers using social media tools.

The age of the mouse-pad activist has truly arrived and this has implications for EfS. As many of the studies highlighted thus far suggest, there are a range of causes for and effects of nature detachment, namely urbanisation, fear, phobias and the ever-growing influence of our digital world.

A common thread throughout the literature suggests, experiences in local places provide a bridge, for reconnecting people with nature, between the urbanised/digital world and the natural world (Louv, 2011). The digital world presents many opportunities for enhancing field and environmental learning, providing a new 'place' as a context for learning, whilst at the same time the cyber world can be a place where people become detached from 'real' places by spending too much time online (Fauville et al., 2014; Louv, 2011). In EfS, the purpose for using digital tools is to support environmental learning and the development of eco-literacy. Fauville et al. (2014) argue in most cases it seems reasonable that complementarity between ICT, traditional classroom instruction and field experiences offer a better way forward than seeing ICT as in opposition to them.

Further, it is not envisioned visiting real places for EfS would be replaced by digital learning alone (Fauville et al., 2014; Spicer & Stratford, 2001), as the complexity of real ecological interactions are difficult to reproduce accurately in virtual environments. In supporting the notion that experiences in real habitats are an essential aspect of contemporary EfS and EE, it may serve us well to look into our past to investigate how people made connections with the natural world prior to the digital revolution and virtual reality.

2.8: The nature writers: naturalist perspectives for learning

The American nature writers played a unique part in the development of modern environmentalism, and did so through their intimate writing about their everyday experiences in the north American wilderness (McBride et al., 2013). Their reflective practice may hold useful insights into how children's environmental learning and ecological literacy might be advanced through reflections and

observations about local places. In his famous 1949 book, *A Sand County Almanac,* naturalist Aldo Leopold describes his rising concern about the impacts of human tourism on wilderness areas around the globe stating humanity has "poured into his gas tanks the stored motivity of countless creatures aspiring through the ages to wiggle to pastures anew. Ant-like he swarms the continent" (Leopold, 1949, p. 166). In hindsight, Leopold's words can be interpreted as predicting the oncoming environmental crisis we confront today.

References to nature can be found in ancient texts like The Hebrew Bible, the Tao Te Ching and the Bhaghadvita. However, the "nature writing" tradition can be traced to English curate Gilbert White's book *Natural History of Selbourne,* published in 1789 (Armbruster, 2016). Armbruster explains that following White's tradition, "nature writing" generally includes blending lyricism with scientific facts or observations of nature, which incorporate reflective and philosophical perspectives of human impacts on ecosystems. The great North American nature writers Aldo Leopold (1887-1948) and Henry Thoreau (1817-1862) for example, both loved the special places they inhabited: Walden Pond for Thoreau and the sand country of Wisconsin for Leopold. Through their experiences and discoveries in place, they built a deep understanding of, and affinity with, the natural world and shared their reflections through writing. Leopold (1949) argued, any experience reminding us of our dependence on food chains and the biosphere is valuable.

Currently, our society continues to hold the values of naturalists in high esteem. By way of example, it was Wilson (2006) who said:

> To be a naturalist is… an honourable state of mind. Those who have expressed its value and protected living Nature are among America's heroes: John James Audubon, Henry David Thoreau, John Muir, Theodore Roosevelt, William Beebe, Aldo Leopold, Rachel Carson, Roger Tory Peterson (p. 140).

Elements of nature writing evolved in the early days of conquest and colonisation. One of the earliest recognised nature writers, pioneer naturalist William Bartram (1739-1823), wrote about and recorded flora, fauna and his observations of American Indian tribes, in patronising ways. More recent writers such as Edward

O. Wilson, Jane Goodall, David Suzuki and David Attenborough are all contributors in the natural history genre and are, as Stewart and Müller (2009) describe, key and inspiring naturalists. Their work observes, records, reflects and shares knowledge of the ways biodiversity and ecosystems are interconnected, threats to them, their relationships to humans, and even the very future of life itself (Wilson, 2002).

Criticisms of the American nature writing tradition point toward its association with privileged classes, of mainly white men escaping from the limitations of society, into the wilderness, seeking enlightenment (Armbruster, 2016). Further to this, Armbruster suggests traditional nature writing has been called parochial and regional, which does not account for urban environmental perspectives and contexts in which the majority of people live. Armbruster states that an overarching concern of traditional based nature writing is that it reinforces a separation between culture and nature, which is a root cause at the heart of environmental crises.

Significantly, a nature writing philosophy is also present in Native American Indian and indigenous cultures around the world, which offers a different perspective to Anglo-European traditions of nature writing (Schweninger, 1993). For example, in a well-known story by American Indian writer, Leslie Silko, a fictional character named Tayo becomes the spokesperson for the naturalist's lament about the separation between man and nature (1993), which is also a key theme in works of Aldo Leopold, Edward O. Wilson and Jane Goodall. Both Anglo-European and indigenous nature writers lament the growing separation between humans and our environment.

Works by naturalists often include an element of discovery, as indicated by (Wilson, 2013), who acknowledges those biologists who set out to find new species to be among earth's great explorers. In her literature review about Geography field work in the USA, O'Loughlin (1997) argues that our task as teachers is to evoke in our students, the spirit of the traveller. Environmental expeditions are being undertaken today and the tradition of adventure is alive:

> On March 26, 2012, National Geographic Explorer-in-Residence, James Cameron, succeeded in tackling his biggest challenge ever - a solo journey

> to Challenger Deep, the deepest known point in the ocean. Challenger Deep is 10.99 kilometres (6.83 miles) deep and is found at the southern end of the Mariana Trench near Guam (National Geographic Society, 2012).

In an environmental sense, educators seek to invoke in students the spirit of the naturalist, who gains a sense of adventure, potential discovery and pleasure from exploring the biodiversity and natural world around them.

The quest for discovery and seeing the world through the eyes of a naturalist may help build the global environmental ethic we will need to live sustainably (Wilson, 2002). Role models such as teachers may be important in building such an ethic. These ideas underpinned earlier research that investigated the personal actions and pro-environmental behaviours of students (Chawla & Flanders-Cushing, 2007). A key finding in this particular research was the importance of role models for encouraging pro-environmentally aware, knowledgeable and active students. For the modern "nature writers" like Jane Goodall, who has spent 55 years in the Gombe Stream National Park in Tanzania studying chimpanzees, the field becomes a significant place that inspires discovery, stories and other values, a notion that is taken up next.

2.9: The value of being in the field: Implications for environmental learning

My research situates 'the field' as a central element of environmental learning. In what follows, literature pertaining to the educational value of field experiences across a range of learning domains and disciplines is investigated.

Fieldwork involves experiences outside the classroom, in a variety of settings: wetlands, state forests, gardens, zoos and museums. Within the great diversity of out-of-school learning environments, field trips in nature are different from museum, planetarium or science centre visits because they provide direct experiences with wildlife and nature in less humanised habitats (Morag & Tal, 2012). This does not diminish the role and value of a variety of types of field experience, which Brandt (2013) suggests can involve long trips to completely new ecosystems or a walk outside the classroom door, experiencing local school grounds, in both urban and rural landscapes.

Gardens also constitute being in the field, and have been identified as communal places where stories of gardens, homes, food, family and places are generated and shared (Green, 2011). A review of the research literature about school gardens in the USA suggests that applied garden-based pedagogy can lead to improvements in students' test scores in science, social studies, math and thinking skills (Blair, 2009). Furthermore, engagement across a range of disciplines, in different field contexts, which involve 'hands on' experiential learning outside classrooms, are listed as major factors for improving student learning (Ballantyne et al., 2010; Carlson, 2008; Green, 2011; Zarmati, 2009).

In a study of 22 field trips facilitated by the same environmental organisation in Israel, Morag and Tal (2012) used a framework to assess field program planning, pedagogy and student learning outcomes. They interviewed 41 (9-12 year old) students and used trained field observers to assess the characteristics and learning outcomes of student experiences along environmental walking trails. In assessing student activity, Morag and Tal found that only 10 of the 22-field programs involved physical activity other than walking. They also found a majority of the student activities along the trails involved facilitator demonstrations and passive student learning, and only eight of the 22 programs assessed included substantial student activity.

Being 'in' the field does not guarantee active student learning, however field experiences are considered to be a critical component of effective EfS and the life-sciences curriculum (Lock & Tilling, 2002; Nundy, 1999; Rickinson et al., 2004). Field experience outcomes include a deepened and broadened understanding of the political, cultural, economic and aesthetic implications local environments have in our society and in our lives (Chawla & Flanders-Cushing, 2007; Wattchow & Brown, 2011).

Others have argued that fieldwork provides opportunity to study issues first hand, which can help students to build eco-literacy and an ethic of care for biodiversity conservation (Ballantyne & Packer, 2002; Barker, Slingsby, & Tilling, 2002). Other field trip benefits (as compared to learning in classrooms) include positive outcomes for students' long-term memory, reinforcing connections between the affective and cognitive domains of learning, improving students' environmental knowledge, and creating pro-environmental attitudes (J. Farmer, Knapp, &

Benton, 2007; Nundy, 1999, 2001). Some of the fieldwork examples provided this far speaks to the potential of field experiences as a breeding ground for future scientists and naturalists.

This is particularly important given that many students describe science as boring and irrelevant to their lives (Carlson, 2008). The students also value being able to have some choice or ownership of learning as part of their field experiences (Ballantyne & Packer, 2002; Lai, 1999), which has an increase on student engagement in science learning.

An aim of EfS is to encourage students to pursue careers and work opportunities created by new 'green' industries (Australian Government, 2010). In light of this, school field trips may have a part to play in motivating careers in science, a notion taken up by Knapp and Barrie (2001) and Louv (2011), who cite student field trip experiences as an influencing factor in career choices in science and engineering. In spite of this suggestion, the links between career choices in science and field experiences as a student are somewhat tenuous and not well supported in research generally.

Outdoor learning contexts can vary greatly, as the research at the beginning of this section details. Museums, zoos, wetland habitats and school-gardens can all provide benefits for developing student eco-literacy, however as Morag and Tal (2012) stated, field trips in outdoor places provide opportunities for direct and 'hands on' experiences in nature, which other field locations like zoos and museums cannot provide. The research reviewed in this chapter suggests that field learning improves student environmental knowledge, their pro-environmental attitudes and behaviours, and when real world problems are included students consider different environmental perspectives. Issues like active student engagement in field workshops, greater student ownership in learning tasks and the value of field experiences in the outdoors for affective domain learning, require further investigation.

2.10: Field day experiences and affective responses in children

Building on the definitions and value of field trips, this section examines how field experiences influence student learning in the affective domain. Following on

from Blooms 1956 taxonomy of educational objectives, the affective domain includes the manner in which we deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes (Evans, Ziaian, Sawyer, & Gillham, 2013). Including affective learning in the field could improve student feelings of connection with nature.

In a quasi-experimental study exploring 239, 6th grade students feelings of connectedness to the environment in Israel, Kossack and Bogner (2012) compared intervention and control groups using pre, post and long term post-field test results. The intervention group programs contained a mixture of class based and field learning in a nearby forest, whereas the control groups had no field experience. The intervention group spent one session of the program day in the field and two sessions in their classrooms, yet there was moderate growth in their feelings of connectedness to nature when compared with the control group in both medium and long-term test results. The short amount of time the intervention group students, in this study, spent in the field diminishes the certainty of the claim that field experiences alone account for improvements in student nature connectedness.

There may also be a need to improve teacher awareness of the importance of affective learning experiences to build student environment connections in field, classroom and curriculum contexts. A study of geography teachers in the Netherlands (Oost , De Vries, & Van der Schee, 2011), shows teachers perceive that the cognitive domain gets more attention than the affective domain in field learning. According to the authors of this study, the methods they used also reflect the dominance of quantitative rather than qualitative approaches in the Dutch education system. In concluding, the authors state affective environmental learning is less valued than cognitive learning in geography, which indicates a need for greater systemic recognition of the value of qualitative approaches for assessing and improving student environmental learning in the affective domain.

Indeed, one of the problems of measuring biophilia or connectedness to nature is that assessment of feelings or affective domain learning can be difficult (Lumber, Richardson, & Sheffield, 2017), which is probably reflected in a lack of affective learning outcomes in curriculum standards and assessment documents. Similarly, it was reported in a literature review of garden pedagogy (Blair, 2009), that

quantitative data is good for assessing content knowledge, however it is inadequate for assessing environmental attitudes and behaviours.

In a review of EE research literature published between 1999 and 2010, which focused on EE programs for youth (18 years or younger), Stern, Powell, and Hill (2014) found out of the 66 articles they reviewed, the authors of nine studies believe the emotional connections students made in the field, like interactions with animals, were the primary drivers of all measured student environmental learning. In conclusion (2014), it is suggested the absence of affective domain as a central concept of study in EE literature, indicates a lack of clear focus on the importance of affective learning in program design and environmental learning.

There is a growing body of literature that recognises the importance of learning in local field habitats, such as the work of Sobel (2005) and Somerville (2010) who suggests local, place-based education helps students to develop ties to community and an appreciation for natural places. According to a case study exploring a sixteen year old girl's (Cara) experiences of learning in nature about the importance of bogs as ecosystems, Brody (2005) explains Cara's feelings and affective connections to place were derived from her experiences in the bog, which were developed and extended over a period of time through reflective study.

Wattchow and Brown (2011) question the power of single-day field trips for developing feelings and connections with our environment and they caution overemphasising the value of them for developing connections with place. They argue, focusing on one-day trips over multiple visits risks not fostering the development of deep connections to place. In fact it has been shown that single-day and multiple visits are helpful, encouraging students to become more knowledgeable and informed, and to develop more caring attitudes towards those places (Ballantyne & Packer, 2002; Chawla & Duffin, 2005; Pfeiler, 2007). By way of example, in a study comparing groups of students who attended a half day field program on two occasions at a nature centre, where one group studied ecology, and the other environmental issues, Knapp and Barrie (2001) found that via pre- and post-trip tests of each visit, students made gains in their knowledge of ecology and environmental issues.

Comparing the outcomes of one and two day field trips to a forest school in the U.S.A. involving second grade students, Powers (2004) found that both groups improved their knowledge of factual information, however there was a greater increase in positive attitudes for the students who had attended the two day program. Although the sample number of pre- and post-test participants was significant (132 students) in this mixed-methods study, one of the limitations of the study was the small numbers of teachers (7) and students (32) interviewed.

Deep connections with place, it could be argued, may only be truly gained by living in a place for long periods of time. In saying this, our individual paths and journeys are made from many experiences, and each should be valued. A mixed-methods study exploring pathways for improving nature connections (Lumber et al., 2017), found contact, emotion, meaning, compassion and the beauty of nature are pathways for improving human/nature connectedness, however traditional knowledge and identification of biodiversity had no influence on improving connectedness.

Some people believe care for the environment could be taught as a form of love, which Suzuki (1997) believes is akin to love of family. As contended by Aldo Leopold, "It is inconceivable that an ethical relation to land can exist without love, respect and admiration for her" (1949, p. 223), a point which explains why purposefully teaching respect or love for the environment is educationally important. It is widely agreed we have to consciously teach 'Love' for our environment (Cook, 2008; Orr, 1992, 1994b; Sobel, 2008; Waite, 2011), which has ramifications for teachers, many of whom will need to define their own environmental beliefs in order to do so (Cutter-Mackenzie & Smith, 2003). By including love or respect as part of environmental learning, we are endeavouring to integrate cognitive, physical, social and emotional experiences, as "knowledge accompanied by pleasurable emotion stays with us" (Wilson, 2006, p. 127). Including affective and emotional learning experiences in field day programs improves students' pro-environmental behaviours (J. Farmer et al., 2007). When local environmental issues are studied in 'hands on' ways, in outdoor field settings over time, students are better able to build an affinity with place and develop connections to the environment (Brody, 2005).

2.11: Connecting field and classroom experiences

Seeking to learn about best practices for field days is of ongoing importance in EfS. One strategy for improving the outcomes of field experiences is to connect well-planned classroom learning with field experiences (Carlson, 2008). According to Ballantyne and Packer (2006, p. 28), the best results from environmental field trips are achieved when teachers can integrate learning 'in' the environment with classroom strategies. Similarly, in his exploration of the long-term effects of field experiences, J. Farmer et al. (2007) found that the frequent use of classroom experiences before and after field trips was a valuable strategy for extending field learning.

In Pfeiler's (2007, p. 64) study investigating connections between science, literacy and numeracy learning through a Waterwatch program, the author stated "It is quite evident that student motivation for literacy-based research is greater when it is connected with actual fieldwork" (Pfeiler, 2007, p. 64). Two studies that illustrate how field experiences can be integrated with literacy-based experiences to deepen environmental learning are exemplified in the following research.

Firstly outdoor experiences can sensitise some students to feeling care for our environment (Wason-Ellam, 2011). Secondly, in their research exploring bringing literacy and environment together, Comber, Nixon, and Reid (2007) conclude teachers believe that field learning improved student attitudes towards the science of places and their knowledge of ecological relationships. Collectively these studies are important for highlighting how field experiences can be integrated with literacy-based experiences to deepen environmental learning.

Exploring how teachers integrate multi-modal literacies to assist their students to communicate knowledge about a local environment, Nixon (2007, p. 103) suggests that research challenges literacy educators to use a variety of digital formats to investigate, report, produce and distribute information about environmental issues. Nixon's study emerged from an action research-based teacher professional development program, which included university researchers, teachers and other partners. As part of the study, Nixon teamed up with a teacher who took the experience of the professional development back to her classroom.

In applying a multimodal approach, she found that field and classroom-based learning improved student knowledge and skills in literacy and the environment. This study speaks to the importance of integrating digital technologies, and is helpful for understanding how multi-modal literacies can be imbedded in post-field classroom learning to advance the goals of EfS.

From their research examining students' understanding of the subject matter of a field trip experience to Washington State Arboretum, Farmer and Watt (1997), suggest that post-field activities lead to improved student learning outcomes. Whilst this research is valuable for understanding how post-field, school-based study might improve learning outcomes, it is not clear to what extent post-field study occurred. In Farmer and Watt's study, the post-field tests became part of the follow-up lesson and a limitation of the study, as the post-field tests were conducted directly after the follow-up lesson, with no time in-between. The investigation of post-field learning should probably focus more on how teachers, rather than researchers, plan and implement it to connect the field and classroom learning.

2.12: The limitations of field experiences

While the use of local places for outdoor learning makes such experiences more accessible for students, their families and schools, research suggests that field trips, excursions and special events can involve a significant commitment of resources, from a range of sources (Carlson, 2008). Limitations around funding and financial disadvantage have been identified as key barriers to outdoor programs across the broader literature (Smythe, Zappala, & Consedine, 2002) as exemplified in an English survey about practitioners' aspirations and implementation of outdoor learning experiences involving 334 school settings (Waite, 2011). Similarly, in school visits to the Australian National Museum, only 43 per cent of schools used paid museum education programs, presumably to keep costs down (Zarmati, 2009). Similarly, it has been found that field activities can be restricted by other constraints such time, resources, participant security and suitable field sites (Anderson, Kiesel, & Storksdieck, 2006; Barker et al., 2002; Curtis et al., 2013; Fauville et al., 2014; Spicer & Stratford, 2001).

Notwithstanding these limitations, Barker et al., (2002) argue that local field settings, as compared to those further afield, are more economical, improving access for multicultural and disadvantaged students with the aim of improving learning. According to Barker et al., when it comes to field trips, the most pertinent question to be asking is: How can we afford to not participate in field trips?

2.13: Concluding comments

This chapter has explored literature relating to the suspected causes and effects of the environmental crisis. A number of environmental learning themes relating to the crisis, including the Anthropocene, detachment from nature and its implications for EfS, biodiversity, eco-literacy, the impact of field learning etc. were investigated, suggesting that both urban and rural places are important in EfS if we are to successfully reconnect children with the natural world. The literature reviewed compared visiting more natural places versus humanised ecosystems for learning, considered the concepts of biophobia and biophilia, and highlighted the choices educators are urged to make to encourage children's connection with the natural world.

The digital world presents some paradoxes in EfS. It has the potential to connect and disconnect people from the natural world. For improving classroom learning, when compared to traditional teaching methods in EfS, evidence supporting the notion that new ICT tools improve environmental learning outcomes is not conclusive (Wrzesien & Raya, 2010). Using the nature writers as a model for connecting with nature, the need to learn love for the environment and the values of fieldtrips for cognitive and affective learning, offer positive implications for improving student eco-literacy through field learning.

This research is about connecting field and classroom learning. The literature I explored supports the notion that this practice benefits student environmental learning, however research detailing this process in recent times is scant.

The following chapter, Chapter three, provides the second part of the literature review, which investigates several common pedagogical approaches for teaching EfS.

Chapter Three

Pedagogical Approaches and Frameworks for Environmental Education and Education for Sustainability

> A single tree in a city park, harbouring thousands of species, is an island, complete with miniature-mountains, valleys, lakes and subterranean caverns. Scientists have only begun to explore these compacted worlds. Educators have made surprisingly little use of them in introducing the wonders of life to students (Wilson, 2002, p. 145).

3.1: Introduction

In following the theme of biodiversity in this research, Wilson (2002) points out that even though a vast array of biodiversity exists right in front of our eyes, teachers have made little use of such topics to educate their students. Building on the review of literature undertaken in Chapter Two, the purpose of this chapter is to examine a range of pedagogical approaches, specifically their impact and application, in the context of environmental education (EE) and education for sustainability (EfS). The chapter commences with a focus on biodiversity education and its contribution to environmental learning. This is followed by a discussion on the influence and limitations of the multi-dimensional environmental approach 'in', 'about' and 'for' the environment. Next, the chapter considers the pedagogical contributions, including the benefits and challenges of citizen science, inquiry, integrated and experiential learning.

Permeating all of these considerations, the chapter pays particular attention to the significance of place and place-oriented pedagogies, which are highlighted as critical elements of education for sustainability. Finally, the chapter highlights the significance of student learning within field settings, before identifying some of the challenges and barriers faced by teachers in relation to the delivery of environmental education and education for sustainability.

3.2: Biodiversity education, historical connections and current perspectives

As Chapter 2 highlighted, different understandings about biodiversity are integrated in society and biodiversity itself permeates all aspects of our lives. Our

historical connections to actual biodiversity are important for understanding how biodiversity education has developed and evolved, and how indeed, biodiversity education correlates with environmental learning today.

It is claimed that modern humans (*Homo sapiens*) evolved and lived in intimate contact with nature, in the savannahs and forests, for almost their entire 120,000±-year history (White, 2004). From this we can presume that human life has always included nature education, to share knowledge of plants and animals as food sources, medicine, for clothing, housing, defence etc. These ideas are supported by Hayes (2009, p. 1076), who argues that people have been learning and teaching each other about the natural world for many thousands of years, as depicted by Palaeolithic artworks that reveal an intimate knowledge of the natural world as far back as 30,000 years ago.

Frequently acknowledged throughout the literature is the belief that biodiversity education and environmental education evolved from nature study, outdoor education and conservation education (Daudi & Heimlich, 2002). Biodiversity education is also referred to as natural history pedagogy, as cited by Stewart and Müller (2009), who describe this form of learning as being attentive to our environment; recording and reflecting on observations and experiences in place, and observing how differing aspects relate to one another. Understanding the ecology of places, the ways humans interact with nature culturally, and the way we see ourselves as interconnected with an influence on shaping nature are, according to Stewart and Müller (2009), important elements of biodiversity education.

A study investigating a post-modern perspective of biodiversity education (Dreyfus, Wals, & van Weelie, 1999), states that in order to know exactly what is lost and what should be done to stop biodiversity losses, scientific education encompassing all life forms is essential. Biodiversity education is important in the context of EfS because of the threats towards all types of animals, plants and whole ecosystems for a whole variety of reasons (Orr, 1994b). Ironically, according to Castro, Anabela, and Paiva (2016) very few people realise 2011-2020 was declared the "Decade for Biodiversity" by United Nations Secretary General Ban Ki Moon in 2011. In this book chapter about biodiversity and education for sustainable development, Castro et al. (2016) believe this was a

United Nations attempt to raise awareness that we cannot survive without biodiversity. The UN believes human impacts are placing Earth's systems under increasing pressures, requiring urgent actions to restore ecosystems, reduce impacts and stop species extinctions.

From a conservation biology perspective, Trombulak et al. (2004) reviewed existing Conservation Biology Education (CBE) research and suggest five principles for guiding education. The five principals include, understanding the goals of CBE, the importance of Biological Diversity, Ecological Integrity, and Ecological Health, concepts for understanding these, threats to them, and knowledge of the protection and restoration of the three key pillars of CBE. These guiding principles provide many options for educators engaging in biodiversity education. Interestingly, from the conservation biology perspective of Trombulak et al. (2004), understanding classification and examining taxonomy is seen as a relevant topic for understanding how scientific knowledge and biodiversity is organised. Further, like Stewart and Müller (2009) assert: natural history pedagogy, the study of human nature connections, human impacts on environments and ways we can resolve environmental issues are important for biodiversity conservation.

In response to the some of the tensions and debates raised, it seems timely to examine the active biodiversity education model as described by Ramadoss and Poyya Moli (2011), which provides the framework used in their study to assess the efficacy of biodiversity education for high school students in India. This model involved teaching methods including active class lessons, 'hands on' training, and field trips. The main aims of the program were to change student attitudes and behaviours to promote local nature conservation. Ramadoss and Poyya Moli (2011), compared an experimental group of students participating in a biodiversity education experience/program, and a control group with no biodiversity experience. Using pre-test and post-test measurements, they examined three factors: assessment of biodiversity knowledge, interest in biodiversity conservation and student skills in conservation. They conclude that active biodiversity education improves student knowledge, interest in local biodiversity, and the skills needed to conserve it. The study suggests that any action for the environment undertaken in the study's modules was hypothetical

and rhetorical, with no actual 'direct' action projects for the environment occurring during their research, which appears to be a weakness of the study.

In another study involving biodiversity education in an Australian context, Stewart (2011) suggests that, using a pedagogy of 'becoming animal' may be one strategy for rethinking teacher practice. This pedagogy comes from the ideas of the French poststructuralists Deleuze and Guattari (1987). In becoming a bird, a Speckled Warbler in Stewart's example, is to visit its place, get to know it and think from its perspective about the past, present and future. How these aspects relate to habitat, ecology and ultimately the power relationships between human and non-human life forms is important, as it can help us to understand the conservation needs of all existing species (Stewart, 2011). Correspondingly, in another Australian study that explored the concept of 'becoming frog', Somerville (2011a) describes a comparable perspective as an enabling pedagogy of place, which suggests new ways place knowledge might be assembled and refined in biodiversity education.

The term biodiversity is used across each of the three environmental education approaches EE, EfSD and EfS, presently operating in the Australian education system. In the Australian state of Victoria, where this research was conducted, the topic of biodiversity is one of the core modules in the EfS curriculum, along with waste, energy and water ("ResourceSmart Schools," 2005). Despite this, finding ways to improve biodiversity education is important for conservation, particularly at a time when research in natural history education in Australia is limited (Stewart, 2011). This raises the question of how biodiversity education might be embedded in student learning to advance eco-literate citizenship and biodiversity conservation.

A paper exploring the use of Howard Gardiner's naturalistic intelligence[7], and the great naturalists of our world like Charles Darwin, Jane Goodall and Edward O. Wilson as models for designing biology curricula, suggests that the development of naturalistic intelligence is needed if we are to live sustainably and conserve nature in the future (Hayes, 2009). As discussed in this section, biodiversity

[7]Howard Gardner PhD developed the theory of multiple intelligences in 1983. Nine intelligences currently exist: linguistics, naturalistic, musical, visual, mathematical, kinesthetic, interpersonal, intrapersonal and existential.

education probably began many thousands of years ago. With biodiversity now under threat, biodiversity education and conservation is important. A range of models and perspectives for biodiversity education have developed in recent decades, all of which suggest students have experiences 'in' real places, exploring biodiversity.

3.3: Learning 'in', 'about' and 'for' the environment: A framework for EfS

This section reviews the interdependent nature of the approaches: 'in', 'about' and 'for' the environment. It also examines the relevance of these terms in contemporary EfS and their integration across field and classroom learning contexts. The term 'environment' specifically denotes the biosphere: the zone that sustains our lives, as defined by Wilson in Chapter Two who defines the biosphere as a thin membrane of life around the earth that constitutes a zone of living things (Wilson, 2002).

It was Donaldson and Donaldson (1958) who first used the terms learning 'about', 'in' and 'for' to define outdoor education. According to Bennett and Heafner (2004), Palmer re-introduced the framework of learning 'about', 'in', and 'for' the environment to guide the planning, teaching, and learning of environmental education in her book, *Environmental Education in the 21st Century* (1998). Like nature itself, the three elements should be viewed as interdependent (Connell, Fien, Sykes, & Yencken, 1998), a view reiterated by Cutter-Mackenzie (1998, p. 16) who states "Education 'in' and 'about' the environment builds a platform upon which education 'for' the environment stands".

3.3.1: Learning 'in' local outdoor places

This section discusses the first of the three elements – learning 'in' the environment, which according to Cutter-Mackenzie (1998) is concerned with experiencing the physical environment. She explains that being 'in' our environment allows students "to expand and develop their skills such as data gathering, observation, sketching, photography, interviewing and using scientific

instruments, together with social experiences, co-operation and aesthetic appreciation" (p. 15).

Tracing the evolution of the theory of learning 'in' nature, Brody (2005) states that for meaningful learning to take place, individuals must have experiences in physical settings. He goes on to suggest that students should be afforded experiences where they interact with the setting both individually and socially, working as a group to compare and interpret the environment, and using their senses to explore it.

Brody's continuum includes three elements of learning - prior learning, direct learning 'in' the field, and continuous learning over time. His case study research involved examining a 16-year-old Scottish student's experiences of learning about bogs in an effort to explore meaningful environmental learning. Brody concluded, the learning 'in' nature framework provides an explanation of acting, thinking and feeling over time. In Brody's theory, learning 'in' physical settings is the catalyst for all other environmental learning. While it has been argued that nature-based learning 'in' environments is essential, (Fien, 2003), Cutter-Mackenzie (1998) and Brody (2005) suggest that such a premise provides only one aspect of learning to live sustainably.

3.3.2: Learning 'about' biodiversity and ecology

The second element of Palmer's (1998) framework is concerned with learning 'about' the environment, and is sometimes associated with traditional nature education, whereby students are drilled in rote learning style to learn the names of plants and animals. According to Wilson (2006), placing names and labels on all plants to memorise them is not an effective way to learn as rote learning fades quickly from memory. Using Palmer's framework, learning 'about' the environment contains the 'content knowledge' aspect of EE and EfS, such as learning about the names of species or food chains. Cutter-Mackenzie (1998) believes learning 'about' the environment can provide a basis from which to make informed decisions about how to take action for the environment. Furthermore, Stewart and Muller (2009) and Wilson (2006) reinforce a similar view, suggesting

that identification or naming different species can lead to further knowledge of how creatures or plants behave and interact with us.

Early childhood educators have argued that biodiversity is an important topic for study because it helps young children to learn about diversity, the interrelationships of living creatures and the ecosystems they inhabit (Edwards, Moore, & Cutter-Mackenzie, 2012). In earlier research, Cutter-Mackenzie and Edwards (2006) state that some educators view content knowledge as secondary to pedagogical approaches that emphasise learning for the sake of learning. In contrast, they advance a socio-cultural approach for environmental learning 'about' the environment that focuses on children's contextual experiences, which includes an emphasis on the interface of content, pedagogical technique and socially constructed knowledge. Such a view widens the scope of learning 'about' the environment.

Teaching 'about' animals and biodiversity in general should give preference to outdoor ecological settings (Killermann, 1998; Lock, 1998; Prokop, Tuncer, & Kvasničák, 2007a; Tilling, 2004 as cited by Braun, Buyer, & Randler, 2010). Teaching 'about' biodiversity however, comes with considerable ethical considerations. For example, Braun et al's. (2010) study involved the investigation of non-native birds in an urban context where the incidence of native birds was minimal. The key learning objective in this study was concerned with improving student knowledge of invasive species, assessing their impacts, ecology etc. The authors conclude that studying non-native species is educationally valuable because of its capacity to effectively connect outdoor and classroom contexts (p. 11). Studying non-native species outside is likely better than not studying outside at all. The study poses an important ethical question about the role and treatment of invasive species in urban ecosystems as a focus of study: do students become connected to invasive species with a propensity to protect rather than control them? Some environmentalists would view this approach as counter-productive to the conservation of native species of animals, which are so adversely threatened and impacted by invasive and feral animals the world over (Wilson, 1992).

Teaching and learning 'about' nature has also been criticised for having ideological, techno-centric and vocational aims. By way of example, in a critical

analysis of student's affective engagement in field contexts, education 'about' the environment was referred to as a detached, science-based approach with parallels to a techno-centric worldview that places human development and growth above the value of environmental conservation (Cook, 2008). However, learning 'about' the environment also involves learning about environmental issues which, according to Melamed (1994), can energise or enervate students to take environmental action.

Building on this understanding, Forbes and Zint (2010) assert that students can learn about the nature, causes and consequences of environmental issues. Learning to develop the skills and wherewithal to solve such issues is a critical element of learning for sustainability.

3.3.3: Learning 'for' the environment: moving towards educating for sustainability

Learning 'for' the environment is an approach that develops a sense of responsibility, as well as the skills and motivation in citizens to actively contribute to the preservation of the planet (Cutter-Mackenzie, 1998). Significantly, the notion of learning 'for' the environment is embraced by the United Nations (UNESCO-UNEP, 1977), and manifested through its Education for Sustainable Development (EfSD) framework, which emphasises participatory action learning 'for' the environment via active involvement that seeks resolution of environmental problems. The continuum of these problems may extend from the local to the global, and should involve an affiliation of sustainability theory that embraces the 'bigger picture', which includes the systemic interconnections and causes and effects surrounding environmental issues (Sandri, 2013).

The notion of learning 'for' the environment was examined in a study by Flanders and Chawla (2007), which involved reviews of four bodies of research relating to promoting active care 'for' the environment, all from the perspective of environmental activists, educators and young people. The authors found that active relationships and feelings of care 'for' the environment were often associated with childhood experiences in nature, being able to see environmental problems like pollution first hand, and good role models like parents and teachers

as sources of inspiration to act ‘for’ the environment.

The researchers make a distinction between *private sphere* action and *public sphere* action for the environment. For example, private sphere action might involve using less energy at home, composting or recycling etc., whereas public sphere action may encompass direct actions like replanting habitat, placing nest boxes in a habitat or participating as part of a group to engage in political discourse about relevant environmental issues. Flanders and Chawla note that EfS mostly emphasises private rather than public sphere actions, which can be seen as contentious in school communities (Whitehouse, 2001).

As Kumler (2010) describes, political, consumer, and information-sharing realms, are rarely incorporated in school curriculums. Kumler uses terms such as ‘direct action’ and ‘indirect action’, ‘eco-management’ and ‘non-eco-management’ to create categories of action ‘for’ the environment. By comparing social studies and science teachers’ use of environmental action projects, and the subsequent outcomes and impact on student actions, Kumler’s research found that public sphere actions are more associated with a politics based social studies curriculum. According to Kumler, such curriculum is rarely developed in schools due to a lack of teacher knowledge, and it is not conceptually well aligned with standardised tests. A key finding within this research suggests that because public-sphere action is often seen as politically delicate, some teachers are concerned it oversteps their role.

Although environmental education includes facilitating opportunities for students to engage in action projects ‘for’ the environment (Chawla & Flanders-Cushing, 2007), learning ‘for’ our environment via action projects in schools needs careful consideration. Cutter-Mackenzie (2009) argues that learning ‘for’ the environment can be anthropocentric, indoctrinating, and not socially critical. Similarly, such an approach has been criticised for being a ‘red-green’ form of eco-socialism, e.g. large groups of school students are enlisted to plant 1000’s of trees ‘for’ the environment, and techno-centric due to the big business, government and state controls which are inferred in the term’s very language (S. Gough, Scott, & Stables, 2000). These authors suggest, as the terms are generally associated with learning ‘for’ the environment, this reflects learning for ways to sustain ourselves and manage the environment for production, rather than ways we can sustain

nature for its intrinsic value. In a techno-centric view, doing something 'for' the environment can infer paying the environment back to offset some business development. According to Nicholls (2010), action learning projects 'for' the environment are often dominated by teachers and others, with students having little, if any, ownership in the learning process.

In light of these debates, it is worth paying attention to significant empirical research that examined 90 primary teachers' knowledge and implementation of education 'about' 'in' and 'for' the environment in Queensland, Australia (Cutter-Mackenzie & Smith, 2003). Significantly, half the primary teachers surveyed in the pilot study had never heard of learning 'in', 'about' and 'for' the environment. Cutter-Mackenzie contends that pre-service teacher courses have a role to play in developing teacher skills, considering low levels of teacher eco-literacy and knowledge of the terms: learning 'in', 'about' and 'for' the environment. An understanding of such basic environmental frameworks and concepts is a pre-requisite of teacher eco-literacy according to Cutter-Mackenzie.

3.4: Experiential learning in education for sustainability

The very terms 'experience' and 'action' complement each other in the EfS framework. Modern understandings of experiential learning derive from the influences of John Dewey's experimental method, Piaget's constructivism, and Kurt Hahn's humanistic ideals (Seaman, 2008). According to Beard and Wilson (2002, p. 17), John Dewey is the foremost exponent of the term 'experience for learning', and he used the term 'theory' as a way of analysing interactions between people and their environment. This duality can be applied in many ways: mind and body, knowing and doing, subject and object etc., however, it essentially means the duality between theory and practice (Beard & Wilson, 2002).

However, Kolb (1984b) developed an experiential learning cycle that goes beyond theory and practice as a way of identifying the stages and types of thinking engaged throughout the experiential process. According to Miettinen (2000), each stage was considered by Kolb to be a different mode of learning, with individual abilities corresponding with each mode. According to Kolb:

> Learners, if they are to be effective, need four different kinds of abilities - concrete experience abilities (CE), reflective observation abilities (RO), abstract conceptualizing abilities (AC), and active experimentation abilities (AE). That is, they must be able to involve themselves fully, openly and without bias in new experiences (CE). They must be able to reflect on and observe their experiences from many perspectives (RO). They must be able to create concepts that integrate their observations into logically sound theories (AC) and they must be able to use these theories to make decisions and solve problems (AE) (1984b, p. 30).

Beard and Wilson (2002) suggest that experiential learning may be a chronological process, in that we can learn concurrently, retrospectively or prospectively. The authors go on to note that when one perceives a stimulus, one learns from experience; in other words, we conceptualise, generalise, evaluate and act on those experiences. For example, whilst walking in a natural setting we see a snake; we instantly draw on our previous knowledge that snakes are dangerous, and then act to move away from the threat. After conceptualising the experience, we may decide to avoid walking in that area again or we may choose to look more closely to study the snake, deciding that it is safe to observe if we keep our distance.

Individuals perceive situations and objects differently using an experiential approach, and such a process involves cognitive, affective and behavioural responses to the stimulus according to Bloom (1956; as cited in Beard & Wilson, 2002). According to Miettinen (2000), Kolb's intention was to suggest through experiential theory a holistic, integrated perspective on learning which combines experience, perceptions, cognition and behaviour.

Analysing Dewey's notion of experiential learning, Miettinen (2000) identifies how Dewey elaborated on Kolb's thinking by expanding on each learning phase. Miettinen suggests that, the phases of learning in Kolb's experiential cycle are too broad to adequately recognise the complexity in Dewey's original theories. Ord and Leather (2011) also discuss the limitations of using cyclical models for experiential learning, which they propose lead to an oversimplification of Dewey's experiential learning theories. Instead, they argue it is useful to think of

experiential learning three dimensionally, as a continual spiral of action and reflection, where activities are designed to build upon each other to enhance student experiences using a time continuum of living from the past, through the present and into the future. Viewed this way, experiential learning is dynamic, and overlaps learning processes through a time continuum.

Resembling the field experiences highlighted throughout this thesis, Kolb shifted the emphasis of learning to a variety of settings; somewhere beyond school and the classroom, and encompassing of individual and socially constructed learning experiences. These epistemological considerations of experiential learning are reflected in the work of Miettinen (2000), who cites Dewey, stating: "Concepts and meanings are not constructed in the head alone. They are generalizations of the interactions between humans and the entities of environment, in practical activity" (p. 68). Similar factors underpinned research that investigated learning environments framed by integrated experiential programs. Findings showed that secondary students rated group cohesiveness as a highly important skill for effective learning, in a range of places (Koci, 2013). In this way, experiential learning occurs as a combination of individual and social experiences, across a variety of learning contexts.

Historically, experiential learning has been an important part of adult education in the USA, Europe and Australia (Miettinen, 2000), and it has also been affiliated with adventurous 'outdoor education' activities (Beard & Wilson, 2002). In an environmental context, outdoor education learning has become increasingly focused on experiential and environmental learning, as is evidenced in the year 12 study guide, *Outdoor and Environmental Studies*, for Victorian secondary students (Victoria Curriculum and Assessment Authority, 2011). The guide requires students to experience a range of activities in local places, to develop experiential knowledge of human relationships with nature, human impacts on environments, sustainability and outdoor environments.

Beard and Wilson propose a refocussing of experiential learning to include more active, arts-based experiences for students, as demonstrated through their use of Dale's (1969) Cone of Teaching shown in Figure 3.1 below:

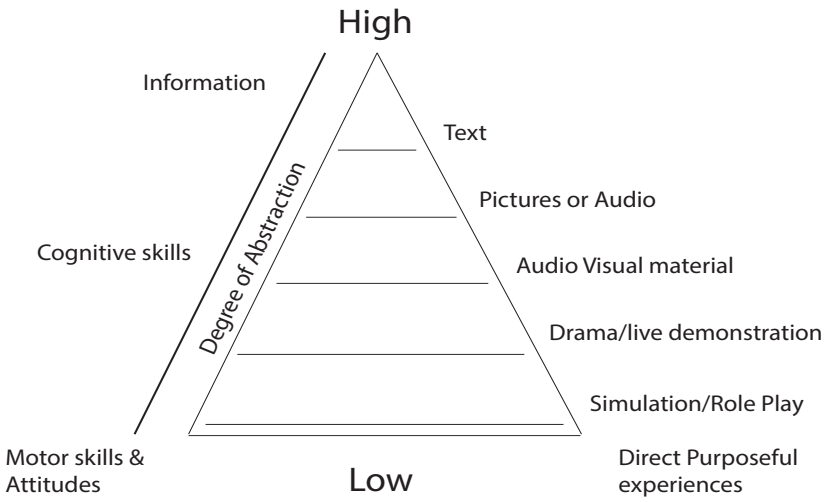


Figure 3.1: Dale's Cone of Teaching (Dale 1969; modified by Beard & Wilson, 2002, p. 108)

Dale's representation of experiential learning is helpful for understanding a clear shift in the focus of learning from reading and writing, to active and sensorial learning that utilises role-play, story-telling, drama and audio-visual aids, reality, critical thinking and real problem solving to stimulate learning. According to Dale's model, as learning becomes more text based, information increases, it becomes more abstract for learners and requires high levels of teacher instruction and intervention, which discourages independent learning. In this way, Beard and Wilson (2002) suggest that experiential learning allows greater student autonomy and independence in learning.

3.4.1: Benefits and challenges of experiential learning

Experiential learning improves student knowledge of the connections between nature and human culture. In her study of the impacts of an EE program at an eco-attraction, Dunkley (2016) found students learnt about the role plants play in the human world after visiting a botanic garden. She concluded that, understanding connections between plants and ecosystems helped students to improve their understanding of the potential impacts of climate change.

Other research investigating the outcomes of student learning in experiential learning programs suggest, students develop higher order thinking skills such as analysis, synthesis and evaluation as a result (Ives & Obenchain, 2006). Warkentin (2011) emphasises the potential of experiential learning for engaging students' senses in nature. This provides opportunities for experiencing place through the interaction of imagination, real places and story to stimulate ecological learning (Payne, 2011), and such flexibility allows experiential learning to be applied holistically, across and within a range of learning disciplines.

According to Koci (2013), more research is needed to develop teacher understanding of the important roles they play in facilitating experiential learning programs. As I demonstrate here, the *Green Classroom* program in Germany involves a half-day visit to a nature centre with an adjoining garden space where students learn to value small animals like invertebrates through direct interaction and experiential learning. Drissner, Haase, and Hille (2010), found that student attitudes towards nature improved and students had greater motivation to learn 'about' animals after *Green Classroom* experiences. The study supports the catching of invertebrates in EfS, and it adds weight to the belief that experiential field trips can benefit student's environmental learning.

There are however, some challenges for practitioners. Experiential learning is said to require the teacher or field presenter to act as a facilitator, who manages the learning environment to assist individuals to achieve value from the learning process (Beard & Wilson, 2002; Singh, 2001). In reviewing the theoretical and philosophical underpinnings of the term experiential learning, Roberts (2008) describes four theoretical variations of experiential learning: Dewey's interactive experience; the phenomenological concept of embodied experiences; the critical theory based experiences as praxis, and finally the neo-liberal view of experiences within education, (becoming more common in school contexts). Taking up the last point, Roberts explains that within a neo-liberal framework, experiential learning becomes a subject allocated a specific time within existing curriculum frameworks to fulfil content standards. A neo-liberal experientialist model of learning, he suggests, can be best seen in the predominance of one-off, isolated experiential programs like half-day ropes courses, visits to environmental centres

to fulfil curriculum standards, or the use of climbing walls on ships or flying fox lines in parks, as 'edutainment' centres. It is important for practitioners to choose wisely, from the four theoretical variations listed above, if they are to maximise student learning through connecting field and classroom learning.

3.5: Integrated approaches to environmental learning

At its most basic level, integrated learning involves making a package of different subjects: physical education, leadership, environmental science, geography and English, for the study of theme topics like sustainability (Russell & Burton, 2000). As a theoretical model, integrated learning approaches provide a valuable starting point for the effective coverage of EfS, within all curriculum learning areas whilst engaging students in various learning processes and skills (Littledyke, Taylor, & Eames, 2009). In education systems where environmental learning is not a discipline subject, integrated learning is seen as a favoured way of teaching EfS curriculum.

Integrated approaches to EfS have been identified by others who have (a) highlighted the increasing challenges of a crowded curriculum for teaching EfS, and (b) argued for pedagogical strategies that address EfS remaining as a small segment in one of the existing curriculum learning areas such as science or geography (Cutter-Mackenzie & Smith, 2003). Furthermore, integrated, holistic, multi-disciplinary approaches or models have been widely advocated for EfS (Australian Government, 2009a; Carlson, 2008; Combes, 2005 ; Flanders & Chawla, 2007; Littledyke et al., 2009; Sharpley & Gough, 2006), because they are seen as a way of imbedding greater levels of sustainability in school practice.

A model for integrating EfS across the curriculum is shown below in Figure 3.2. This model provides a graphic view of integrated learning to assist with an understanding of how such frameworks can be set out in an Australian context (Littledyke et al., 2009), and it serves the same purpose in this research. It shows how understanding the world in key domains like science or geography can be linked to the study of processes and skills in other learning disciplines. Students use various skills and forms of expression to connect key domains and communicate learning.

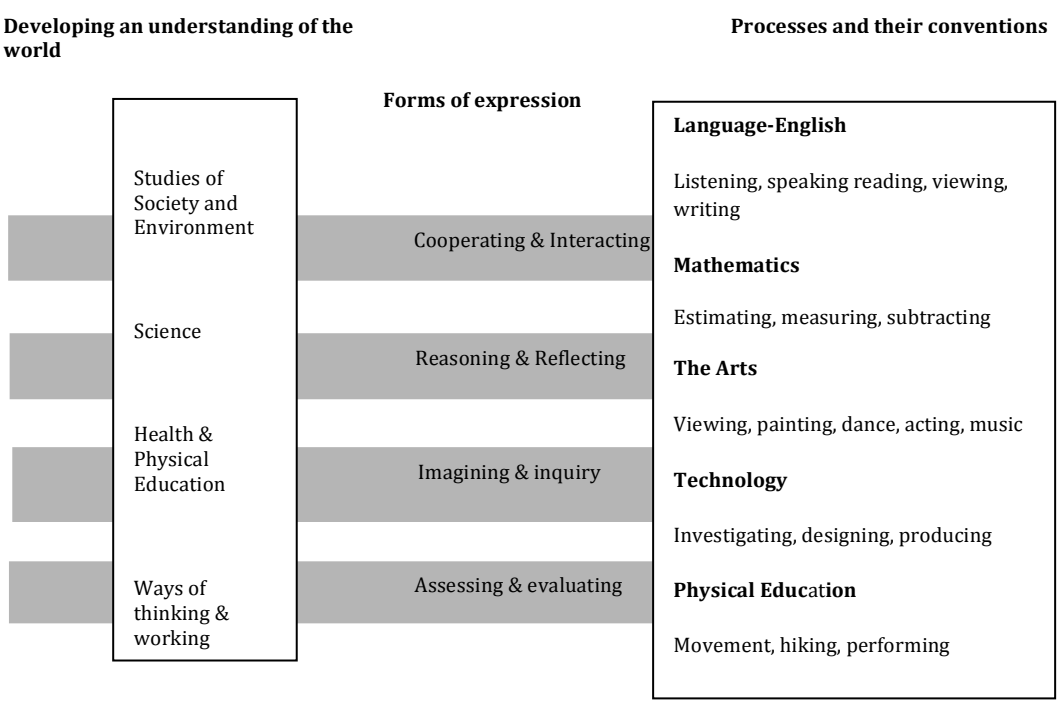


Figure 3.2: A Model for Integrating EE and EfS Across the Curriculum (Littledyke et al., 2009).

A recommendation in a report from the Fourth International Environmental Education Conference in Ahmedabad, India (UNESCO, 2007, p. 6), *Moving Forward from Ahmedabad,* was "to take an integrated approach so that EE can be a process of transformation". The report suggests teachers and students draw on local environments and knowledge critically and creatively to inform their studies. According to Russell and Burton (2000), integrated learning programs in a range of forest centres in Ontario show much promise as a way to develop environmental literacy. Another promising pedagogy, in EfS and science education, is the developing field of citizen science.

3.6: Citizen Science

Citizen science is form of biodiversity education according to Lundmark (2003), is designed as part rapid biodiversity assessment and part public outreach, where scientists, citizen scientists and the public gather over a short period of time to survey all sorts of life, often in an urban community, to compile a snapshot of

local biodiversity. Notably, Bug Blitz[8] and its various approaches to biodiversity education was modelled on the BioBlitz philosophy and adapted for Australian education contexts (Bug Blitz Trust, 2010).

In a mixed-methods study examining various citizen science projects and their outcomes, Newman et al. (2016) concluded that citizen science is experiencing an explosion in growth with the Internet, yet this is not making an impact on conservation decision-making. They hypothesised, if citizen science integrates the power of place, increasing people's affinity, understanding and connection to their local places and homes, this will improve the role of citizen science in conservation decision making.

Studying patterns in nature involves collecting large amounts of data over vast geographical areas, sometimes for long periods of time, and citizen science projects have been successful in contributing to science in this regard (Bonney, Cooper, et al., 2009). This research examined Cornell Laboratory of Ornithology citizen science projects, and provides a nine-step model for designing such projects. The model involves the development of a scientific question, a science evaluation team, designing data collection protocols, recruiting and training participants through to analysing data, sharing outcomes and measuring success.

Like many citizen science projects, the citizens involved are more often adults; ornithology groups and community science organisations, however there is evidence of growing opportunities for school groups to contribute. Some projects such as, *BirdSlueth,* encourage school student participation and provide online study materials to accompany projects. Data reliability and management is an ongoing challenge for citizen science according to Bonney, Ballard, et al. (2009), which I suspect is probably also the case when working with children.

The results of a thematic analysis of citizen science projects (Newman et al., 2016), show some projects focus on engagement and environmental education, some on long-term monitoring to provide scientific data for use in decision-making and some emphasise emotional attachment and connections with place.

[8] Bug Blitz Trust: a not-for-profit environmental organisation principally concerned with biodiversity and environmental education.

Another study analysing citizen science in the context of informal education settings (Bonney, Ballard, et al., 2009), assessed the impacts on knowledge, engagement, skills, attitudes, behaviours and other environmental learning, of ten different citizen science projects. Most of the projects investigated did not aim at engaging school student participants, however one project, *The Monarch Larva Monitoring Project* (MLMP), found the participants: teachers, naturalists and parents reported that they monitored Monarchs with three to five children each. Evaluation of the MLMP program (Kountoupes & Oberhauser, 2008), found children gained a variety of skills and understanding about science processes, and contributing to real science projects gave children a sense of pride. The evaluation suggests citizen science offers children opportunities to experience inquiry and discovery learning processes that scientists use to explore natural phenomena, however it concludes there have been few studies exploring the educational value of citizen science.

3.7: Inquiry Learning

There are links between citizen-science and inquiry-based learning, which has been recognized in mathematics and science pedagogy as a student-centred approach to teaching that facilitates students in a process of problem solving, posing their own questions, undertaking research, and forming and communicating solutions collaboratively (Calder, 2015). An inquiry process often involves guided interventions by a facilitator or experts and encourages greater student ownership in deciding the direction of their learning.

In a review of inquiry learning in the early years of schooling, Marian and Jackson (2017) found play, guided interventions and small group inquiry learning could lead to improving scientific general knowledge skills such as observation, questioning, choosing resources, measuring, and making inferences that form the basis of scientific inquiry and reasoning that question the real world. They assert that traditional learning assessments can be content focused and do not assess science skills adequately. As a result of Marian and Jackson's (2017) review of literature, a model for assessing inquiry learning in early childhood science

contexts has been developed, however it remains untested at the time of publication.

In the U.S.A. it is common for colleges and universities to offer courses for non-science students to develop their understanding of scientific processes, through small group, student directed inquiry projects (Jackson, Laws, & Franklin, 2017). The rationale for such courses is to build student eco-literacy and encourage students to become active and informed environmental citizens. One of the findings of this essay, was the students needed 18-24 hours of time to adequately complete their inquiry projects, which could present challenges for schools with already crowded curriculums.

In a study examining the use of inquiry learning projects, involving university science students cooperating with groups of secondary students to gather samples and make assessments of their local water sources, Saitta, Legron-Rodriguez, and Bowdon (2013) found university student participants improved their science communication skills. They recommend maximising student learning through including writing about science for a range of audiences and purposes, as part of the inquiry learning process.

In the research I have reviewed, inquiry learning includes student directed learning in small groups, employing scientific processes to pose questions, investigate problems, communicate and share findings, which lead students to suggesting solutions and taking actions. Inquiry learning does not always include outdoor field learning experiences and can be laboratory based in subjects like physics (Jackson et al., 2017). However, in a biodiversity context, learning ‘in’ the environment can be a vital and exciting part of inquiry learning. Being ‘in’ a habitat is akin to being ‘in’ place, which I will discuss next.

3.8: Philosophy of place–based learning

In addition to the number of pedagogical approaches cited above, another key approach for EE and EfS is place-based learning, a philosophy that stems from a well-theorised body of research and knowledge that recognises the significance of ‘place’. According to Gruenewald, “places are profoundly pedagogical, teach us

how the world works and make us" (2003b, p. 621). A new form of post-colonial place pedagogy, was proposed by Somerville and colleagues to develop a framework that explores the complexity of place engagement, in a non-binary way:

1. Experiencing and perceiving local places in embodied ways (body),
2. Making meaning about self and others in the natural world through individual and shared stories (story),
3. Place as collective meaning making through a contact zone of perspectives (contact zone) (Somerville, Power, & de Carteret, 2009, p. 8).

In their exploration of place pedagogy, Somerville, Power, and de Carteret (2009) suggest that a deep embodied sense of connection gives rise to a different ontology, where a child sees themselves becoming other, between self and the natural world composed of animals, plants, weather, trees and rocks. In this way, embodied learning is an important principle on which understanding and connections with ecosystems *we are embodied in* can be established.

Similarly, McKenzie (2008) considers place learning from a socio-ecological perspective, whereby learning takes place between thought and the sensed, via a range of inter-subjective experiences and locations. According to McKenzie, the use of the term 'inter-subjective' locates the 'where' of learning and includes "physical places but can also be in and of experiences of friendships, art, literature, irony, cultural differences, community" (2008, p. 361).

The association with place is a fundamental aspect of individual identity formation (Somerville et al., 2009; Wattchow & Brown, 2011). In analysing how place educators across Gippsland came to know and love place, Somerville (2011b, p. 159) found that connections to places were crucial aspects of educators' identity formation. For some, this involved a constantly evolving learning process of becoming embodied in their own place journeys. Within any society, place perspectives vary between people: a farmer, an indigenous family, a miner, a gardener, a naturalist etc., (Wardell-Johnson, Amram, Salvaratnam, & Ramikrishna, 2011). Thus differing political and socio-cultural perspectives of place (including aspects like social justice, peace, power relations, gender roles), need consideration when negotiating learning in *those places* (Wardell-Johnson,

Amram, et al., 2011). The notion of place as a contact zone of differing perspectives is best exemplified by the clash between western and indigenous cultural perspectives, stories, knowledge and power (Somerville et al., 2009). Therefore, when thinking about learning *in place* it is important to keep in mind the possibility of different cultural connections, uses and contestations over ownership (governments, landholders etc.).

Building on these notions, a critical pedagogy of place aims to evaluate relationships between our socio-ecological places and ourselves (Gruenewald, 2003a). A critical pedagogy of place arises from social critical theory and place-based education, and is useful in encouraging communities to confront ways that power influences humans and non-humans, or to be, as Gruenewald (2003a, p. 7) puts it, 'critical' of the ways power limits possibilities for humans and non-human interactions in our environment. In examining the idea of places as pedagogical, Noel Gough postulates that EE is neither at the beginning or end of its development but rather as somewhere that is always in between, and that developing an eco-critical literacy towards EE pedagogy is a healthy place to be, particularly at a time when powerful groups can influence the environment in negative ways, a critical eye is needed (2009, p. 170).

3.9: Local places as a connecting platform for global issues: valuing local knowledge

Place-based learning approaches require students and others to engage in a range of local places to enhance environmental learning. Such opportunities are important for actively locating students in their immediate environments, and provide opportunities for students to apply a wide range of skills (Cutter-Mackenzie, 1998; Green, 2011). As argued above, local places can be seen from a diverse variety of perspectives and the participatory styled field programs in my study involved the sharing of differing place perspectives like those of hunters, Park Rangers, bird-watchers, local naturalists, scientists, teachers, students and artists. According to Somerville et al. (2009), learning from these local perspectives of places are essential for laying the foundations to explore issues relating to sustainability within a wide context.

Others suggest that learning in local places is a prerequisite for connecting local, national and global environments (Barker et al., 2002). These concepts were highlighted in the research of Berke and Conroy (2000), which found most local environmental plans excluded any connections with the issues at a global scale. As an attempt to mitigate what was seen as parochial localism, the concept of integrating different environmental scales was introduced in the 1980s and is encapsulated in the phrase 'act locally, think globally' (Klinsky, Sieber, & Thom, 2010). Klinsky et al. emphasise the importance of students having opportunities to explore how local, regional and global environmental actions are interrelated. They argue that the environmental interdependence of nature does not recognise human borders, and that environmental issues at all levels of ecosystems are ultimately connected.

The need to connect local and global views is further extended by Somerville and Perkins (2010, p. 327), who state:

> In Australia the local and the global have powerfully intersected in ways that make attention to global/local issues of greenhouse gas emissions, climate change, drought, increasing problems of water scarcity and local negotiations about water use, an imperative.

Furthermore, a number of environmental educators advocate connecting student learning to the local and the personal (Somerville et al., 2009; Stevenson, 2011), as children interact and relate best to the environments around them. In their research of place studies for a global world, Somerville, Power and de Carteret (2009) propose we are always situated in local and personal places and without an attachment to them there is no beginning point for understanding global perspectives. They argue, place pedagogy begins in local, personal places where stories are shared, with embodied learning occurring between the self and the natural world, creating an enabling ontology of the self becoming-other.

Advocates of place-based education urge schools to focus on local places, as they keep learning locally relevant, with students actively contributing to their communities (Ballantyne & Packer 2009b cited Gruenewald, 2003; Smith, 2007). In a review of four bodies of research relating to EfS in the U.S.A., Flanders and Chawla (2007) suggest that pre-school and elementary (5-12 year old) students

are best suited to carrying out 'action' projects on a small scale in local environments, school grounds and in classrooms. This sentiment was exemplified in a 4-year place-based research project that examined students' community/place-based learning in a local coast care project. According to Green (2011), as a consequence of this work, many students become more connected to local place and "children come to see themselves as authentic custodians able to act and speak on behalf of their coastal landscape" (p. 118). As Malone (2004) similarly reminds us, it is through their interactions and exchanges with the environment that children become active participants in designing their world, and see themselves in relation to it.

Localised place-based learning is being encouraged throughout current national curriculum developments across Australia and internationally. For example, key considerations in the Australian Science Curriculum focus on equity and opportunity, which "include school and community contexts, local science learning opportunities, historical perspectives, contemporary and local issues and available learning resources" (National Curriculum Board, 2009, p. 82). A key focus of the Australian Academy of Science school curriculum program *Primary Connections* is to connect science learning with local communities (AAS, 2005).

According to the Australian Government's National Action Plan for Sustainability (Australian Government, 2009b), EfS is driven by a broad understanding of education and learning that includes people of all ages and backgrounds and takes place in different learning spaces; formal and informal; in schools, workplaces, homes and communities. In analysing the Australian National Curriculum from an EfS perspective, de Leo (2012) cites UNESCO IIS (2004, p.40), which states that curriculum content should be derived from local contexts and issues. Taking all of these considerations into account, local places can be viewed as critical sites for engagement with EfS, as they are often the everyday places where people reside, and visit most frequently.

In a recent English study about the frequency of children's visits to natural environments, Hunt, Burt, and Stewart (2015) found that in an average month, 47 per cent of all children in England (4.8 million) visit a local green space. Half of all children visiting green spaces monthly are a significant proportion visiting natural areas. However, green spaces in this study included local playing fields,

many of which may not qualify as bio diverse habitats. Significantly, public parks were found to be the most popular outdoor space visited by children under 16 in England. The purpose of the study was to determine the types of places visited, the frequency of children's visits, and who they visit with, in an effort to assess how greater public engagement with nature might improve public health and learning. Two key findings suggest that (a) children were most likely to visit natural environments with adults from the same household, and that (b) children were significantly more likely to visit local rather than far-away places.

In exploring young children's relationship with nature, White (2006) and Bell (2001) warn us that school grounds and yards may be a last option for reconnecting students with natural areas, in a world where natural areas are disappearing under the weight of urbanisation. The inference of such research is clear: out-door spaces, and in particular school grounds, are becoming the most immediate natural and pedagogical space for advancing children's engagement with natural systems, and environmental learning. Whether urban or rural, social justice issues need to be considered when negotiating learning in local places (Wardell-Johnson, Malar Salvaratnam, & Ramakrishna, 2011).

In writing about biodiversity and social justice in local places, Lasimbang (2010) asserts, much is made of scientific knowledge however, Indigenous knowledge is similar in knowing places for resource location, water conservation and livestock management. Lasimbang believes Indigenous knowledge and perspectives of place have been denied and ignored the world over for centuries, and best represent how issues of place and social justice are interdependent.

In some Indigenous communities women are considered to be the custodians of traditional practices and knowledge, like the identification and use of local medicinal plants (Giridharan & Gribble, 2011), which has implications for knowledge sharing, medicine, social justice and issues in EfS. Giridharan and Gribble's study highlights the importance of valuing local indigenous knowledge in educational contexts, a notion advanced by UNESCO (2006, p. 18), who consider local knowledge to be " … a repository of diversity and a key resource in understanding the environment and in using it to the best advantage for current and future generations." Local people have knowledge to share within and outside their community and varied perspectives of place only enriches outdoors

educational experiences.

3.10: Student environmental learning preferences in a range of field settings

Student perceptions of environmental learning provide important insight into preferences they have for certain approaches and styles of learning, which occur across a range of different field and classroom settings. Understanding these can help us to design better field programs. A range of research has identified that students like going into the field and undertaking 'hands-on' or practical learning (Barker et al., 2002; Carlson, 2008; Green, 2011; Maloof, 2006). According to Ballantyne and Packer (2009), children favour opportunities where they learn 'by doing', including investigating, discovering, exploring, collecting data, and sensory learning in real places.

In contrast to this, Ballantyne and Packer (2002) found that worksheet activities and long stories were considered to be unpopular by students when out in the field. In this research, students perceived the most engaging, effective and enduring learning in the field to be experience-based rather than teacher-directed. This point was made evident in a study completed in Washington State, U.S.A. (Allen & Fraser, 2007), that examined student perceptions of science learning in classrooms and found students wanted more hands-on investigations in science classes as well. The literature clearly shows that students perceive 'hands on' learning to be a highly important quality, in both field and classroom contexts.

Another place students have 'environmental experiences' are at environmental education centres. Student perceptions of learning after attending centres are positive in Australia Ballantyne & Packer (2009) found, after surveying 199 students who participated in centre field programs, with each student reporting an average of six learning events. Of these, half related to new knowledge including what they could do to help the environment, 10 per cent related to changes in the way they felt; and over a third related to changes in what they would like to do for the environment (2009, p. 252). Despite these findings, no 'real' actions that stemmed from field experiences were indicated within the study.

Other research by Gladstone et al. (2006), investigated the effectiveness of a program teaching field-based biodiversity conservation that involved adult

students participating in habitat restoration projects in partnership with government agencies and community. This study addressed the significance of connecting field experiences and real issues via partnerships, which resulted in positive outcomes, not only in new knowledge and skills acquired, but also in experience gained "in a real issue in biodiversity conservation" (2006, p. 27). Despite the study involving university students, these aspects may be transferable to younger students.

According to the broader literature, students indicate preferences for experiential and 'hands on' learning as opposed to teacher directed learning. These student preferences it appears, are not only applicable to field contexts but equally apply to classroom learning. Exciting innovations in field learning offer educators a chance to trial new programs and strategies for teaching EfS, and gaining regular feedback from students will be important in the field of EfS research.

Building on this, teachers' understanding, views and knowledge of EfS also play an important part in contributing to student learning.

3.11: Teacher perceptions and knowledge in EfS: challenges and barriers

Teachers are ultimately responsible for facilitating a range of disciplines, particularly in primary school settings. Australian teachers are also required to embed the subject of sustainability as a cross-curriculum priority across all learning areas (Australian Government, 2010). Despite this expectation, the delivery of EfS remains compromised in school settings.

This is often due, according to Dyment, Hill, and Emery (2015), to inadequate levels of teacher eco-literacy, and their lack of understanding of complicated environmental systems, processes and interrelationships. Teachers often report they have little EE content knowledge or limited professional development to build such knowledge (Cutter-Mackenzie, 2003). Another study investigating teachers' beliefs, knowledge and understanding of EE, Cutter-Mackenzie (2009), highlighted that only 14.5 per cent of the teachers surveyed indicated they had received training or professional development in EE. Cutter-Mackenzie further found that, most teachers are ecologically illiterate. In this way numerous studies demonstrate that, "…teachers have completed little or no pre-service or in-service

training in environmental education" (Lang, 1999/2000, p. 59), with most Australian teachers and researchers agreeing there is a need for more professional development (Heck, 2003).

Paul and Volk (2002) put forward a similar argument with regard to lack of teacher understanding of environmental issues and actions, which they believe prevent teachers from undertaking EfS in their schools. Paul and Volk's research was conducted over ten years with 132 participating teachers. The study found that the teachers, who had participated in extended teacher learning as part of the program, were more likely to implement a greater extent of EfS in their classroom curriculums. Teachers "often report a lack of subject-matter knowledge … to support learning about the environment" (Forbes & Zint, 2010, p. 32). A lack of pre-service or in-service teacher training in EfS, limits the extent of EfS in schools.

In response to the dilemma of teachers being ill equipped to undertake EE and EfS, tertiary education needs to create and implement more effective courses to better prepare graduating teachers (Barker et al., 2002; Kennelly, Taylor, & Serow, 2012). This imperative was illustrated in a longitudinal study of early career teachers who experienced EfS as part of their teacher university studies, Kennelly, Taylor, and Serow (2012) suggest that if sustainability is addressed in pre-service teaching courses, its prevalence in schools will increase. It cannot be assumed that pre-service teachers have the knowledge, skills or desire to include EfS in their curriculum or that they will acquire these skills and knowledge in their teaching experiences, if they do not have any training (Kennelly, Taylor, Maxwell, & Serow, 2012). Overall these findings support the need for more pre-service and in-service training to develop teacher eco-literacy and their knowledge of teaching in EfS.

Even though an integrated, holistic or multi-disciplinary approach to EfS has been advocated for many years (A. Gough, 2006), secondary school curriculum tends to be discipline based with teachers specialising in subjects or disciplines of study, like for example Science or History. This is a view reinforced in an English study by Gayford (2000), which involved 20 science teachers working in focus groups to discuss biodiversity education. The study found that essential links to expand knowledge across the curriculum were neglected by teachers, as they had pressure

to cover all objectives of the science curriculum in a limited time. Crowded curriculum demands provide barriers for teaching EfS.

In another vein, environmental teaching includes teaching about topics that are controversial, and contain diverse and sometimes opposing views (Whitehouse & Evans, 2010). EfS is considered to be somewhat controversial because it encourages active social action in environmental issues (Hart, 2003). This can be controversial in communities that engage in environmental action projects, as Whitehouse (2001) found when a school principal in her narrative research described how she was referred to negatively as a 'greenie' when she implemented an action project in her school community. Whitehouse proposes that school engagement in EfS might require careful communication and negotiation with the wider school community.

Research about teacher perceptions of the 'environmental crisis' are not conclusive, with Cutter-Mackenzie (2009) suggesting that teacher perceptions probably align with general societal trends. According to a 1998 Australian Bureau of Statistics survey of people's concerns about environmental problems, relatively large declines in the proportion of Australian people concerned about toxic waste, the greenhouse effect and extinction of species were reported between 1992 and 1996 in the survey. The survey also reported that, people are not convinced that human impacts are the main driver of climate change. A later Australian Bureau of Statistics (2012) survey claims, concern about climate change has continued to decline in the past few years, falling from 73 per cent to 57 per cent of the national population being concerned between 2008 and 2012.

These ongoing surveys indicate that concern about environmental problems has continued to experience periods of decline in Australia. A study done in England by Gayford (2000) found the majority of 20 teachers interviewed believe that biodiversity is under threat, but they were not convinced at that time, that the threat is a result of human impacts via climate change. If teacher perceptions, understanding, and concern for environmental issues like climate change are in decline like those illustrated in the recent Australian Bureau of Statistics population surveys, and backed by Cutter-Mackenzie's (2009) study showing teachers' lack of environmental knowledge, the need to raise teacher knowledge

and eco-literacy, will be essential if we are to have any hope of improving the extent and the relevance of EfS in Australian schools.

3.12: Conclusion

The purpose of this chapter was to examine a range of pedagogical approaches, and their impact and application, in contemporary EfS. Some interesting pedagogies are evolving in an effort to develop human/nature/culture connections and skills to conserve biodiversity. Citizen science offers exciting pathways for students to experience a scientific process in a collaborative inquiry, however most citizen science projects are not targeted to engage school students. Inquiry learning is complimentary to citizen science, however it encourages greater student ownership of learning, a quality desired by students. The influential framework of learning 'in', 'about' and 'for' the outdoors was first published in 1958 (Donaldson & Donaldson, 1958). Regardless of its influence in EfS, literature indicates that half of all teachers have never heard of this basic framework and that low teacher eco-literacy is inhibiting progress in EfS (Cutter-Mackenzie, 2009). The approaches I explored include common elements like 'hands on', sensory and holistic learning approaches, which students indicate they prefer more than traditional teacher directed learning.

Of great interest, place learning in local places appears capable of building students' affinity and connection with local nature. EfS literature recommend educators use multi-disciplinary approaches capable of transforming student knowledge, however this appears will be difficult to achieve in discipline-based and standards driven curriculum that currently dominate many school systems. Given the complexity of the environmental crisis, new pedagogies and ways of thinking will be required if we are to successfully build eco-literate citizens.

The next chapter will outline the qualitative methodologies, which were applied across research as a way of interpreting student and teacher perceptions of the value of biodiversity field days. A range of methods were needed to enable the collection of interpretable data, from both field and classroom contexts, to investigate the questions of my study, and these are explained in the following chapter.

Chapter Four

Methodology and Methods

> Ecologists have learned food chains making up the web are very short. If you track who eats whom in different parts of the web, you will usually find the number of links in the chain to be five or fewer (Wilson, 1992, p. 168).

4.1: Introduction

Like tracking the links in food chains, the purpose of this chapter is to outline the methodology I applied to track changes in student and teacher eco-literacy, as a result of connecting field and classroom learning. In this chapter I describe the qualitative nature of the study, including the methodological frameworks of grounded theory and ethnography that have assisted with investigating primary school student (5-12 year olds) learning in single-day biodiversity field events and the student connections with their teachers in school.

The study is geographically located in two towns in the regional context of Gippsland, Victoria, which are introduced. This chapter also outlines the research design and data collection methods, which include digital video data, semi-structured interviews with teachers and their students, field notes and student document samples. I also draw attention to the methodology used for recruiting participants. Finally, I discuss the specific phases of the data collection that were undertaken in my study.

4.2: A qualitative study

As described in Chapter One, I am a curious 'observer', someone who is interested in how the world works, and eager to know more about the field of Education for Sustainability (EfS). When beginning this study, I was drawn to a qualitative research process that was 'hermeneutic' or interpretive, involving close observation of things in their natural settings to interpret or make sense of the phenomena being studied (Denzin & Lincoln, 2003). It is in this tradition that I

pursued my interest in teachers and their students' perceptions of learning in field-based settings, within the phenomenon of single-day biodiversity education programs, and their perceptions of any related post-field learning in school.

My role in this research is like that suggested by Denzin and Lincoln (2005a): a *bricoleur* assembling pieces of data to understand the lived realities of participants. The qualitative researcher is described as one of multiple identities, and could be, among other things, a scientist, teacher, musician, writer or social-critic. Furthermore, there are many different methodological approaches from which they may consider their research (Denzin & Lincoln, 2005b). Each researcher is, as I mentioned, like a *bricoleur,* or 'quilt maker', in that they build or create a montage from a series of images that are situated in to the specifics of their research situation (Denzin & Lincoln, 2005a). In this sense, my research is designed to understand student learning in single-day biodiversity field events through creating a quilt of images to describe participants' experiences in this process.

According to Denzin and Lincoln (2005a), a qualitative approach believes in "the socially constructed nature of reality, the intimate relationship between the researcher and the topic of study, and the situational constraints [that] shape the enquiry" (p. 10). In order to understand a range of diverse social participants who contributed to the construction of knowledge in this research, it was my task, as the qualitative researcher, to "find the best way of studying how meanings and interpretations are constructed in their particular research" (Liamputtong and Ezzy (2005, p. 2). My research aims to 'discover', 'seeks to understand', 'explores a process' and 'describes the experiences' of participants, which according to Punch (1998, p. 19), are some of the key terms that underpin qualitative research approaches.

Situational factors, such as field and classroom contexts, shaped the study's inquiry. Indeed, all participants have had some input into how learning was constructed during the field to classroom process. The participants in this study included school students, teachers and field presenters. For the field events, presenters chose the key concepts they taught, thus contributing to the social construction of environmental knowledge. The teachers in my study shaped student learning by deciding on the directions of any post-field learning in their

classrooms and by independently implementing some student data collection activities for this research. The students chose the specific topics of their research in classrooms and the forms of writing they would use to express learning.

In undertaking this research, my questions focused on exploring teacher perspectives of, and student learning during, a one-day biodiversity field event, and any links between the two contexts – field and school – using the overarching research question:

> *To what extent do place and experiential pedagogies facilitate, enable and enhance Education for Sustainability?*

My study investigated the following subsidiary questions:

1. What do children learn in a one-day biodiversity field event?
2. What are the connections between environmental field day events and the classroom?
3. How do primary teachers perceive students' environmental learning experiences in the field and in classroom contexts?
4. How, if at all, do primary school teachers connect field experiences with classroom learning?
5. What influences, if any, do field presenters have on children's environmental learning?

In using these questions as the basis from which to continually interrogate the data, I have sought to develop a deeper understanding of the phenomenon being studied through grounded theory (Burke-Johnson & Christensen, 2014, p. 460). In the next section, I explore the methodological tool of grounded theory to investigate the topics of my study.

4.2.1: Grounded theory

My research sought to examine approaches to undertaking biodiversity field day studies as a way to increase EfS in schools, and build a more eco-literate citizenry. This line of thinking correlates with a grounded theory methodology. As Charmaz

(2005) states, “A social justice researcher can use grounded theory to anchor agendas for future action.” In discussing the criteria for grounded theory studies in social justice inquiries, Charmaz (2005) discusses the criteria of usefulness by asking the question: “How does the work contribute to making a better society?” (p. 528).

According to Charmaz (2005, p. 507), “the term ‘grounded theory’ refers both to a method of inquiry and to the product of enquiry.” Cohen, Manion and Morrison (2007) suggest that “grounded theory starts with data, which are then analysed and reviewed to enable the theory to be generated from them; it is rooted in the data and little else” (p. 492). As discussed in Chapter One, having been a participant in many biodiversity field programs working for Bug Blitz, I was keen to analyse such experiences from the perspectives of other participants, in particular children, to better understand the nature and scope of learning.

I chose to use grounded theory as I could work up from the participants’ data to explore in-depth the questions of my research. Using grounded theory as an analytical tool reinforced and is compatible with the interpretive framework I have also used, and according to Birks and Mills (2011): “It is common for studies within another methodological framework to employ grounded theory methods because of their value in the analytical process.”

In discussing codes in grounded theory, Birks and Mills (2011, p. 93) advocate that regardless of the type of data, the process of analysis stays the same; reading field notes, listening to recorded interviews or looking at visual document samples and results to identify concepts that underlie experiences. In addition, Birk and Mills (2011) suggest, there is no way of avoiding the hard-work process of analysis, which is done “to find patterns and conceptual recurrences and similarities in participants’ experiences” (p. 93). As detailed previously, I have used a grounded theory approach to search for conceptual recurrences and elements of experiential and place-based learning as they coexisted between field and classroom contexts.

It has been said that, grounded theory emanates from the data (Lichtman, 2006). As my research project unfolded, student document samples were revealed to me

and they enabled me to explore children's learning in post-field contexts. I have used the voices of the participants to frame the findings.

Grounded theory differs from other research approaches in that it explains the phenomenon being studied through ongoing generation and analysis of data leading to the explanation of a process (Birks & Mills, 2011, p. 17). Building on this approach, I used the second methodological framework of ethnography, which is discussed in the next section.

4.2.2: Ethnography

Traditionally, ethnography involves the researcher or scholar physically entering into the spaces and places where data is to be collected (Delamont, 2014, p. 27). The boundaries of a space or place are often defined and the researcher immerses themselves in this context. My role as a researcher was immersed across a range of spaces and places and I spent time across the boundaries of the field and the school. Fetterman (1998) describes ethnography as the art and science of describing a group or culture, with a strong focus on exploring the nature of a phenomenon or social group. I sought to understand three cultures within this research – field presenters, students and teachers to understand the connections (and disconnections) between them for student learning. Ethnography was used as the main focus of this research methodology for three key reasons: (a) To share my teaching journey as a way to explore current EfS perspectives, (b) to investigate the value of partnerships in biodiversity field learning events, and (c) to explore how field experiences were integrated within school culture to develop student-learning outcomes.

While typically an ethnographer spends a long period of time within a place – I navigated the spaces over a year – entering the different spaces and places of school and field and listening and observing the participants. However, my own experiences as both teacher and field-presenter over many years, made me already familiar with the culture of schools and the non-formal environmental sector, which connected me to the participants as well. The research process began for me when I visited the two schools participating in this study to negotiate the field programs, and the schedule for the research. During these early visits I was able to

understand the schools' commitment to EfS, and familiarise myself with the teachers I would be working with during the research process. I also knew all of the field workshop facilitators, who represented community organisations such as Landcare, and other individuals who brought specific knowledge, such as a local ornithologist and an Aboriginal educator, well before the research began.

Ethnography tends to involve unstructured data, generally relies on small samples of participants, and seeks to interpret the meaning and functions of human actions with descriptions and explanations taking priority (Atkinson & Hammersly, 1994). In this research context, I have sought to interpret how teachers and students make sense of their field experiences, and how field-learning experiences cross over and connect into classroom learning more broadly. According to Punch (1998 p. 21), ethnographic data collection is "eclectic, not restricted". Even though my study employed a range of data collection techniques, as suggested by Punch (1998), it is the interpretation of data from a range of perspectives that is important to the ethnographer.

An aspect of educational ethnography that Delamont (2014) considers to be important is to take the standpoint of the 'other'. In reference to Punch, the research data collection in this study was eclectic. Indeed, I have been a school 'insider', and working with Bug Blitz I have taken the standpoint of the other from a non-formal education perspective. These varied perspectives have enabled me to contribute to EfS discourse from outside a formal school setting, as well as inside settings. My role has been, very much, that of a participant observer. The ethnographer's role is concerned with interpreting the data accurately and deeply, with the understanding that there will always be uncertainty associated with the nature of the qualitative process.

According to Punch (1998, p.161), ethnography is likely to be an unfolding type of research, of which fieldwork is a central part. This is true for my research as it was located in environmental field settings that promoted EfS and included both natural habitats and school settings. As discussed above, understanding the point of view of the participants of the field in which they are being studied is a crucial part of the ethnographic approach (Liamputtong & Ezzy, 2005). However, in the spirit of ethnography, I was interested further still in exploring the cultural underpinnings of the participating schools, including their shared beliefs, values,

norms etc., and the potential impact of these school cultures on field and post-field learning, including the barriers and enablers for field and post-field learning. There is a great need to explore the value of biodiversity field days as a way to improve EfS.

This research seeks to understand the lived realities of field workshop facilitators, teachers and students in an outdoor setting or field location, as spaces and places are important in educational ethnography (Delamont, 2014). As well as field learning, an ethnographical methodology has been useful in exploring post-field learning, from student and teacher perspectives. I have gained insights into three separate cultures: field presenters, students and teachers. On my own learning path I have been the student, the teacher and the field presenter, and now as a participant observer I seek to understand how these perspectives interact to enhance environmental learning.

4.2.3: Participant observation

Punch describes participant observation as "a central ethnographic data collection technique" (1998, p.188), and includes observations of, and interactions with participants or 'fieldwork' (Paul ten Have, 2004). Participant observation is defined as "a method in which a researcher takes part in the daily activities, rituals, interactions, and events of a group of people as a means of learning the explicit and tacit aspects of their life routines and their culture" (DeWalt & DeWalt, 2011, p. 1). It includes an amount of genuine interaction with subjects in the field, some observation, some systematic counting, some collection of documents and informal interviewing (McCall & Simmons, 1969; as cited in Paul ten Have, 2004, p. 107). These indicators of ethnography exist in my research.

I have sought to understand the connections between field and classroom contexts using a variety of approaches, including direct observation of situated activities and "the actual lived reality" of teachers and students (Paul ten Have, 2004, p. 108). Although I was involved in the lives of participants in the field events, I could not describe my involvement as taking part in the 'daily activities' of a participant like that suggested by DeWalt and DeWalt (2011), as an everyday presence. The participant observer role I undertook in this research is closer to

that described by Pelto (2013) who argues that most participant observation takes the form of the observer residing near the research community, and "moving about the community becoming known to many people in the study population, and getting the chance to observe a variety of different activities" (p. 129). I was actively involved in field events for the entirety of each field day, presenting a field workshop, and I visited schools during the research.

Collecting video data acted as a kind of participant observation, at one of the field days in my study, and allowed me to observe the different field workshops and how field presenters delivered them. This data also required me to examine my own field workshop presentation. In this scenario, ethnography places two demands on researchers: one observing a setting and collecting data, and the other directly involved themselves as the objects of inquiry (Silverman, 1997, cited in Freebody, 2003, p. 76). Finding ones place in the research, as researcher, as Green (2011) suggests, is important and can lead to the emergence of new knowledge, and like Green, I did not want to locate myself in this research as a detached observer, only looking in from a non-formal educator's perspective from outside schools.

As well as presenting field workshops, I participated in some classroom activities, as both a participant and an observer. These activities included student interviews, student Mindmaps, an art activity, comparing photo samples of bugs and sharing poems at the opening of a group biodiversity artwork in a local park, which was installed about three months after the student field day.

Even though I was not embedded in the school settings each day, I felt as though I was part of the school's community. I felt familiar with the schools and the student participants after visiting several times, and from existing connections I had with them in previous years. There was willingness from the teacher and student participants, who subsequently felt comfortable freely giving information during my visits and interviews (Pelto, 2013). Having been a teacher in the area for a long time I knew many of the teaching staff of both of the schools in my study, and for this reason the teachers felt comfortable co-operatively planning the field days and the follow-up projects with me in my role as Bug Blitz Program Director.

Thus in this research, I was not a participant observer in the traditional sense of the word, that is, 'embedded' in the daily lives of the participants or culture being studied, living as part of the everyday culture as Tedlock (2005) describes, but rather as an observer participant who was associated with a number of different events or interactions with the groups being studied (Burke et al, 2014). While a disadvantage of this approach is the difficulty in obtaining an insider's view of the research context (Burke et al, 2014), having been a teacher in schools for a long time, I understood the school cultures I was examining from an insider's view, whilst simultaneously gaining an outsider's perspective from my work with Bug Blitz. I have found these two perspectives to be remarkably similar yet at the same time remarkably different. These elements of positionality, insider and outsider, are now discussed further.

4.2.4: Positionality: In between emic and etic perspectives

Agar notes that both 'emic' and 'etic' (insider and outsider) frameworks can work effectively together for comparing, describing and explaining experiences of particular cultures (2011, p. 39). In reference to these frameworks, I had dual roles as researcher in this study, and was positioned as both 'insider' and 'outsider' to the school system, which impacted the way the research unfolded. For example, I was:

1. Event planner as Program Director for Bug Blitz
2. Workshop facilitator during field experiences, and
3. Participant researcher.

When I began this research, I was teaching in a primary school and located in an 'emic' position, that is, inside the school system. This provided me with a sound understanding of daily school life, and how it can impact student learning in field and school contexts. Shortly after beginning the research, my position in this study changed as I took an environmental educator position with Bug Blitz, (as described, in Chapter One), and assumed a more 'etic' position; that is, I was more of an outsider to schools than I was before. This gave me an additional perspective of being independent of the school system and able to look back objectively in order to offer meaningful insights that contributes towards how to

improve biodiversity education in the context of EfS.

Having been a teacher for a long time in the same region the study was located in, I have been able to relate to the groups involved in my study: field presenters, teachers and students alike. Now working for a not-for-profit environmental organisation providing EfS events, I have a more 'outside' or 'etic' perspective. As Pike has argued: "Emic descriptions provide an internal view, with criteria chosen from the system" (Pike, 1967; as cited by Paul ten Have, 2004). Being free from the constraints of school systems allowed me a greater sense of objectivity and freedom to choose my own criteria for study.

Undertaking research has provided me with opportunities to examine the questions of this study from both perspectives, correlating with Hoare, Buetow, Mills and Francis' (2012) view that researchers can move along a continuum between 'emic' and 'etic' positions making the research more thoughtful and reflective. Indeed, I feel I have moved along a continuum in this research between 'emic' and 'etic' perspectives in the belief that this can lead to generating new insights into the impact of environmental field programs.

Before outlining the methods I used in this study, the next section will provide a geographical location to show the vast region of Gippsland, and to briefly describe the participant schools in the context of their locations.

4.2.5: Geographically locating this research

The region of Gippsland occupies 41,556 square kilometres of Victoria. Beginning on the outer eastern edges of Melbourne, Gippsland is a rural zone that covers the south-eastern part of the state, running all the way to the N.S.W. border. Gippsland is divided into four sub-regions: south Gippsland, Latrobe Valley, west Gippsland and east Gippsland. The region is associated with the coal power industry of the Latrobe Valley, timber, oil, agriculture, and tourism sites like the Gippsland Lakes Coastal Park and the Alpine National Park. The Gunnai-Kurnai people are the traditional owners of most of the Gippsland region, excepting parts of south Gippsland, where the Bunurong people are the traditional owners. Sale is located in west Gippsland, whilst Toongabbie is on the edge of the Latrobe Valley (see Figure 4.1).

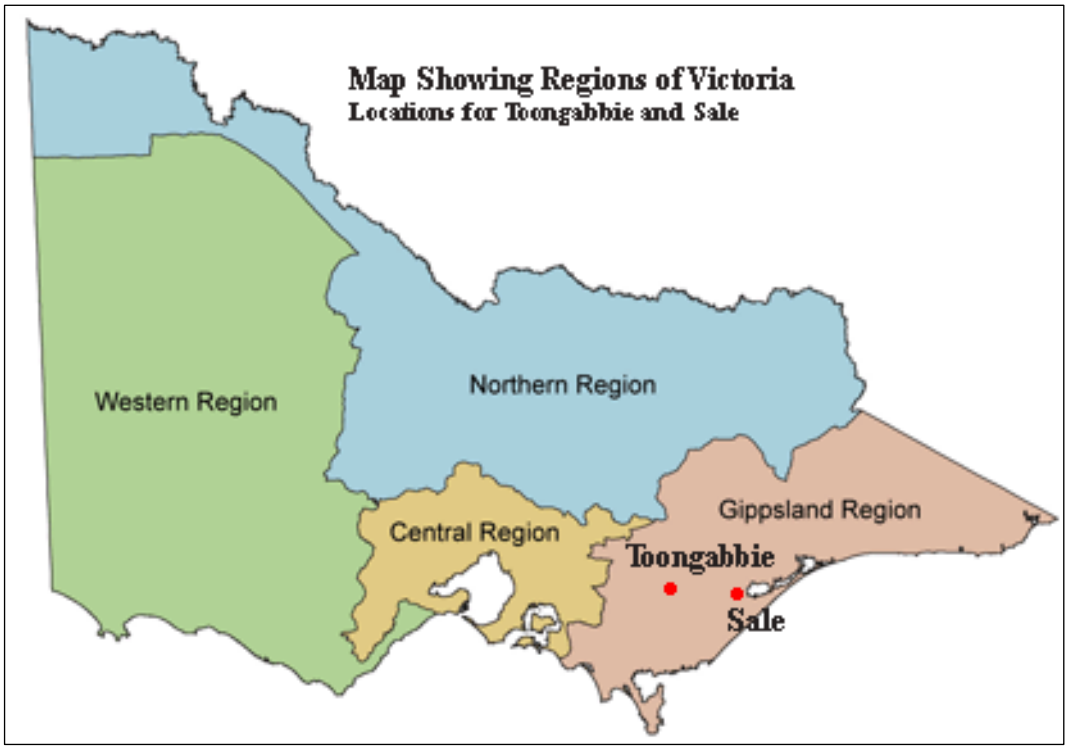


Figure 4.1: Locating Gippsland, Toongabbie and the city of Sale

Background of Participant Schools

Sale 545 Primary School

Sale is a large regional city with a population of approximately 15,000 people. In 2012, Sale 545 Primary School had a student population of around 450 students and a staff of 25 teachers. The socioeconomic status of the school's population can best be described as middle class. At the time of the study, the school was a member of the Resource Smart Aussie Vic. Sustainable School's program and received a grant to reduce rubbish and improve recycling in 2012. The school has an established vegetable garden program with associated learning integrated into the school's curriculum and is supported with a part-time teaching allocation. As part of their sustainability curriculum the school has two environmental student clubs: Garden Gorillas and The Green Team.

The field event for the school reviewed in this research was located at the Sale Common, part of a major wetland ecosystem of the Gippsland Lakes, and a 10-minute journey by bus from the school. The children who participated were aged about 10-12 years old and were in years 5/6. In 2012, there were five year 5/6 classes with approximately 27 students in each class. I received permission for 20

to participate at School One. Teachers worked together to plan curriculum in teams, which they are required to do by school policy.

Toongabbie Primary School

Toongabbie is a small rural town located about 20 kilometres northeast of the Latrobe Valley in Gippsland. The town has a population of around 900 people of mainly Anglo/European decent and is located in a farming community, close to the major industrial city of Traralgon. In 2012, Toongabbie Primary School had around 70 students and six teachers. The socioeconomic status of the school population is described as middle class. Toongabbie Primary has a vegetable garden. The school includes the Carbon Kids program in their school curriculum and they have participated in annual Bug Blitz programs since 2008.

The location for the research field event, the Toongabbie Wetland, is a small man-made wetland reclaimed from land where the town's railway station once stood, and is a short walk from the school. In 2012, there was one grade 4/5/6 class with 27, 9-12 year old students. I received 12 parental permissions for students to participate, however due to student absences on the scheduled interview days, only eight of the participants submitted Mindmaps and seven were interviewed at Toongabbie. The classroom teacher was responsible for preparing curriculum for the upper-school.

Having outlined my methodological approach to this research, the following section explains the methods I used for the collection of data. These methods are part of the ethnographic and grounded theory research framework, as I have discussed earlier in this chapter.

4.3: Method and data collection

In keeping with a qualitative approach, I have used four different data collection methods to inform my study; interviews, video data, student document samples and field notes. This section explains how collecting field observation data enabled me to consider insights about field-learning goals, pedagogical approaches and student learning. Collecting video data and the interview process involving students and teachers is also outlined, followed by a description of the

student document samples I collected to examine field and post-field learning, and triangulation examples of student learning across my data, are provided. This section finishes with a description of the process of participant recruitment used in this study, and procedural explanations of the phases of the research as they were implemented.

4.3.1: Field observations (Video Data-School 1, Field Notes)

All Bug Blitz programs begin with a field experience, and as I have explained in Chapter One of this study, two field events (one with each school) have been the focus for this research. As a participant observer, I decided video data would be an effective way to gather data for my research.

4.3.1.1: *Video data*

My role during the two field events was as a workshop presenter. Given my role video data was determined as an effective method for data collection as, "in some situations it is impractical to collect observational data at the same time the critical behaviour is occurring" (Borg & Gall, 1989, p. 486). Having organised all of the field workshops as part of my role as Bug Blitz Program Director, I was familiar with the outlined plans of each workshop presenter, and how a balance of activities and topics were to be covered prior to each event. I wanted to be able to hear, word for word, and observe each workshop facilitator in action so I could assess the key concepts presented. This included: the key environmental concepts presented and the teaching approaches used; the resources and aids used by facilitators to introduce and reinforce concepts; and to observe the general ways students were engaged and interacted during field workshops. Face to face interaction is an immediate form of social reality, a way to analyse the talk of situational experiences (Perakyla, 2004, pp. 874-875). The video data provided a rich medium for achieving this, and enabled me to estimate the time structures of field workshops.

I was interested to explore how students and teachers perceived different pedagogical approaches in the field, and any correlational evidence indicating

student preferences for particular pedagogies during the process. Comparing video and interview data has provided some evidence of this, which is discussed at length in the analysis chapter of this study. To collect the video data, I enlisted the services of an independent videographer to record the field day experiences of Sale 545. I instructed the videographer to focus on the workshop facilitators, as they presented their activities in the field, and to remain in the position of a detached observer not interacting with the research participants at all.

Furthermore, I had transcripts of the video data made as, "for close study of language trends, video transcripts are reliable in microteaching studies" (Borg & Gall, 1989, p. 487). The costs of undertaking this process, and the amount of data it produced for a single researcher to analyse, resulted in my decision to undertake this process at one field day only. Further, obtaining ethics permission to collect video data involving children is difficult. I invited 54 students to participate at Sale 545 and I received 20 parental permissions from the children to do so. The 20 student research participants from Sale 545 were allocated to a separate group, in the field, and were accompanied by one of the teacher participants to fulfil ethical requirements regarding video capture of children.

In this way, using video data enabled me to assess how one of the field days transpired. Similarly, it was helpful for describing and comparing field experiences, and for identifying correlations of student perceptions of learning, which were illustrated on the student Mindmaps, and also appeared in student and teacher interviews. Information and communication technologies such as video data can provide a wealth of evidence to support research and the development of grounded theory, however as Birk and Mills (2011) highlight, we need to be aware of its limitations. An example of this was when the videographer turned the camera off before one activity was completely finished. The video missed 10 minutes where students walked back to base, through the wetland, interacting informally with peers and the workshop facilitator. This example reveals how collection of video data can be susceptible to human error and technological glitches, and is a weakness of this data method alone.

At the second field event I did not use video data, but instead collected field notes after talking through the workshops with their facilitators, as discussed below.

4.3.1.2: *Field notes*

Some ethnographers describe field notes as positivist; a remnant of the colonial past where ethnographers journeyed into newly conquered countries to document indigenous cultures, which were seen as primitive at the time (Denzin & Lincoln, 2005b), whereas others see them as a tool that is valuable and valid in modern contexts (Pelto, 2013). For some, field notes present problems of voice and reflexivity because the person responsible for writing up the notes is in a position of unequal power (Olesen, 2004). With all of these considerations, field notes have been a minor part of data collection in my study.

I used field notes to record a brief description of the field workshops at the second field day event, which Toongabbie attended. I have included a section from field notes I collected during a post-field visit to Toongabbie on the 20th of November, 13 days after the field day event. In this example, I was able to obtain a recount of the workshop Lisa (the school principal) presented in the field and gain an understanding of the pedagogical approach she used in her workshop. A sample is provided in Figure 4.2, which follows.

I also had a discussion with Lisa, the principal of the school, who presented an activity in the field. Lisa presented an art activity where students made group sculptures using natural and found materials. Lisa had to suddenly replace an artist presenter who had to withdraw from the field day so she had only very short notice, 2 days, to devise the activity.

The key concepts of Lisa's workshop

Making artworks from found and natural materials

Recycling and returning the materials back to our environment after completing the sculptures

Being creative with materials that are natural

Students using their imagination

According to Lisa, the students were making connections between food webs and other things whilst they were making sculptures such as: What materials could they find to make a web?

The activity was cooperative and in small groups. Students could move between sculptures and could contribute to various works. Artworks were cumulative in that children kept adding to the artworks from group to group. They could choose to start again or they could continue working on an existing artwork from a previous group.

Figure 4.2: Example of Field notes: Toongabbie PS 20/11/13

Whilst some of the field notes I collected related directly to field days, such as short post-field recounts of facilitators describing the main aims of their workshops at Toongabbie, others were short reflections of post-field visits I made at both of the schools in this study. In contrast to field notes, I found the teacher and student interviews to be far more valuable for analysis.

4.3.2: Interviews

As part of the interview method I conducted face-to-face, semi-structured interviews with both teachers and students. Fontana and Frey (1994 cited in Punch, 1998) suggest there are three types of interviews; structured, semi-structured and unstructured. Punch (1998 p.175) argues that, "whichever typology we use, the main dimensions of this variation are the degree of structure in the interview, how deep the interview tries to go, and the degree to which the

interview is standardised across different respondents and situations." For the purpose of my research I sought structure through having a number of guiding questions that enabled the exploration of the interviewees perceptions of student learning, as the interviews unfolded.

Interviewing needs to be conducted in a sensitive way, with good interviewers recognising that a sensitive approach can influence responses (Fontana & Frey, 2005, p. 703). Tensions can be created with participants being observed as they can feel threatened because their practice is being evaluated, interviews recorded etc., and the ethnographer needs to be extremely sensitive to this so as to reassure the interviewee that they are contributing to valuable knowledge to an important field (Paul ten Have, 2004). When interviewing students and teachers, I was conscious of the power relationships between myself as researcher and the interviewees, so as not to create an "I ask, you answer" basis where the interviewees could feel subordinate (Green, 2011). With time constraints for interviews, I struggled as a first time researcher to avoid what Matthews, Limb and Taylor (as cited in Green, 2011) liken to a 'snatch and grab' process where, like a burglar, a researcher moves in quickly, steals the loot and quickly moves away.

As the interviews progressed I became more relaxed and confident at working within the time constraints imposed. The interview process began with the students. A list of the questions I used to guide the student interviews can be found in Appendix D – Questions for Students, on page 260.

4.3.2.1: *Student interviews*

In this research I have attempted to provide students with a voice, as understanding their place and roles in environmental education is an important starting point for educators (Hacking, Cutter-Mackenzie, & Barratt, 2013). In defining 'student voice', Conner, Ebby-Rosin, and Brown (2015) purport it is a strategy that engages student views on educational experiences as a way to encourage change in educational practice. In research about design in school gardens, Green (2011) argues that students are not pre-adult versions of themselves, and have unique perspectives and ways of interpreting of their

ecological experiences. For these reasons, she believes it is important to give students 'voice' so we can learn more about the multi-faceted ways they learn and experience place.

Having extensive experience working with children in classrooms as a primary teacher, I felt confident in being able to quickly develop rapport with students. My aim as the interviewer, was to create a situation where the interview becomes like an easy conversation (Paul ten Have, 2004). Students' perceptions of their learning experiences are central to this study. I began interviewing students four weeks after their field day experiences. Interview durations were from 6-35 minutes in length, with most being around 15 minutes.

The teacher participants and I had agreed that I could interview the students at Sale 545 over two half-day visits. Due to an outbreak of illness at the time, a number of students were absent on the planned interview days and this reduced the final number from a potential 20 interviews, to a total 11 students in age range from 10-12 years old. The students at Sale 545 were interviewed, 27-28 days after the field event.

At Toongabbie, I received 12 participation consents from students and, a total of seven students in age range from 9 -12 years old were interviewed. Students were interviewed 24 days after the field event, and the interviews were carried out in a room adjoining the students' classroom. Because I was a teacher with relevant working with children in schools permission, I was allowed one-on-one access with the students. These interviews were between 5-24 minutes in duration.

Conducted Interviews (Total 21)	Participants
Sale 545 Primary (13)	• 11 students • 2 teachers
Toongabbie Primary (8)	• 7 students • 1 teacher
	Students= 18 Teachers = 3

Table 4.1 Conducted Interviews – Student/Teacher Numbers

All interviews were digitally recorded using audio recording software called Cool Edit Pro. A dynamic microphone (picks up clear audio 400-800mm away from the source) was used, as they are less intrusive for children. The interview recordings of students and teachers completed in this way were clear and easy to decipher, resulting in accurate transcriptions. I transcribed two student interviews to experience the process of undertaking this task, and I had the other 16 student interviews and three teacher interviews transcribed professionally by a university recommended service. According to Green (2011), transcription of interviews provides the researcher with access to return to conversations, making immersion in data more efficient.

An issue in interviewing approaches is the 'matter of degrees' between totally structured and totally unstructured approaches, with semi-structured being a sensible compromise and choice (Wellington, 2000, p. 74). In my circumstances, nine guiding questions were used for students (see Appendix D). The interviews ranged from being like easy conversations (Paul ten Have, 2004), to more structured interviews where less talkative students waited for the next question to answer.

Two important dimensions of this research were to investigate what students learnt during the field day experiences, and to determine if such experiences stimulated further learning back in schools. As part of student interviews, I included questions to find out what they had enjoyed about their field experiences

and whether or not learning back at school connected to the field trips. To serve this purpose I asked specific questions such as: *How did you enjoy the field day experience?* And: *Can you tell me about any related activities you did after the field day, at school?*

Questions regarding student feelings about science and our environment were also included in interviews. For example: *How did participating in the program make you feel about science and the environment?* During the interviews I wanted to explore students' feelings about the activities they experienced in the field, for example, which activities they enjoyed and why. I included questions like: *What makes a good activity in the field?* I also included the question: *Did your field experiences motivate you to do more study back in school?* The semi-structured interviews also provided important insights into the workshops students preferred such as interaction with and handling animals (e.g. snakes, frogs, bugs), and workshops containing the greatest amounts of student activity. I compared the pedagogical techniques and approaches used with the learning outcomes evidenced in both field and school contexts, to find out if particular learning approaches were preferred by students.

Understanding student perspectives and interpretations of their ecological experiences is important in this research, and acknowledges that students have a role in shaping their experiences and change in EfS. I also used interviews to investigate teacher perspectives of field and post-field learning (see section 4.5: Ethical considerations, for the ethical processes and considerations for these interviews). The next section outlines the structure and time frames of the teacher interviews.

4.3.2.2: *Teacher interviews*

Teacher perceptions of student field learning experiences and how they connected their classroom studies post-field are a central aspect of this study so interviewing these educators was very important. Three teachers agreed to participate in interviews for this study. A list of the nine questions I used to guide teacher interviews is included in this thesis (see Appendix E: Questions for Teachers p. 261). I asked them to assess the field days as environmental education

experiences, before asking them how they connected their field experiences with classroom learning and school curriculum. My first consideration was to make the teachers feel comfortable and not like they were 'being assessed'.

Teacher interviews lasted anywhere from 34-52 minutes in duration, and were conducted six weeks to three and half months after the field day. Although I originally intended to interview teachers three to five weeks after the field day, timetable changes and teacher circumstances delayed the interviews. One of the teachers at Sale 545 was absent for approximately one month after the field day, and she felt a little uneasy with the time delay. She was also concerned she would not remember enough detail so long after the field day. However, the results from her interview provided valuable insights and perceptions about the research topic, and from my perspective, the time delay deepened her recollections and perceptions.

I returned the transcripts for the teachers to review, and they accepted them as a true record of their interview and required no changes. As well as gaining detailed interview data from teachers and students, I also chose to examine student document samples in order to assess some of the post-field learning that had occurred.

4.3.3: Student document samples

I collected three types of student document samples: student Mindmaps, students' published writing and some other examples of student classwork. As is stated by Birks and Mills (2011), concurrent generation of data is reminiscent of grounded theory, as data is generated as the study unfolds. This was the case regarding some of the student document samples in my study. I did not initially plan to collect samples of students' published writing, but have found them very useful for interpreting how teachers integrated field experiences with classroom learning. The work samples provided concrete evidence of the different subject disciplines integrated into the writing project, at Sale 545 primary. Around 100 year 5/6 students from Sale 545 each wrote and published a page for a combined book called, *Reflections of Biodiversity*. Interpreting the process provided a glimpse into some of the post-field learning the students at Sale 545 participated in. I also

collected student Mindmaps, which were completed by students from both schools, around three weeks after the field days.

From the beginning of this study, I decided to use a concept mapping technique to assist students to graphically organise and represent their perceptions of learning in both field and classroom contexts. According to Bowker and Tearle (2007, p. 89), concept mapping was pioneered by Novak and Gowin (1984). There are now more cognitively-demanding forms of simple diagrammatic representation and concept mapping, such as a 'Mindmap' (Buzan, 1993), in which interest is concerned with what a child knows, rather than how accurately she/he recalls what she/he has been taught.

4.3.3.1: *Student Mindmaps*

Document analysis is a key method for collecting data in ethnographic studies (McMillan, 2004). Using Mindmaps in this research provided a consistent process for gathering student perceptions of what they learnt during field days and back at school. Using the cumulative ideas method of Mindmaps, key words stimulate further word associations about a given problem or topic. I believed that a Mindmap approach would stimulate a good number of student responses to the topic, yielding sufficient information for the purposes of this research. I also chose this method because children can complete Mindmaps in 90 minutes of class time, making this approach reasonably unobtrusive in the busy lives of teachers. In total, I collected 21 student Mindmaps and the table below details school locations and student numbers.

In Buzan's (1993) view, Mindmap experiences engage both the left and the right hemispheres of the brain through combining text with pictorial representation of knowledge. However, there are scientific doubts with Buzan's left and right brain theory according to Elhoseiny and Elgammal (2016) who state, neurological studies suggest the brain hemispheres interact interdependently and no evidence of hemisphere bias has been found in neurological monitoring of the human brain. Regardless of this, Elhoseiny and Elgammel believe evidence shows that Mindmaps can be a valuable tool for encouraging student learning, joint text summarisation and visualisation. Research involving pre-service Kuwaiti science teachers use of Mindmaps for facilitation learning and digital analysis generated

from text (Safar, Jafer, & Alqadiri, 2014), found Mindmaps are valuable for assessing conceptual changes in a range of experimental and classroom environments. Of growing benefit to teachers is the availability of digital Mindmap generation from existing text sources, as a technique and form of evaluation (2014), which shows a growing recognition and ways Mindmaps are being used in research. In a quasi-experimental study exploring the use of Mindmaps in science teaching and student learning, Balım (2013) states: based on constructivism, Mindmaps help students to assimilate information, think, develop conceptual knowledge and find solutions to problems through practice.

Collected Mindmaps (Total 21)	Participants
Sale 545 Primary (13)	• 13 students
Toongabbie Primary (8)	• 8 students
	TOTAL = 21

Table 4.2 Collected Student Mindmaps – Locations and Numbers

I collected 21 Mindmaps and conducted 18 student interviews. The 18 students interviewed, also completed Mindmaps. Outlining the process as it occurred, and providing an example of a Mindmap that I used to present to the teachers prior to beginning this research, is useful here for understanding this form of data visually.

On June 13, 2012, two weeks after the field day, I met again with the teachers from Sale 545 to revisit the process of implementing the Mindmaps as a form of data I wished to collect. I gave teachers a small handout containing information about Mindmap theory and visual examples, one of which is shown below.

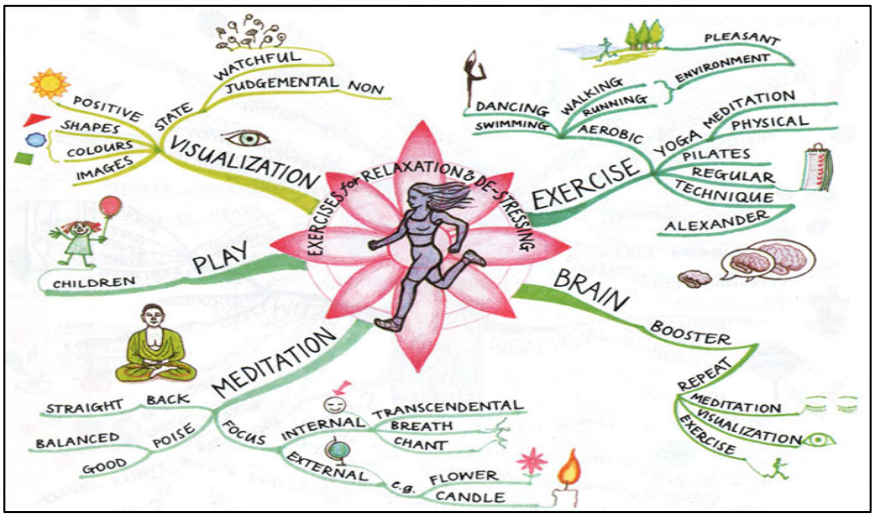


Figure 4.3: Demonstrating Mindmaps: Teacher sample

One of the main ideas behind Mindmaps is that they can be used as an aid to verbally re-tell and trigger memories for sharing learning experiences or information about the topics of inquiry. I used the Mindmaps for two purposes in this research:

1. To look for categories of learning from field and classroom contexts
2. To enable students to use their Mindmap to encourage conversation during interviews.

As mentioned in the second point, the Mindmaps were able to support student conversations during the interview process, and provided evidence of field and classroom related activities. Most of the students chose to use their Mindmap in this way as an aid for sharing their perceptions.

The Toongabbie student participants considered the Mindmaps to be an example of post-field related learning in their school. I also collected evidence of post-field learning from incidental conversation with teachers willing to share outcomes of their classroom programs, and from the final results of the writing project Bug Blitz and Sale 545 negotiated prior to beginning the program. I will describe some selected pieces of student writing that were published in the school's book, as I describe earlier (see p. 90). Using student document samples, I hoped to examine ways the teachers' integrated research, literacy, science and digital tools in classroom learning.

4.3.3.2: *Student published writing and work samples*

As a teacher, I remember reading 1000's of pieces of writing produced by my students. Reading and evaluating student writing is a stock practice in a primary school teacher's life, and they are generally good at using student writing as a method for investigating learning outcomes. Collecting examples of student writing for evaluation purposes, felt like a natural process for me as a teacher.

At, Sale 545, the teachers and Bug Blitz agreed on the follow-up project during the field program planning. This project involved each student completing an A4 sized piece of published writing that related in some way to the theme of biodiversity and our environment. Some members from the local University of the Third Age (U3A) were invited to contribute a page to this book, adding another layer of socially constructed knowledge.

The book contained a range of styles of writing focused around the theme of biodiversity. The year 5/6 students chose mainly to write on the topic of 'bugs'. I had not suggested a particular topic within biodiversity and believe they chose 'bugs', rather than birds for example, which they also studied during the field day, because they associated the project with Bug Blitz. I had no input into the writing topics for the students' book, besides helping with the publishing costs, providing assistance with the layout and organising the book to be published. In the case of the student book *Reflections of Biodiversity*, Bug Blitz Trust spent some time formatting the publishing layout for the book, and paid for two hard-covered copies to be printed and bound. When the teachers gave me copies of the student works to share with colleagues, I realised they contained rich and valuable data for assessing the impact of field and post-field activities.

At Toongabbie Primary, a follow-up project with students was planned, however the original field event took place in late November 2012, so staging a family event was overly ambitious given reporting and end of year demands on teachers, and it did not occur. However, when I visited the school post-field, the teacher gave me some samples of poems students had written. The students also wrote letters thanking Bug Blitz for organising the day, which I received. The letters demonstrated how the teacher used the field event as a motivation for a handwriting lesson. The teachers from both schools gave me student recounts,

which I had not anticipated receiving. The range of student document samples I collected has provided rich data for analysis.

4.4: Data Analysis

Data analysis proceeded according to the grounded theory methodology with a series of steps occurring in a sequential, yet cyclical, process. As is typical of grounded theory according to Clarke (2005, p. 8) who states, "many different phenomena and many different properties can be named, tracked, and traced through reams of all different kinds of data. There is no one right reading in grounded theory."

I used a variety of data types to identify evidence of student learning in the five domains of eco-literacy: knowledge, dispositions, competencies, environmentally responsible behaviour and contexts of learning (Hollweg et al., 2011). I will apply Hollyweg et al. framework for assessing the field programs, in this research thesis, to determine if student experiences have any influence on improving student eco-literacy, particularly when field and classroom learning are connected.

Examining various learning contexts reflects situational analysis in grounded theory, where an ethnographer moves between contexts to investigate participant experiences, investigating the phenomenon of interest (Clarke, 2005). This research thesis investigates the values students and teachers attribute to biodiversity field day experiences, student environmental learning, and how teachers connect field and classroom learning to develop student eco-literacy. Implicit in the study design are a range of different situations where the phenomenon being investigated occurs. In this way my research is grounded in places. Like the American philosopher George Albert Mead's (1932) concept of perspective in grounded theory, where differing perspectives dominate the interpretation of data (Clarke, 2005), this analysis is also concerned with interpreting different perspectives of student biodiversity learning experiences and their effect on developing student eco-literacy.

In considering eco-literacy to examine the environmental learning experienced by students, I chose to use a simple example of an experiential learning cycle devised by Kolb (1984a), as a way to investigate if the four stages of learning were

apparent in the process of learning in field and classroom contexts, over time. Criticisms of Kolb's learning cycle include ongoing questions of data reliability, as the four-stage cycle represents stages of learning, rather than styles of learning, as Kolb believes it does (Bergsteiner, Avery, & Neumann, 2010). A further criticism of Kolb's experiential learning cycle is the subjective interpretation required to rationalise concepts like abstract conceptualisation, observation, experience and experimentation. Reminiscent of a grounded theory approach (Clarke, 2005), I used open coding to categorise and compare interview data to investigate if an experiential learning cycle was evident in the students' experiences, and if so, did this appear to influence the development of student eco-literacy.

Using an interpretive methodology to analyse video data from Field Day One, I determined and listed the key learning aims of each workshop facilitator (see p. 108). In watching each workshop on DVD, I made general observational assessments of the pedagogies and lesson structures the field presenters had applied to determine how environmental concepts were introduced, the teaching aids used and the types of activities students completed.

As Clarke (2005) purports in her exploration of grounded theory, one of its core criteria is that it is open always to modifiable responses to new data. On watching the video data repeatedly, I noticed that the field workshops appeared to vary in student activity, so I decided to measure the direct student activity time involved in each workshop at Field Day One to investigate if such differences had any influence on student learning. I completed this task by using a stopwatch to time the amounts of student activity in each field workshop. A simple criterion was chosen to measure direct student activity time. In direct student activity time, students are participating in an activity as opposed to passively listening to group instructions or group explanations. Reflecting Clarke's (2007) view of grounded theory, differences between the phenomena being studied can appear as the researcher explores the data. It is acknowledged that this method does not provide an exact measurement of student activity time; it is rather a close estimate of two variables, student activity time and teacher whole-group instruction/explanation time. Based on interpretation and subjective analysis by the researcher to frame the criterion for measurement of student activity time, the outcomes are probably

not generalizable in other research contexts. In grounded theory research, Clarke (2005) believes a vitally important part of researcher reflexivity is to show themselves in and through analysing what 'we' do, as well as what 'they' do. Even though such mixed-methods approaches are not unusual in grounded theory (Glaser & Strauss, 1967), this study is qualitative and was never intended to be quantitative in any way.

Completing transcripts of the field presenter workshops from the video data meant I could use multiple forms of discourse—narrative, visual, historical, and in varied combinations, as is typical of grounded theory (Clarke, 2005). Doing this revealed the role stories and place pedagogy play in developing student eco-literacy.

It is believed two explicit goals of grounded theory are to build on potential differences, making them more visible and making the silences speak (2005), which is a feature of situational analysis and useful for comparing the two field locations in this research project. The main purpose of collecting field notes was to identify the field presenters' workshop teaching aims and descriptions of the activities the students experienced in the workshops at Field Day Two. Collecting field notes enabled me to make general comparisons of the similarities and differences between the two field day programs.

Semi-structured interviews allowed me to examine students' perceptions of the value of field experiences for environmental learning. In directly asking students what they learnt during the field day, provided me with a natural place to begin open coding. In defining initial-stage coding in grounded theory, Glaser and Strauss (1967) distinguish two types: substantive and theoretical. Substantive coding uses the respondents' words, ideas, observations and behaviours to identify categories (Oktay, 2014). Using an in-vivo approach, using words drawn directly from responses (2014), categories of similar words, used by multiple students to explain their experiences, were identified: excellent, engaging, fun, seeing things, 'hands on' and motivating were categories that appeared from the data. From a theoretical perspective codes come from the analyst doing the coding (2014), and categories like key learning concepts, elaborated on key concepts, feelings and learning 'in' 'about' and 'for' the environment were derived in this way.

To analyse student learning, three further broad categories representative of my research questions were used, which Oktay (2014) describes as the second stage of open coding in grounded theory. These categories are: field learning, connections between field and classroom learning and what did students learn during the program? Using textual and discourse analysis, my aim was to identify statements used by multiple students, as they related to the questions of my study. I identified learning themes within each broad category and used these themes to identify evidence of student learning in cognitive, affective and behavioural domains of learning. Other themes identified in student interviews include the social-construction of knowledge, post-field studies and action learning 'for' the environment.

On analysing teacher perceptions of student learning, five general categories appeared from within my data: field learning, building connections between field and classroom learning, student learning in the program, teacher environmental learning and barriers to field learning and EfS. I used textual and discourse analysis to interpret and codify my data into the relevant categories. The first category, field learning, investigates the qualities teachers' perceive of student field learning experiences and includes sub-categories like: engagement, new information, Aboriginal knowledge, embodied learning, seeing things for themselves, interacting with animals and student motivation. For each category, further sub-categories were drawn by interpreting common themes in teacher discourse and textual analysis, as is usual in a grounded theory approach which includes working up from the data (Clarke, 2005). The small sample size of teachers (3), limits the generalizability of any results.

The students at both schools completed Mindmaps, which they titled Biodiversity and Environment: What I've learnt. The Mindmaps were used to encourage student conversation during interviews, if required. They were also used to look for categories and examples of student learning from field and classroom contexts, which may correlate with similar themes emergent from my other data sources such as, field learning, post-field classroom learning, biodiversity, human impacts, Aboriginal knowledge and environmental feelings.

The main themes were clearly provided on the Mindmaps, as students had labelled the branches on their own documents, guided by their teachers. At Sale

545, most students named the branches on their Mindmaps using four to six of the following categories: Bug Blitz, ecosystems, human impacts, feelings, plants, Aboriginal culture, living/non-living, insects and classroom. At Toongabbie most students used: bugs, reptiles, Aboriginal culture, macro-invertebrates, art and at school as categories. Again the differences between the Mindmaps from each school are apparent, Sale primary school included greater references to post-field classroom learning, whereas the Toongabbie Mindmaps focussed mainly on field learning experiences.

Being based mostly on single words and short phrases, I used a small number of Mindmaps to make judgements about student learning using Palmer's (1998) framework of learning 'in' 'about' and 'for' the environment. I selected two Mindmaps, which showed a reasonable number of student responses for this task. I circled all of the words or short phrases, which I interpreted as examples of learning 'about' biodiversity, on a small number of student Mindmaps. I did this to interpret the influence and extent of these elements in the student learning process.

I also interpreted Mindmaps to examine how students elaborated on streams of learning in field and classroom contexts. The final form of data, which appeared as my study progressed, was 105 samples of students' published writing, the topics of which were associated with the field experiences.

I selected a number of student documents as examples illustrating the different criteria I used in my analysis. The selection of student documents was not random and the results of my interpretation are therefore not generalizable. It is important in grounded theory methodology according to Robertson (2007), to remain open to new and emerging theory whilst simultaneously recognising issues of researcher bias and subjectivity, as we all have some preconceived notions of what our findings may reveal. With such a large body of data, I had to choose a small number of samples of student writing, which represented common themes apparent in student learning and also informed my research questions. I did this by reading all of the students' writing and selecting a small number of good examples, which represent some distinct themes and genres of writing used by the students.

By interpreting the students' published writing samples, I have been able to: make judgements about student research; assess the forms and environmental concepts in student writing; interpret the types of experiential thinking students applied in the process; and explain a variety of ways teachers integrated tasks across the curriculum to develop student learning.

Assessing the students' writing also enabled me to identify some direct links students made between field and classroom learning. Having examples of published writing demonstrates how a school-based project-learning task was integrated and connected with the field experiences in this study, to develop student environmental learning. The writing samples also allow a glimpse into the affective learning experienced by some students who reflected on the beauty of nature and biodiversity in their writing. From another environmental perspective, student sharing through publishing is examined as a form of environmentally responsive behaviour, which stemmed from the integration of field and classroom experiences. I will now outline the phases of research as they occurred in this study.

4.5: Phases of research and data collection

The study was conducted over a number of stages. The following section describes the sequence of these, as they occurred in this research.

Phase One: Immersion in the Schools

I met with teachers at each school, and we finalised all of the details for the field programs, in both locations. I presented the required documentation and outlined the purposes of my research with the principals and teachers. I was able to gauge a feeling for the tone of each school, and their interest in EfS curriculum. Primarily, my next visit was to outline and explain the use of Mindmaps as a form of data collection. Being interested in how teachers connected field learning back in schools, I also provided some classroom teaching resources to support such endeavours.

Phase Two: Presentation of Curriculum Materials for Teachers' Consideration and Outlining Mindmaps

I visited the teachers' team meetings at the schools pre-field events, and shared Bug Blitz curriculum materials made available from Bug Blitz Trust, which included *Bug Blitz: Primary Unit of Work Victorian Essential Learning Standards (VELS 4),* a published VELS aligned curriculum teacher resource guide (Boulet & Kinns, 2008), I alerted teachers of the Bug Blitz website, and gave them a teaching guide containing an A3 sized collage of bug photos titled "Playing Games and Using Photo Collages of Arthropods – Bug Thinking and Other Ideas." We shared some other web resource leads and ideas. I left the curriculum materials with the teachers for their reference.

After a meeting between the team of teachers and Bug Blitz, I met as an independent researcher with the two teachers who had volunteered to participate in the research at Sale 545. I outlined the plan to use Mindmaps and handed out information, described in the Methods - Student Mindmaps section above. I used the Mindmap information to explain the procedures for completing them with students. I explained that at least 90 minutes should be allowed for students to complete this activity, however there was no strict maximum time limit applied. I explained that it was my intention to work in classrooms with the teachers and students participating in the research, to facilitate the completion of the student Mindmaps three weeks after the students' field experiences. We agreed on a date to complete this process at Sale 545. The same process occurred at Toongabbie. As it turned out, teachers at Sale 545 completed the Mindmaps independently, whereas I visited and worked with the teacher and class during their completion at Toongabbie, as originally planned.

Phase Three: The Field Days

The focus of the field days was twofold for me: one as a participant researcher and the other in my role as field presenter representing Bug Blitz Trust. Two field days were held:

1. Sale 545 - 30th of May, 2012

2. Toongabbie – 7th of November, 2012

Eighty year 5/6 students, from Sale 545, attended the first field day. It rained heavily five days before the field event, and the original field location was flooded two days before the event was to be held. We found an alternative location at the Sale Common Wetlands, which was nearby, and filled to the brim with water. Originally, the field day was to include an activity that engaged students in planting trees and shrubs to contribute to a wetland restoration planting however, the flood prevented it. The facilitator, a catchment management employee, Matt Bowler, adapted quickly, deciding to take the students on a wetland boardwalk showing them how wetlands have different ecological layers.

Seventy years Prep to 6 students from Toongabbie, attended Field Day 2 at the Toongabbie Wetlands. It was whole school event, so the workshop facilitators had to cater for multi-aged groups of students. Each group contained 14 students. At Toongabbie Wetlands, two teachers took on roles as field workshop facilitators. The school's principal, Lisa, conducted an art activity, facilitating students in making sculptures from natural materials and raffia, while the other teacher participant in my research, Yvonne, ran a macro-invertebrate[9] sampling workshop and was the teacher participant in this research, at Toongabbie. As discussed above (see Phase Two), I arranged with the teachers to visit their classrooms three weeks after the field event dates to observe the students completing their Mindmaps.

Phase Four: Implementing the Mindmaps

I collected 13 Mindmaps from Sale 545 and eight from School Toongabbie. At Sale 545, a teacher implemented the Mindmaps independently about three weeks after the field event. Figure 4.5, below, shows the visual similarity between the student Mindmap and the example Figure 4.2 (p. 20), which was provided to teachers prior to classroom implementation of the activity, to show what a

[9] Macro-invertebrates are animals without backbones that can be seen without the aid of a microscope. Aquatic macro-invertebrates are animals such as Dragonfly larvae and crustaceans.

completed Mindmap should look like. The strategy was a success and the student Mindmaps were similar enough to codify and compare.

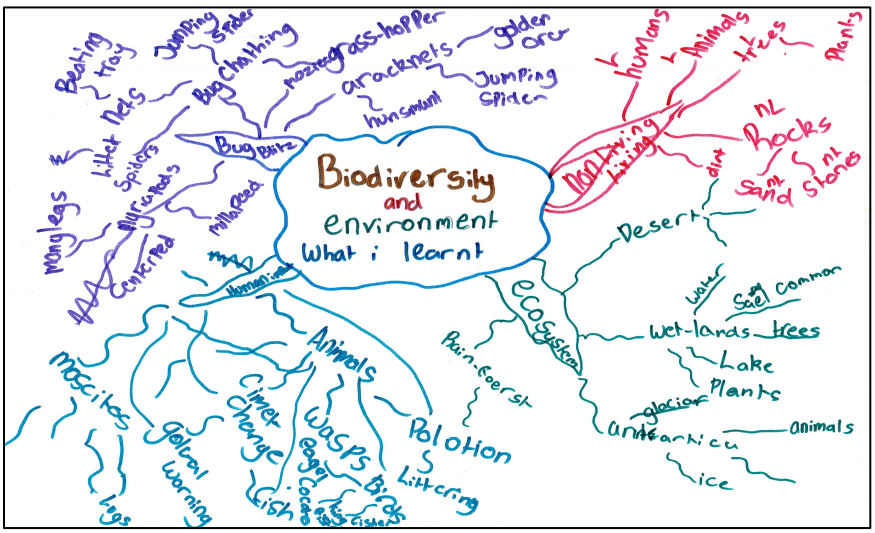


Figure 4.4: Completed Student Mindmap from Sale 545

The original plan to visit Toongabbie to work with the class to complete Mindmaps, was also rescheduled. Timetable clashes and the busy schedule of the school at the end of the year made co-ordination of times difficult. The teacher agreed to implement the Mindmaps with her class independently as a result of changes in her timetable.

At Toongabbie however, when I collected the student Mindmap samples, they were in a project form and not similar to Mindmaps. I discussed this with the teacher, and she invited me back to participate in the activity with the class. I visited the classroom two days later and the teacher and I worked with the students, who completed their Mindmaps in a session lasting about 90 minutes; which was a lot of fun. My role was as a participant observer at Toongabbie, and I was able to collect the Mindmaps after the session.

After collecting the Mindmaps I digitised them, which made their access for analysis, comparison and use in this research convenient. Doing this allowed me to flick between the digitised Mindmaps to compare similarities and differences between students' responses.

Phase Five: Student Interviews

At both school locations the student interviews occurred over two visits. On each occasion I was allowed a half-day visit to do this, and was provided with a quiet location where I could withdraw students from their classes for interview. I aimed to interview all the students with parental consent, so none would feel left out. I used my list of guiding student questions to refer to however, being semi-structured interviews, I often found that the interviews became more conversational. Students were invited to refer to Mindmap during interviews. This strategy gave the students' confidence, helping them to recount certain experiences and stimulating conversation in some interviews. The final phase of the research process involved teacher interviews and I will briefly describe this phase next.

Phase Six: Teacher Interviews

As I have discussed earlier, in the methods section of this chapter, the original dates for teacher interviews were postponed to later dates that suited all participants. I do not believe the changes to the original interview schedule detrimentally affected the results of teacher interviews. I have outlined the six different phases of this research as it occurred, concluding this section. The next section will briefly outline the ethical considerations needed in this study.

4.6: Ethical considerations

My ethics application to conduct the research highlighted the need for separation between myself as researcher, and that of Program Director of Bug Blitz Trust, and the teacher and student participants. A problematic issue for interviewers is to recognise the degree of involvement with the group under study (Fontana & Frey, 2005), with the most important ethical consideration being to tell the truth (Johnson, 2002 cited in Fontana & Frey, 2005). In this instance, I informed potential research participants that the study was separate to Bug Blitz Trust, and would have no bearing on any future interactions between schools, field presenters and Bug Blitz Trust.

To overcome any potential conflict of interest I adhered to the Monash University Human Research Ethics Committee (MUHREC) recommendation that the invitation to teachers/students to participate, be forwarded via email to school principals via a third party representing the researcher (see Appendix A: Email invitation to school principals). School principals could then present the invitation for participation to teachers for their consideration, instructing teachers to then contact the researcher if they voluntarily agreed to participate; or if they would like further information about the research before making a decision.

As the research was set in the context of two field events involving a range of independent presenters, some of whom were paid to present activities, a similar conflict of interest issue arose. MUHREC recommended that field presenters should also be invited to participate in the research via a third party. This process was followed, and all invitations to field presenters to participate were sent via email (see Appendix B: Email invitation to field presenters), by a third party representing me. Seven field presenters agreed to participate, and all of them appeared genuinely interested in the research topic.

Ethics approval was granted by MUHREC on 23 May 2012. From hereon in, email invitations to participate in the study were sent to the principals of three schools, who in turn forwarded the invitations to relevant teaching staff in their schools. I received expressions of interest for more information from two primary schools, which prompted me to meet with them to outline my research proposal.

I organised meetings with interested teachers (April 2012), provided plain language statements (see Appendices A, B and C – Plain Language Statements (Schools, Field Presenters and Children and Families) to six teachers, and explained the nature of the research. During the meetings with teachers, all attempts were made to provide clear information about the research. Open discussions about the nature of the research and the processes involved were held. Teachers were encouraged to ask any questions about the research, or to raise any concerns. They asked questions about the time length of the interviews for students, and we discussed the specific research methods that would be used. Three primary school teachers from two schools accepted the invitation to participate.

At these initial meetings, the teacher participants were asked if they could distribute the Invitation to Participate, Explanatory Statement and Consent Form to their students (children under the age of 18), to which both schools agreed. Student invitations were distributed via a normal school process of handing them out to students to take home for parental consideration. After distributing the student invitations, I organised to meet with teachers two weeks later to find out if any students and their parents accepted an invitation to participate.

As part of the normal process for organising field programs, I met with all teachers involved in the program: five teachers from Sale 545, and two teachers from Toongabbie PS). At those meetings, we finalised timetables for the field events and discussed shared projects Bug Blitz and teachers had negotiated to undertake post-field day. During these meeting processes, recognising power issues became evident. It is suggested by Crang & Cook (2007) that the existence of such issues are almost unavoidable in any research. It is considered ethical to recognise that this type of research involves humans (adults and children) and that care should be taken to avoid harm to them. Further, participants should not be manipulated and treated as objects for the benefit of the researcher alone, and that truth and openness about the purpose and uses of research is paramount (Fontana & Frey, 2005). Crang and Cook (2007) reinforce these views and list three important points when referring to ethics:

- Honesty to research staff about the purpose, methods and intended and possible uses of the research;
- Confidentiality of information supplied by research subjects and anonymity of respondents; and
- Independence and impartiality of researchers to the subject of the research guidelines relevant to all organisations involved (Crang & Cook, 2007, p. 29).

In the case of my study, appropriate disclosure and explanation of the methods and uses of research were agreed between the participants and organisations involved in this study. All ethical recommendations provided by institutional review were followed in this research. While the real names of the two schools are used in this research, the student participants are identified by pseudonyms only.

Teachers are referred to as: Teacher 1, Teacher 2 and Teacher 3.The workshop presenters however, are referred to by their real names, and this includes two teachers who were also field presenters.

4.7: Conclusion

In this chapter I have justified the application of a qualitative methodology using the approaches of grounded theory and ethnography to explore my research questions. I have outlined my positions in the research contexts and described my data collection methods and analysis strategy. The methodological approaches I used in this study have enabled me an understanding of how to conduct ethical research in a respectful way. In this chapter, I explained how I collected data for: interpretation, comparison, analysis, and to synthesise its elements into a coherent whole to generate grounded theory about how we can respond to environmental crisis through creating eco-literate citizens.

The following chapter is framed by these approaches, and draws on this fieldwork to provide rich descriptions and explanations of how environmental learning was implemented and experienced by the research participants in field and school contexts.

Chapter Five

Analysis

> The ability of living things to hold children's attention should be used to help them learn to understand the living environment, respect the appearance of the world and take responsibility for its care (Kellert, 1995, p. 192).

5.1: Introduction

The significance of the interactions between students and living things, the key benefits students and teachers attribute to field learning, and how, if at all, the field learning experiences influenced and were connected to classroom learning to develop student eco-literacy, are analysed in this chapter. In the last chapter I outlined the qualitative methodology and methods that I have used to form the analysis of my data. I explained how I am located in this research, as a participant observer: Bug Blitz[10] field day organiser, field workshop presenter and researcher investigating biodiversity education.

In this chapter I draw on video and other data to examine two environmental field-day learning experiences for 9-12 year old students, from two Gippsland primary schools: Sale 545 and Toongabbie. Student Mindmaps and interviews reveal student and teacher perceptions of field and classroom learning, and student post-field writing samples provide evidence showing how field and classroom learning were connected to improve the extent of EfS and student eco-literacy. Overall this chapter will explore the extent of student learning 'in', 'about' and 'for' the environment, and examine if experiential learning and place pedagogies intersected in differing contexts to enhance student learning in EfS.

5.2: Student learning in a biodiversity field event: children and teacher perspectives

Kellert's assertion (above) speaks to the ways in which biodiversity, or in other

[10] Bug Blitz Trust: a not-for-profit environmental organisation principally concerned with biodiversity and environmental education.

words, living things and living environments serve as a powerful motivating force in environmental learning for children in general. Drawing on this claim, this chapter explores the impact of 'in' the field experiences for children's learning 'about' biodiversity through interactions with the living environment, animals and Aboriginal knowledge. This section speaks about the cognitive and affective benefits of the embodied field learning experiences, the students in this research experienced.

5.2.1: The field: Motivating new information and learning

Learning in an outdoor environment, as Cutter-Mackenzie (1998) and Green (2011) assert, provides a launching point from which students can learn and practice a range of environmental knowledge and skills. In particular, the in field learning experiences enabled opportunities for children to learn to use new language as a way of understanding previously unknown concepts, as highlighted in the following conversation. I asked at the conclusion of Genny's interview: "Finally, what's the one thing that sticks out in your mind that you feel that you've learnt through being in the field and learning back at school?"

> A: Well that's hard, but it's probably the - what I think it's biodiversity, bio – oh I can't say it, biodiversity. (Genny)
>
> Q: So, you learnt just more about biodiversity? (Interviewer)
>
> A: Because I didn't, I did not know what biodiversity was, I had no idea. (Genny)

Throughout my interviews with students, they rarely used the term biodiversity. Instead, they referred to terms such as, 'the environment', 'nature', 'ecosystems', and 'variety', which I interpreted as being related to the concept of biodiversity. They told me:

> I think that the field trip helped us learn a bit more about environments, about the ecosystems, because that's a wetland. (Genny)

When I asked Dusty what he could say about the field habitat after finding different bugs there, he replied:

> It [variety of bugs] means we've got good habitat for all the different types of bugs that live there... (Dusty)

By making a judgement, Dusty associated the environmental concepts of biodiversity and habitat health. The following student responses suggest the extent to which the field setting opened up opportunities for learning new information. As the following students claimed:

> Well I think going on field trips is just really important for education because if you go out [you] can learn new things and enjoy it as well. (Robbie)

Robbie associated the outdoor field experiences with 'hands on' learning, which helped him to "learn new things." I asked Tina: How important do you think field day experiences are for a student's learning?

> It's helped me to learn different things that I didn't know before. (Tina)

When I asked Genny what she learnt during the program, she referred to her Mindmap and replied:

> I've written the catching bugs…I didn't know that there was nets and the beating tray [sic].[11] (Genny)

Similarly, teachers at Sale 545 also referred to the value of students gaining new knowledge in the field, which according to Teacher 2 was valuable. Teacher 1 was also positive about the experience noting new knowledge and indicating a sense of discovery:

> We didn't know what type of bugs you were going to come across. (Teacher 1)

One student related the benefits of learning factual information in the field directly to his project at school, and in doing so, acknowledged a clear connection between field-based and classroom learning. I asked:

> Q: How did you feel about the field day? (Interviewer)
>
> A: I thought it was quite fun and I've learnt a lot of facts and lots of information, which really helped me with my project at school, which is kind of about the environment. (Kenny)

[11] Beating tray: A tool used in entomology to catch invertebrates shaken from the leaves of plants.

A student at Toongabbie primary school used his field experience to compare the ponding activity results of 2012 with the previous year's field day ponding experience at the same location. His comments: "I learnt that last year we didn't catch any fish, I don't think, and this year I caught a fish, so that was pretty cool", suggest the potential for students to build ecological knowledge about local habitats through in the field opportunities that involve monitoring biodiversity over extended periods of time.

When asked if field days motivated them to want to learn more, the majority of interviewed students responded positively. They alleged:

> [field trips] Makes me want to learn more about science ... (Andrea)
>
> Yes … I want to know more about this stuff and becoming more curious about the environment and how animals live, yeah. (Kenny)

The teachers also believed students were motivated by the field experiences. In discussing the post-field classroom writing project the students completed in class, Teacher 1 commented:

> The motivation that they had from the field event carried right through to three months later. (Teacher 1)

When I asked if the field experiences motivated students to do post-field learning, Teacher 2 replied:

> Definitely and it had become real to them rather than just something they were reading about, and it definitely sparked an interest for some. (Teacher 2)

Elaborating on this comment, the teacher believed her motivation for teaching EfS back in class was improved by the field day experiences also. As she indicated:

> I know I came back more motivated to go through the unit… (Teacher 2)

After asking Teacher 3 if field days were beneficial for teacher learning, she referred to the field experiences motivating students to undertake post-field study back in class, and a longer-term experience where students were motivated to explore insects in their school ground after a field day. For Teacher 3, motivated students benefit classroom-learning experiences for teachers, as students are more eager to learn.

Based on the preliminary analysis of children's perceptions of learning outside in this study, as well as earlier research that speaks to the ways in which field experiences might connect to classroom learning (Carlson, 2008), we can surmise that connecting the two contexts may have an important part to play in harnessing student and teacher motivation for education. My data suggests that field education is a key instrument in driving student and teacher motivation for environmental learning.

5.2.2: "Yeah we got to hold the snakes around our necks": Embodied animal interactions in the field

According to Sobel (2008, p. 32), our goal for children should be to foster allegiances between them and the animal world through "… playing at being animals, interacting with animals and taking care of animals." Furthermore, it is these 'hands on' experiences in nature that are important for building early connections with biodiversity (Wilson, 1994b, 2006). With these considerations in mind, the following analysis focuses on children's embodied interactions with reptiles, which involved a professional reptile show, which was one of the five field day workshops at the Toongabbie field day. I asked an interviewee to explain what made the reptile workshop at Field Day Two memorable. Direct interaction with animals was important, as the student explained:

> Yeah, we got to hold the snakes around our necks... It was actually really amazing how the different species were rough and like soft with their skin. (Indy)

When I asked another student what he had learnt in the reptile workshop, the student listed a range of information, indicating that the 'hands on' experiences in the workshop stimulated learning. The student responded:

> We learnt about the deadliest snake in the world, the Inland Taipan … that frogs have very little hairs that help them stick to things on their feet … that crocodiles and alligators only open one part of their jaw…how pythons eat their food and have constrict their prey. (Dusty)

Getting to hold and touch lizards, snakes and frogs during the reptile show at Toongabbie Wetlands, appeared to have an influence on student's excitement and their retention of new information. On the Toongabbie students' Mindmaps, when

compared with the other field workshops, reptiles were the category containing the most student responses. Teacher 3 highlighted the value of students handling reptiles, suggesting they had gained new information from their experience. She believed the reptiles were a 'big hit' and something new to students:

> What the students came back with and what they talked about from that was absolutely astronomical. (Teacher 3)

Another form of animal interaction at the Toongabbie field day involved students sampling pond life. This form of interaction with animals is significantly different from the reptile show that involved bringing a range of reptiles (not necessarily endemic to the area) into the field for display and handling. In contrast, water and terrestrial bug sampling involved children using nets to collect arthropods and pond life in local habitats. Terrestrial bug collecting happened at both field days. Children's reactions to such experiences as illustrated below, highlight the impact of their interactions with smaller critters:

> I thought that was good finding all these tadpoles and little fishes... (Andrea)

> We actually got to get in there and actually do shaking trees and getting bugs and putting them in cups. And even ones that were poisonous… (Tex)

During the interviews at Sale 545, I asked:

> Q: Are some activities more interesting than others in the field?

One of the students responded:

> Well, I like them all, but the ones that I sort of like most are the animals and like how they've been helping the environment and sometimes with the plants too. (Angie)

The teachers' perceptions of student excitement levels when sampling invertebrates in the field correlated closely with students' comments:

> The bug catching – they all loved that and loved seeing what they caught and how it all worked and … to get out there and learn how to find bugs. (Teacher 2)

In addition to these comments, Teacher 3's insights signalled a subsequent outcome of finding animals in local habitats. For example, after collecting bugs during a field experience the year before at the same location, the students at Toongabbie experienced an explosion of grasshoppers in their school grounds. I explained in the previous chapter that Toongabbie had participated in an annual Bug Blitz each year since 2008 (see section 4.2.5: Geographically locating this research – Toongabbie primary school). According to the teacher, the previous years Bug Blitz experience stimulated students to catch and study the grasshoppers, reflecting earlier research that encourages educators take advantage of the powerful motivating force of animals in science learning (Kellert, 1995).

The use of animals for enhancing science education for students is well acknowledged within the broader literature. A key finding in a study that examined the use of animals in science classes for students with learning disabilities (Gurzau, 2013), found that inquiry learning enhanced student engagement and collaboration, and student knowledge was improved after the students learned science using animals. Similarly, an earlier study (Ballouard et al., 2011) concluded that children's natural attraction to animals focus on local species by engaging students with practical experiences in local places.

Although my study differs contextually from earlier research (Gurzau, 2013; Kellert, 1995) that involved students with learning disabilities, the analysis of children's interactions with animals shares a similar understanding of the profound and direct effect animals can have on student learning, their language and general understanding of biodiversity (Wilson, 1984). Direct experiences with biodiversity, or interactions with living things, could be another bridge for building student feelings of care for biodiversity and connections with nature.

5.2.3: Learning Aboriginal perspectives and valuing Indigenous knowledge

Earlier in the thesis, Chapter Two referred to the work of Lowan (2009), who intimated the importance of learning from Indigenous ways of knowing to support children's connection to/with place/country. In relation to this, many students recounted their experiences of a particular field workshop presented by an Aboriginal man, Gnarnayarrahe Inmurry Waitairie, (a *Yindjibarndi* man from Mt

Tom Price, in Western Australia). After acknowledging the traditional custodians of the place (e.g. the Gunai peoples' country), Gnarnayarrahe Inmurry Waitairie shared the story of how he got his name. Here is that story:

> Gnarnayarrahe means little blue joey kangaroo, Inmurry born beside a spring, Waitairie in the dreamtime. My mother dug a hole in the ground 'cause she was too scared to go near the white people and she went to the bush and dug a hole in the ground and put the grass, put the tea-tree bark over the hole and I was born in a hole in the ground and that's when the kangaroo came and put their nose on my tummy and my mother gave me that name Little Blue Joey Kangaroo, and so I got an English name too, Trevor. (Presenter one)

Several students recounted Gnarnayarrahe's stories during interview. The children's collective response is reminiscent of earlier research highlighting how place-oriented pedagogies begin in local places, where stories are shared and embodied learning occurs between the self and the natural world, in an ontology of the self-becoming-other (Somerville et al., 2009, p. 9). In this instance, the students experienced Gnarnayarrahe's cultural perspective. One student told me:

> I think we have a lot to learn from Aboriginal people … because like they actually were born in it... Like when Gnarnayarrahe told us a story about when he was born last year. So … his name actually means Little Blue Kangaroo. (Indy)

Significantly, all teachers commented on the value of Gnarnayarrahe's cultural workshops at the two field days, suggesting there was a general absence of Aboriginal people in both Sale and Toongabbie, and a lack of focus in the overall curriculum on Indigenous culture and knowledge. When I asked Teacher 1 to give her assessment of Gnarnayarrahe's workshop, she replied:

> That was fantastic, because in our community there aren't a lot of Aboriginal elders … there's not a strong connection to Aboriginal culture. (Teacher 1)

According to Teacher 1, Gnarnayarrahe "was very engaging with his stories" and "he was open to the kids asking questions." When I asked Teacher 2: What were the main student learning outcomes you observed from the Aboriginal culture workshop? She indicated that exposure to an Aboriginal cultural perspective was a key element of student learning. She noted:

> Unfortunately, we don't do enough of that within our classrooms, so being able to understand a different culture and the dreamtime stories of how things have been created … was good. (Teacher 2)

In their responses, both teachers mentioned the value of the stories Gnarnayarrahe shared in his workshop. When I asked Teacher 3: What feedback did you get from the students about the Aboriginal culture workshop? She replied:

> The group of students I had last year were just enthralled … to have him there, and the respect that a lot of these students had for him with what he was doing, and they were just awestruck by him doing it.
>
> They were actually enthralled when he was explaining about how the different plants and things he used for medicines and so forth.
>
> He told different stories and they did different dances and so forth. (Teacher 3)

Collectively, the teacher and student views support Raffan's (1995) study, where he illustrated the importance of connecting historical, spiritual and cultural perspectives of Indigenous people as a way to build connections with biodiversity and place. Further, Teacher 3 implied the students exhibited respect for Indigenous culture, an important element of EfS and social justice.

As field experiences are a bridge for connecting people with their environment, including Indigenous perspectives may provide a similar bridge for building nature/culture connections in students. From an eco-literacy viewpoint, interacting with animals and Indigenous perspectives engages students in both the knowledge and dispositions domains of Hollweg et al. (2011) framework for assessing eco-literacy. It was also important, in this study, to explore any influence field presenters may have on developing student eco-literacy.

5.2.4: Understanding the field presenters' workshop aims

As a way of examining the aims and content of the field presenters' workshops, I analysed video data of the workshops at Field Day One. Student field learning can only be fully understood in light of the aims the field workshop facilitators presented during their workshops, which are highlighted in Table 5.1: Field presenters key teaching aims at Field Day One, and this process was undertaken

for one program only. In the case of Field Day Two, I collected field notes to determine presenter workshop aims (see 4.3.1.2: Field notes). Creating the proceeding table enabled me to correlate field presenters' learning aims with student and teacher data, as a way of confirming and triangulating explicit student learning in field and classroom contexts.

5.2.5: Learning environmental concepts from the field days

This section examines a number of environmental concepts that underpinned the two field days. Students' interview responses are used to correlate with examples of the field workshop teaching aims, as a way to explore student environmental learning. Interviews and student Mindmaps (see Chapter Four section 4.3.2.1: Student interviews & 4.3.3.1: Student Mindmaps) are used to examine the extent and types of student learning and to show how students elaborated on their field learning experiences.

Sale Common Field Day Workshops	Key Workshop Learning Aims
Gnarnayarrahe **Aboriginal Culture & Knowledge**	Acknowledgement of Gunai country. Storytelling, being Aboriginal, connection to and ways Aborigines use nature, Didjeridoo bird sounds meditation, song and dance.
Matt **Wetlands Boardwalk**	What are ecosystems, habitats and biomes? Wetlands have different biological layers, the adaptive features of plants and creatures.
Peter **Bird Nests - Make a nest**	Why are wetland ecosystems important? What makes a bird a bird? The different types of nests birds make. Make a nest using clay etc.
Petra **Gum Leaf Science**	Field guides are used to assist plant identification; different eucalypts have varying qualities and uses. Identify tree species by comparing features.
John **Rapid Biodiversity Assessment**	What is a Rapid Biodiversity Assessment (RBA)? Where do bugs live? Techniques for sampling bugs. Different types of bugs found. What do bugs do?

Table 5.1: Field Presenters' Key Teaching Aims at Sale Common

A large majority of students recounted one or two of the key learning aims from each field workshop. During a student interview, for example, I asked: "Can you tell me things you learnt during the field day?" The student gave a precise summary of the field day, indicating a clear correlation between the field presenters' teaching aims and the student's learning.

> I learnt about human impacts, of bringing feral animals to Australia, on ecosystems.
> I learnt there are five layers in a wetland.
> Bugs live on human bodies and live everywhere.
> Birds make lots of different nests, with different characteristics and purposes.
> I learnt Aborigines have their own stories and belief systems.

> I learnt that Redbox is the best for firewood and that there are different types of gum trees: blue box, red box, red gum, the normal gum tree. (Rose)

In this instance, the student recalled key concepts from each field workshop. Generally, students referred to key activities from the field days in similar ways, as evidenced in the following student responses.

> I learnt about different nests, bird sounds and Aboriginal culture. (Angie)
>
> We learnt interesting stuff about the environment; bird's nests, Aboriginal culture, findings bugs in different places, there's leaves that taste like mint. (Steve)

Most of the students gave more detailed responses when referring to particular workshops. In probing the student, Andrea, I asked her: Can you tell us what you learnt about arthropods or bugs? She described the collecting techniques and tools she had used in the field to collect bugs and then stated:

> Bugs live everywhere, they live inside of us, they live in the ground, they live in the air, they live in water, they live everywhere. (Andrea)

When I asked another student: What about gum leaves and tree leaves, what did you learn about them? Kurt replied:

> I learnt that red box is the best firewood that burns and there's blue gum, red box, red gum, the normal gum tree, they're all the types of gum, gum trees. (Kurt)

A majority of students picked up the key aims of the workshops, which was demonstrated across the data. Ecological learning was included in the field workshops and the students could elaborate on this by providing more detail of their environmental learning during interviews and on their Mindmaps. A few students described how some wetland plants were adapted for life in aquatic ecosystems. During the wetland boardwalk the presenter showed the students specimens of rushes with foam-filled stems. The data I collected provides further evidence showing how students elaborated on the key aims of field workshops.

5.2.6: Children's field day learning: elaborating on ecology

Students elaborated extensively about their learning during interviews and via their Mindmaps, which were titled "Biodiversity and Environment: What I Learnt". The Mindmap below illustrates how one student described learning on the branch labelled 'Bug Blitz'. The student used words such as: exoskeleton, myriapods, arachnids, crustaceans, insects, whitetail and jumping spiders and pseudoscorpions, and included ecological knowledge – e.g. 'when bugs die they fertilise the soil'. The Mindmap is a good example of how the student formed knowledge about invertebrates, science processes, ecology and other concepts, which all belong to an eco-literate repertoire. Again, using Hollweg et al. (2011) framework for assessing eco-literacy (see p. 27), the student responses indicate knowledge of creatures, competencies through investigating invertebrates in a habitat and the personal, social and physical contexts the field experiences involved.

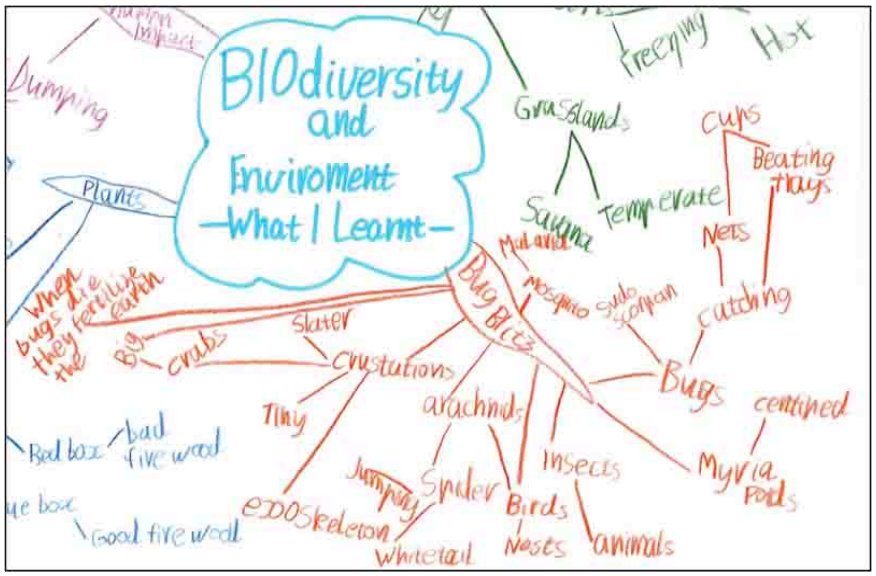


Figure 5.1: Student Mindmap: Sale 545 – What I learnt – Bug Blitz in Orange

Similarly, other students referred to the wetland boardwalk activity, demonstrating their understanding the ecological layers of wetlands and their preference for certain types of activity. When I asked Kurt, what makes an effective activity in the field, he described the wetland boardwalk as "adventuring" or "like going on a tour," which helped him to learn.

> At the wetlands … we went on a boardwalk and they told us about all the, like the, trees that live in all the layers in the wetlands and about seeds and yeah. (Kurt)

I asked Robbie if he could tell me about the wetland boardwalk activity. As this student recounted:

> We went on the boardwalk and we stopped at certain places and we learnt about the different layers of the wetland and some of the trees just grow in the water. (Robbie)

Other students made similar references to learning about the differing layers in wetland ecosystems. As the following interviewee confirmed:

> I really enjoyed going on the boardwalk and just learning about the lake and how many layers it has, turns out there's 4, which is the underground, dirt, the water, moss and trees. (Kenny)

Understanding such ecological concepts can help students to gain a greater understanding of the interconnections between microhabitats, larger ecosystems and even biomes.[12] Evidence from various data sources supports the proposition that students learnt the key aims in the field workshops and they were able to elaborate and provide further information when prompted. In finding that students learnt the key aims of the field workshops, I wanted to investigate the qualities of field experiences, which may have influenced such student learning.

5.3: The benefits of field learning: teacher and student perceptions

The examination of teacher and student perceptions of the benefits of field day experiences for student environmental learning was a primary focus of this study. Subsequently, various forms of data – interviews, Mindmaps and student work samples, were analysed to determine the benefits of field learning.

5.3.1: Field learning: Engaging and 'fun'

In addition to their general perceptions of field learning as important, teachers at Sale 545 identified student engagement as one of the outstanding aspects of the

[12] Biome: a major ecological community, extending over a large area and usually characterized by a dominant vegetation.

field experience. According to one teacher, many students appeared more engaged in field settings in comparison to classroom-based contexts. As she put it:

> It's much more engaging and meaningful for the kids. (Teacher 1)

In another teacher's view, field learning suited students who were not always engaged by classroom learning. She described her observations:

> I noticed with some of our students who are not always engaged, they were 100% out there. (Teacher 2)

Such comments were consistent across all three teacher interviews, including Teacher 3, who believed it did not really matter about the activities, but rather that children were excited by 'out of school' experiences like field trips.

In relation to this notion of children being excited learning outdoors, the first and most rudimentary theme appearing in the student interviews was the way in which they differentiated between classroom and field learning. For example, students inferred that field learning was more active than classroom learning. As they explained:

> It makes it fun and it doesn't mean … we have to sit down and be bored listening to the teacher all the time. (David)

When I asked if field days help student learning, another participant explained when he is learning off a board or in books in the classroom he does not take it in as much as he does when he is in a field setting. As the student commented:

> It's a lot better when you actually get to do it instead of just sitting there, hearing about it … it's a lot more powerful. (Dusty)

When questioned about how learning in the field made him feel about science and the environment, the following student contrasted the limits of school contexts with the 'hands on' activity of field learning. He reflected:

> It gives me a sense of freedom from like schoolwork. Cause we wouldn't be able to climb trees and get clay and put it in trees and then break bits off the tree and stick them in the clay to make nests. (Tex)

Similarly, a majority of students described the field experiences as fun, which links with previous research assertions that in a quality field experience,

intellectual activity and fun go hand in hand (Barker et al., 2002; Packer, 2006). As the children highlighted:

> It is a fun way to learn about the things, instead of using technology and books all the time. (Royce)

In response to the question, how did you enjoy the Bug Blitz field day, one student commented:

> It was very fun seeing all the bugs and the reptiles and doing the art and seeing all the macro invertebrates in the water. (Dusty)

Although the data supports the proposition there is a positive relationship between fun, enjoyment and engaging learning, earlier research reminds us, "the fact that students enjoy a programme does not necessarily mean that the impact of the programme will extend to a deeper understanding of environmental issues or a commitment to responsible environmental behaviour" (Ballantyne, Fien, & Packer, 2001, p. 34). Furthermore, positive correlation in the relationship between enjoyment and mindful learning is not necessarily an indication of an active mental state or information recall (Moscardo & Pearce, 1986). With all of these considerations in mind, it would still seem having 'fun' is an important element of engaging student learning, from both teacher and student perspectives. In delving further into what makes an activity fun and engaging, a number of common responses are given by the interview participants, in the following section.

5.3.2: Embodied learning: seeing, hands on, touching, listening and meditating

In my analysis of student interviews, I interpreted embodied learning as being 'hands on' or learning by doing, or in other words, learning that engaged the senses and integrated psychological, physical, emotional and spiritual thinking (Lane, 2012). An aspect of embodied learning is the act of students 'seeing things' for themselves in the field. Two of the three teachers referred explicitly to the benefit of students being able to 'see how things work' for themselves. When I asked Teacher 2 to assess the field experiences, she made two references to the value of students seeing things for themselves. Referring to the wetland boardwalk, the teacher stated:

> It was good for them to see that and actually be able to touch some of the things as we went along and see how it all works as an ecosystem together. (Teacher 2)

When referring to the rapid biodiversity assessment workshop a similar view was expressed. She explained:

> To get out there and learn how to find bugs and that was really good and valuable for them … to be able to actually see the different types of bugs. (Teacher 2)

The responses given by the teachers were typically associated with seeing things firsthand, and they used verbs such as touching, holding, listening or finding to describe field experiences. As the teachers stated:

> Through **holding** them, they became more accepting of snakes. (Teacher 3)

> The kids loved **hearing** stories. (Teacher 2)

> You can always teach them something from a book or from a website, but when they're actually **seeing** it, they remember it a lot better and can recall it. (Teacher 1)

One of the field workshop facilitators in this research, Peter Ware, is a local naturalist and an avid bird watcher. He told a story about an Oriole, a type of bird that frequents the area.

> Here's another little bird in the bush around here that we see sometimes. It makes a suspension nest. … This is an Oriole … his name's a little bit like his call, he goes Oriole, Oriole - and he's a migrant bird, he only comes here in spring time and he breeds down here, and then he goes back north in the winter. And when he breeds, he builds a suspension nest (Peter Ware).

Peter's workshop began with a story about the Oriole and led to the students making bird nests, which they placed in wetland trees and shrubs. As a student commented:

> I liked the bird nest making and learning about some of the birds and where the nests are, how they make them and just kind of putting myself into their shoes by making a nest. (Kenny)

Research has shown that when students 'see it for themselves', their enjoyment and understanding is enhanced (Hope, 2009, p. 169). Further, Ballantyne and Packer (2002) advocate that seeing things first hand can have a direct impact on student attitudes, and this appears was the case in this research. In the field, students become observers of life (Stewart & Müller, 2009), seeing and understanding the concept of biodiversity through ecological interactions, as highlighted by the following comments.

> Well [field learning] it is very good cause … we're learning about them first hand by seeing them and seeing where they live and learning all about them actually there. (Dusty)

> Nest making - that was really good, that was one of their favourite things to do, because it was hands on and they actually did listen (Teacher 1)

> They [students] were able to build their own and get that practical hands on understanding of what a birds nest was and why they are designed the way they are. (Teacher 2)

In the same vein, during the Indigenous culture workshop, students applied ochre to their faces, meditated and danced. According to the teachers:

> They loved the ochre that they were putting on their faces. (Teacher 2)

> They were also then taken with the meditation … and they did the different dances… (Teacher 3)

In other sensorial ways, the meditation invited children to make spiritual connections with place, which was conducted through the stories Gnarnayarrahe shared with the students and the music he played. Students told me:

> … well he was a native Aboriginal. So he knew from experience so he showed us some dances and that was really fun because it got us moving and everything so it wasn't just a talk. (Indy)

The tactile nature of children's learning experiences was emphasised throughout students' explanations, where they referred to the materials used or encountered in the field like, plant samples, mud etc. When discussing the field experiences, I asked Tex:

> Q: So what a makes a great learning activity in the field?

A: Probably hands on. Not like just looking at a whole heap of different bugs, actually going out and catching them, the bugs yourself and getting in there and getting your hands dirty and doing stuff. (Tex)

Q: So doing stuff. That's what in your opinion makes a great activity?

A: Not just like writing out everything… I like putting it in my memory, doing stuff and picking up mud and picking off pieces of bark off trees to get into little crevices where little animals might be. (Tex)

During this field day, children were encouraged to consider their nest from the perspective of a bird in a habitat, which was reminiscent of Stewart's (2011) research that explored the learning benefits of thinking from 'other perspectives' such as a Speckled Warbler. The children identified these pedagogies of imagination as significant, highlighting the importance and impact of different ways of knowing for children's learning. When I asked the student Kenny: How does going out in the field to do studies and then doing some follow-up studies in classroom make you feel about the environment? He replied:

I think it will help me realise more about the environment and help me learn a bit more … I haven't done this much research on the topic before. (Kenny)

Q: So when you say you've done more research this time about this topic, is that because you had the field experience, or is that just because you had to do some more research?

I think the field excursion … I'm not only learning about it I'm actually kind of living it, like doing some of the stuff. (Kenny)

Kenny connected 'hands on' field experiences and the motivation to complete further study. Being in the field gave Kenny a sense of "actually kind of living it," which helped motivate his interest in biodiversity. I asked the following student, Tina: How was the art activity related to biodiversity, science and our environment? She replied:

[The Art activity] We had to get stuff like leaves and twigs from the ground and like the land we had to make something with it and that was pretty cool. (Tina)

Q: So how does that make you feel about our environment, doing art activities mixed in with science activities?

A: It makes me feel good like I'm doing something for the community and for nature. (Tina)

When sensory learning is integrated with stories of place, students appear more likely to engage with other perspectives. Likewise, for the student Tina, integrating science and art in the field made her feel like she was "doing something for the community," which suggests a step towards environmentally responsible behaviour. As was the case for many of the students, embodied learning involving sensory and 'hands on' experiences where students see things for themselves in the field, and is a foundation for further learning.

5.4: Exploring the translation of student learning from the field to classroom curriculum

The analysis of data in this section specifically examines the translation of student learning from field to classroom programs. When I combined field and classroom data, four important areas of learning emerged; (a) classification and learning about biodiversity, (b) ecosystem learning, (c) building ecological stewardship; and (d) human impact and threats to nature. Throughout the data, students made general references to these four learning themes. This section identifies and analyses how teachers integrated field experience with classroom learning to reinforce and extend student environmental field learning.

5.4.1: Classification learning

The activity of classification, or the grouping of different life forms based broadly on Carolus Linnaeus' (1735) system of nomenclature (kingdom, phylum, class, order), was included inherently in most field workshops. Students showed some development in their understanding of rudimentary classification, as highlighted in Figure 5.1: Student Mindmap: Sale 545 – What I learnt – Bug Blitz in Orange, where the student used words such as, arachnid, crustacean, insects and myriapods – the four classes of the phylum, arthropoda. Student recall of learning via the practice of classification can be understood in the way students discussed reference groups, species or classes of animals. The level of students' classification knowledge was general, with their comments indicating an

awareness that biodiversity can be grouped according to similarities and differences. First Kurt, who we heard from earlier about gum trees, shows he has an understanding of the classification of trees: I learnt …there's blue gum, red box, red gum, the normal gum tree, they're all the types of gum trees. Other students commented:

> I learnt that real bugs have their wings half covered. So we collected a few of those, most of them were actually just normal insects. (Indy)
>
> It was very interesting to find the different crustaceans and things. (Tex)
>
> I think there was around 40 to 60 different species we found that day. (Andrea)
>
> These are different types of lizards – skinks, frill neck lizards and drop tail lizards. (Barry)

Student responses also included the classification of animals through describing their adaptive features (e.g. caterpillar features and constricting reptiles). Additionally, the behaviours of creatures and the important role animals' play in healthy ecosystems were also mentioned:

> The bug catching … some are good … they have a very important roles in the world. (George)
>
> I learnt that when we found the caterpillar it was poisonous and that if you touched it, it actually injects poison into you. (Tina)
>
> [I learnt] … how pythons eat their food and have to constrict their prey to kill them. (Dusty)

Classification was centrally embedded in my field workshop (e.g. the Rapid Biodiversity Assessment activity), which emphasised how bugs can be found in all ecosystems around the world, and involved identifying the different creatures students encountered. I asked a student:

> Q: Can you tell me anything else you learnt during the field day?
>
> And on that day I learnt that bugs live on human bodies. Arachnids are spiders and scorpions and mites and yeah. There is a mite that's an arachnid and it lives on our forehead and one in our eyelashes, they're mites, they're arachnids. (Kurt)

Kurt recounted specific information, which was presented using small posters showing eyelash mites during the introduction of the field workshop. Students were asked to read a short number of statements from a poster titled: Bugs Live Everywhere, before they began searching for bugs to collect. Another student referred to this concept saying:

> … they were interesting, like bugs are everywhere. (Steve)

These findings suggest that short amounts of conceptual teaching during field workshop introductions can be an effective method for conveying a key message about a topic. For the following student however, it was the personal discovery of a Pseudoscorpion in the field, which motivated further learning back in class.

> Well I found out that they [Pseudoscorpions] don't actually have a sting and that they do actually have venom … the venom is deadly to little animals. (Tex)

Both teachers at Sale 545 believed students had successfully learnt about classification, ecosystems and human impacts on the environment during the field program, which were concepts the teachers at Sale 545 reinforced and developed back in class. I asked Teacher 2:

> Q: What type of specific student learning do you think you saw evidence of most?
>
> It was definitely clear when we got back that they had a lot more understanding of classification of bugs - that was evident. (Teacher 2)

During her interview, Teacher 3 and me discussed the motivational value of field days. I asked:

> Q: How do you use that motivation?
>
> I've used it as I said, for other research with looking at animals, and animal behaviours and classes of animals and so forth. So it's used scientifically. (Teacher 3)

I also asked Teacher 3:

> Q: What are the students learning outcomes you feel you may have observed?
>
> … with regard to the classing of animals and where they are… they're becoming more at terms with that sort of work as well. (Teacher 3)

Furthermore, according to Teacher 3, classification began in the field and continued to stimulate children's interest back at school. All teachers suggested this interest was a consequence of drawing on real and everyday ecosystems such as a local wetland.

5.4.2: Ecosystem learning: wetlands, rainforest, Antarctic and coral reefs

Ecosystem learning is a theme that permeated the curriculum in each of the participating schools. By way of example, Sale 545 completed a specific study unit on different ecosystems post field trip. Most of the students at this school were able to name a variety of ecosystems they had studied in class, as evidenced in the following responses:

> The ecosystems, like in Australia there's dessert, rain forest, Antarctica, and the Great Barrier Reef. (David)

> Well with an ocean there's lots of coral and fish and there's wetlands, rainforests, deserts, forests and Iceland. (George)

During their interviews, teachers at Sale 545 confirmed that ecosystem learning was a key goal in their classroom curriculum. They explained:

> It was all based around the ecosystems, so a lot of it was about finding out what is in an ecosystem, what makes an ecosystem. (Teacher 2)

All students at Sale 545 successfully completed a branch named 'ecosystems' on their Mindmaps, as evidenced by the orange-coloured words on the student Mindmap below in Figure 5.2.

Figure 5.2: Student Mindmap: Sale 545 – Ecosystem Learning in Orange

The significance of ecosystem learning and understanding is typified in the above student Mindmap that privileges the different type of ecosystems children were familiar with, including some general features.

Similarly, but with a slightly different orientation, ecosystem learning was evident at Toongabbie in student references to ecosystem health, when some described catching macro-invertebrates in the local pond. The students talked about sensitive bugs (e.g. invertebrates that do not tolerate polluted water), which were indicators of good quality water:

> One of the activities I learnt most from would have to be the macro invertebrates because we learnt about what bugs are tolerant, sensitive and … how you could tell what the water was like, if it's polluted or very clean. (Dusty)

Students from both schools mentioned the ways insects assist ecosystems such as spreading pollen, as well as the role of spiders in balancing fly numbers. Their observations focused on the roles bugs played in ecosystems and food chains, demonstrating an accomplished comprehension of ecological concepts and connections within natural ecosystems. In the students words:

> They [bugs] spread the pollen and they keep the trees alive which helps us too. (Indy)

> … flies go everywhere so they really quite have a lot of diseases and everything. And you don't really want that kind of thing spreading so the spiders are quite helpful. (Indy)

> It [variety of bugs] means we've got good habitat... (Dusty)

Furthermore, analysis of students' ecosystem learning points towards the ways children's conservation stewardship might be advanced through personal action.

> I chose the rainforest … 'cause it gives me a sense of calm and I wanted to know how I could save the rainforest. And what I could do to help. (Tex)

The study of ecosystems at Sale 545, engaged the students in investigating human impacts on environments back in class. It was evident in various data that the students had investigated – rainforests, Antarctica, coral reefs and deserts – and that these investigations led to them exploring human impacts on ecosystems. Teacher 1 confirms this:

> We had kids finding out what is the top predator of the food chain in Antarctica we had some kids saying what's happening, what's coral bleaching at the Great Barrier Reef. (Teacher 1)

As the teachers and students confirmed, the study of ecosystems back in class stimulated the students to explore human impacts on ecosystems.

5.4.3: Human impact and threats to nature: "Like if the food chain gets wrecked, then everything else will go wrong"

The teachers at Sale 545 agreed that students had learnt about human impacts on different ecosystems, in both field and classroom contexts, as taken up in Teacher 2's class:

> We focussed on a lot on looking at well what can we do as humans to help or to lesson our impact on the environment. (Teacher 2)

They [students] realised the impact the humans are having on the environment (Teacher 1). Throughout the interviews, as well as on their Mindmaps, a number of students referred to the most significant environmental threat facing humans – climate change. Although only a small number of students used the term 'climate change', others described carbon dioxide overloads in water and oceans, used the term global warming, and made connections between pollution and the effects of climate change, such as coral bleaching. Although such comments indicate

particular levels of student concern about this unprecedented issue, the depth of their explanations and understanding appeared general as evidenced below:

> Well probably like global warming and how pollution is affecting the world. (Robbie)
>
> That the carbon dioxide is going into the water and killing everything under there, underneath, in the ocean [sic]. (George)
>
> Well I think we're a major threat actually because like the cars and pollution. So we need to really look out at that. (Indy)
>
> That we could run out of trees if too many people cut them down and it might be all coral, because it's all bleaching … [sic]. (George)

The students show an awareness of the issue, some causes like pollution and effects like coral bleaching. The cause and effect connections the students made were broad and general. E.g. Above, George associates deforestation and coral bleaching. Building on this analysis, the following student Mindmap in Figure 5.3 shows the human impact branch in red: feral animals, hunting, climate change, energy and pollution are some of the impacts listed.

Fig. 5.3: Student Mindmap: Sale 545 – Human Impacts in Red

Other data highlighted student knowledge about global human impacts. Deforestation and clearing of habitats was identified specifically as it related to the destruction of rainforest, and its effects on Orang-utans. One student, George,

connected deforestation with monkey and gorilla declines, in conjunction with the impact of feral animals.

> With the cutting down trees, I connect it to killing animals and then connected that to monkeys and gorillas because it's killing them. And there's bringing different animals from other countries is killing other animals here. (George)

The student comments in general demonstrated a collective understanding of basic cause and effect relationships and interdependence in ecosystems, even though some of the student responses were not factually correct:

> Well I know that one of the major things that humans are doing is deforestation which I found a bit about that, cutting down the rainforests and using the space for buildings or paper, it's also where palm oil is which is in a lot of products which the Orang-utans are dying from. (Kenny)

While Kenny identifies the problem to some extent, the products in palm oil are not killing Orang-utans; it is the destruction of habitat for palm oil plantations that is impacting them. I suspect that Kenny would have clarified his response if I had prompted him with further questions during the interview. A number of iconic animals are popular and well known after zoos, museums and other environmental conservation groups have highlighted threats to them and forecasted possible extinctions. Pandas, Polar bears, Elephants, Tigers, Chimpanzees, Gorillas and Orang-utans, are some of these iconic species.

In this research, Teacher 2 described how her class investigated Orang-utans, as a part of their post-field curriculum. They investigated Orang-utan habitats, the impacts of deforestation, and its impact on these primates. The students considered minimising and reducing their use of products containing palm oil as a way of taking environmental action. In conversation, Teacher 2 confirms studying the impacts of palm oil and taking consumer action to reduce deforestation with her class as follows:

> We looked at the different types of products that you can buy that are palm oil free as opposed to buying products with palm oil, and therefore you might be helping to save some of the rainforests, and we looked at waste, consumption and how they might reduce and minimise that. (Teacher 2)

This type of activity has been described as the application of group and political action as a problem solving tool (Flanders & Chawla, 2007), as denoted in Chapter Three, which is the least practised form of environmental action in EfS (Kumler, 2010).

When asked about human impact on the environment, a small number of students identified hunting and feral animals as an issue:

> Some human's bring feral animals over to Australia and some people are shooting animals like ducks. (Johnny)
>
> On the field day I learnt about human impact on we're bringing feral animals to Australia and its impact … on the animals and the echo (sic) systems. (Kurt)

Johnny identified hunting as a local impact in the wetland he visited and he raised the national issue of feral animal impacts. Understanding some of the cause and effect relationships of human impact on the environment is best summarised by the following comment:

> Like if the food chain gets wrecked, then everything else will go wrong. (Steve)

This systemic, big picture view is reinforced by Capra (2007) who stated: "In the coming decades, the survival of humanity will depend on our ability to understand the basic principles of ecology and to live accordingly" (p. 10). These same two points were also highlighted in Chapter Two, through the analysis of the work of theorists (Louv, 2011; Orr, 1994b; Suzuki, 1997; Wilson, 2002). These researchers intimate the need for humans to reconnect with nature in an endeavour to live sustainably, a part of which is identifying and understanding human impacts on our environment and ecology.

While student learning encompassed human impact on the environment, as well as considerations for taking action for the environment, there was minimal evidence to confirm any eco-management actions such as planting trees, cleaning up human impacted sites etc. However, there was evidence the field days had a positive influence on encouraging student feelings of care for the environment as discussed next.

5.4.4: "I know more about it and how it works and how I can help it": Building ecological stewardship

In asking the question: do single-day field experiences impact on student attitudes of care for the environment, the data I analysed suggests a positive correlation between this study and the findings of earlier research, all of which indicate field experiences have positive effects on student attitudes (Ballantyne & Packer, 2002; Chawla & Duffin, 2005; Pfeiler, 2007; Rickinson et al., 2004). I asked students, "How does going into an environment make you feel about your personal connections to our environment?"

> It makes it, I suppose, stronger 'cause I know more about it and how it works and how I can help it. (Johnny)
>
> Field days – Makes me want to learn more about science in every different dimension. (Andrea)

All teachers believed the field program had positive impact on student attitudes of care and concern for the environment. In the words of Teacher 1:

> I definitely think that they would come back with an attitude and hopefully keep that attitude in a year's time or in 10 years time of why it is important to look after it. (Teacher 1)

The students' affective responses were concerned with positive feelings, using words and phrases like 'caring', 'happy', 'learning', and 'feeling like a wetland'. As the students below stated:

> I care a fair bit about the environment like I wouldn't just litter anywhere or yeah. (Robbie)
>
> I felt like… like really happy to be there… I was like really learning lots of things. (Tina)
>
> It made me feel like I was like wetland or a wetland object. (Kurt)

Field experiences provoked other opinions about human behaviour, including how best to advance sustainability practice. The student below typifies such responses:

> Well I think that humans should put more effort into some of this stuff because I don't think they know what we are losing, like pollution for instance. (Kenny)

> I want to make the world a better place and by keeping it clean and respecting it. We do lots of recycling at home, compost, … our water. (Kenny)

From the responses above, students were concerned and motivated for action. Robbie cared for the environment and would not litter and Kurt's feeling 'like a wetland' is reminiscent of theories of becoming 'other than human, like Somerville's (2011a) 'becoming frog' and Stewart's (2011) 'becoming Speckled Warbler', which I investigated in Chapter Three and signal deeper student thinking. Kenny, who wants to make the world a better place, best sums up feeling motivation for action. From an eco-literacy perspective (Hollweg et al., 2011), Kenny's preceding comments demonstrate a disposition towards action, as well as environmentally responsible behaviours like recycling that he already undertakes at home.

Similarly, notions of ecological stewardship were highlighted when Indy described reflecting on threats to biodiversity in the field.

> I found myself thinking when we were doing the art sculpting. Our pollution that we're making at the moment is really bad for the bugs, for the water bugs and the worms in the water and everything in the ground. (Indy)

Indy explained in her interview that she had previously visited the Phillip Island Nature Reserve, where she found out how pollution impacts nature and how to help. She then explained how the field day experiences at the Toongabbie Wetlands, had opened her thinking again about helping nature. I asked Indy:

> Q: Do you think the field day or the program that you did back at school afterwards helped you to understand how you might be able to help our environment?
>
> (After the field day) I started to think like I can help. And I was thinking of like doing a little presentation on how everyone can help in the school because that's still a little – like it's not much of a difference but it will help. (Indy)

Indy had contemplated taking action for the environment through sharing information with her peers. Another student found comfort from finding sensitive bugs, inferring the need to conserve animals for the interest they provide.

> If you pollute the area the water might not be as good and you won't get all them sensitive bugs that interest people so much. (Dusty)

And finally, the following comment speaks to the emergence of an ecological ethic of reducing biophobic attitudes (as discussed in Chapter Three) through field day learning:

> [About field days] Well, it makes me feel a lot better than when I first started with bugs. Like, I thought they were just creepy, but now they're pretty cool. (Steve)

My analysis provides strong evidence that single-day biodiversity field events have positive impacts on students' environmental care and concern, and that this can motivate feelings of ecological stewardship. It appears that studying biodiversity in the field can help children connect with the natural world, with some students showing a desire and intention to take action post-field. This leads naturally to exploring the question of how teachers may facilitate students' desire to participate in environmentally responsible behaviour, back in classrooms.

5.5: Teacher perceptions of connecting field and classroom learning

A central question to this study has been concerned with: How, if at all, do primary school teachers connect field experiences with classroom learning? Prior to addressing this question, the section above explored the translation of student learning from field to classroom curriculum, analysed student's ecological learning across contexts, highlighting learning about biodiversity, ecosystems, human impacts, ecological stewardship and care in students. Expanding on that layer of analysis, this section examines how teachers connected field and classroom study to achieve such conceptual learning outcomes.

5.5.1: School/Local/National/Global: connecting genuine experiences

Chapter Two discussed local learning contexts as a contact zone for different perceptions of local places (Somerville et al., 2011), including understanding how different perspectives of place are an important element of place pedagogy. Similarly, Barker et al. (2002) considered local places as a relevant beginning point for widening studies and actions to regional and global contexts. In taking

up these matters, the responses below refer directly to local places such as the wetland and schoolyard as sites for ecological learning and action. The student comment below confirms the importance of the local wetland ecosystem. .

> I think that the field trip helped us learn a bit more about environments, about the ecosystems, because that's a wetland. (Jenny)

Another student described how she felt concern that pollution was a problem in her local habitat, that she did not believe many people thought much about pollution and that we needed to do something about this. I asked the student:

> Q: What do you think you might be able to do?

The student responded as follows:

> Even just picking up rubbish around the schoolyard. (Indy)

As well as being a place for local action, the schoolyard was also used as a place for the exploration of biodiversity. A memorable activity for one class was venturing out into their schoolyard to collect a sample of bugs after the field day, applying techniques learnt in the field. Teacher 2 also mentioned in her interview that her students had conducted a bug search in the school grounds, during their pre-field trip immersion day. I asked:

> Q: Did the students have a favourite type of activity that they did back at school?

> I think definitely by far the favourite was going out into the yard after we had been on the field trip and looking for bugs because … they actually knew … what they had found. (Teacher 2)

A Sale 545 student recounted a similar experience from the year before, reinforcing the value of connecting out of school field experiences with school ground learning. The student stated:

> Last year we did, where we went out on a grass area on the oval at school and we got a 2 by 2 metre square and we looked at all the bugs … in that square. (Kurt)

Field techniques, like collecting a sample of invertebrates, transfer easily between field and school ground contexts, as is indicated in the interview data. As Teacher 2 hoped, teaching students to care for the immediate environments around them

will transfer into students wanting to care on wider scales. Her colleague reinforced a similar sentiment stating:

> Hopefully, if we're all doing things like caring for our schoolyard, that'll transfer into them, [students] caring for their local environment. (Teacher 1)

While schoolyard learning was cited as an opportunity to care on a wider scale, one student suggested there are "some things you cannot learn in the schoolyard, you have to learn it outside the school" (Andrea). Another student notes:

> I'd say it's [going on field trips] pretty important, 'cause you get to know what's around you … around nature you learn more about it because you find lots of different things and then learn about them. (George)

The teachers in this research used immediate environments like school grounds, to connect field and school curriculum. The local wetland field day locations were located nearby to the schools involved, which the teachers all considered valuable.

In her article "Overcoming 'ecophobia'" McKnight (2010) states: "Learning about the plants, insects, birds, and mammals in their local environment through direct observation will lay the foundation for concern for the natural world in other locations, as children progress from concrete to abstract reasoning" (p. 11). Analysis of the data showed how local investigations led the students to investigating regional, national and global issues as demonstrated in the following excerpts from interviews with the teachers. Teacher 1 referred to 'our local ecosystems' during her interview and Teacher 2 expanded from local to a regional scale by referring to the Gippsland Lakes ecosystem, which the Sale Common Wetlands are a small part of. Teacher 2 believed the field day enabled her to experience what the students had, which consequently helped to inform her program teaching back in class. I asked Teacher 2:

> Q: Was participating in the field experience beneficial to you as a teacher?
>
> I studied the Gippsland Lakes ecosystem with them ... It was a useful resource for that rather than having to look elsewhere and create an experience that's not as a genuine. (Teacher 2)

For Teacher 2, the local context provided a genuine experience for the students. In moving from local to national and global concerns, Teacher 1 referred to feeling

concerned about the Great Barrier Reef. Her answer inferred the importance of learning about human impacts in local and national contexts to conserve nature.

> You can see the impact that humans have on habitats, it's really sad from things like the Great Barrier Reef to just our local level. (Teacher 1)

I found evidence of the teachers at Sale 545 (see section 5.4.3: Ecosystem learning: wetlands, rainforest, Antarctic and coral reefs) deliberately connecting local ecosystem studies to wider scale issues like coral bleaching on the Great Barrier Reef and deforestation on Orang-utans in Asia.

In the following comment, the student referred directly to the importance of local contexts as they related to global concerns, suggesting the classroom work that had been implemented by the teachers. This is a classic statement in light of research presented in Chapter Two (Klinsky et al., 2010), which recognised learning through the famous phrase: act locally, think globally. I asked the student:

> Q: How important is it to find out about your local area?
>
> I think its pretty important because, like, if you can't save the rainforest in Mexico or wherever in the world it is, then you may as well try and help the environment and learn about the environment in your local area. And if everyone in the world did that, it would be a pretty good place. (Tex)

Some students, like Tex, showed a developing sense of environmental responsibility and greater understanding of the interconnectedness of local and global ecosystems. Student and teacher data revealed evidence of how local, national and global environments were connected by teachers to enable the study of genuine issues of sustainability.

5.5.2: Reflective recounts of the field

Teachers at both schools included activities in the classroom involving reflective recounts of the field days. An example of this was their use of student motivation from the field experience to stimulate post-field writing. I asked the teachers:

> Q: What types of activities did you do after the field program that may have been related in any way?

> Well the kids they came back and they all created – they had to do a reflection of the Bug Blitz day … most of them did posters with a bit of a flowchart of the activities that they did and they enjoyed (Teacher 1)

> After the field event we were able to reflect on what did you see; what did you feel; what did you notice to help build students' knowledge of ecosystems and expand their wonderings further in terms of their research and inquiry projects. (Teacher 2)

Teacher 3 explained how she had used field day motivation to encourage student reflection and further research on topics like animal behaviours:

> I've used it [student motivation], as I said, for other research with looking at animals, and animal behaviours and classes of animals and so forth. (Teacher 3)

The student interviews revealed and confirmed teacher views about the importance of reflective learning. The students mentioned making posters, drawing responses, recounting experiences, having discussions and drawing Mindmaps in their interview responses. Again the student responses confirm the variety of reflection lessons the teachers included in post-field curriculum. These reflective activities bring to light the significance of reflection for students as a means to process their field experiences:

> After this field day … we did posters and mind maps expressing all the stuff that we did... (Dusty)

> We played that [Aboriginal music] while watching the photos [from the field day] and we had a good long discussion about Bug Blitz[13]. (Tex)

As previous research about field learning states, "follow-up activities reinforce key concepts and give students a chance to process the field day experience" (Carlson, 2008, p. 98). In the following comment, student Tex used a metaphor of papier-mâché to describe the importance of connecting field and class learning through reflection. He reflected:

> Probably cause you learn the stuff out in the field day, that's where the learning is done and you come back in the classroom and refresh yourself and that kind of really sticks it in. Cause it's like a memory that's gone in and its just swirling around in there somewhere and once you do the activity it starts it up again, it kind of sticks it into place in your mind. So

[13] Bug Blitz Trust: a not-for-profit environmental organisation principally concerned with biodiversity and environmental education.

> it's kind of as if you've, you cut up little bits to do a papier-mâché … the sticking part is the follow up activity afterwards where you stick it into place in your memory. (Tex)

According to recent research (Remmen & Frøyland, 2015), processing and interpreting field data to justify decisions about environmental dilemmas post-field can encourage deeper learning, and Tex's imaginative response is in keeping with this belief. All of the students in this study completed some degree of reflection back in classrooms, as the teachers had deliberately included it in post-field learning. The teachers used reflection as a way of introducing research into the process of student learning, as highlighted next.

5.5.3: Are there any insects in Antarctica? Children as researchers

The teachers at both schools included research tasks in their post-field curriculums. For example, students at Sale 545 completed individual inquiry projects about ecosystems and they researched biodiversity, back in their classrooms. During the teacher interviews, both teachers at Sale 545 described how they planned the inquiry learning projects to extend student knowledge of different ecosystems, and to engage students in researching different features and animals that are uniquely associated with certain habitat types, like insects in Antarctica.

> Some of our students came back and followed that up with some more research on the bird nests. (Teacher 2)

> Some of them were investigating things that they didn't necessarily see on the day, but it inspired them to look. (Teacher 1)

> It's also used as a way of educating with regard to research (Teacher 3)

For teachers, the field experiences provided students opportunities to research broad topics like Antarctica, or field related subjects such as bird nests. As Teacher 1 stated, student research was inspired by field experiences and some student topics were directly related to field experiences. One student related his research topic of Antarctica, to the insects of the field day.

> At the moment I'm doing Antarctica so like all the things, the like animals and just how they survive. I'd probably research about are there any insects in Antarctica cause that's a really interesting topic. (Robbie)

As the teachers had described, the students selected the topics for their inquiry research projects. Discoveries from the field day permeated into classroom research as is evidenced by the following student responses:

> We got a topic, we had to pick one, … an ecosystem, and we had to like pick a question that we wanted to know about it and then we would research it… (Robbie)

> I remember the Pseudoscorpion was probably my favourite one and I did a lot of research on that. (Tex)

A range of different creatures became the subjects of inquiry-based projects the students at Sale 545 had completed back in class, which involved significant research time and student sharing of learning. The teachers explicitly planned and facilitated these learning projects back in their classrooms.

5.5.4: Inquiry based learning and integrated curriculum in the classroom

Inquiry is unsurprisingly at the centre of inquiry based learning (Kahn & O'Rourke, 2005). It has been suggested by Kahn and O'Rourke (2005), this process should be problem orientated and based on existing knowledge to develop further learning, leading to the presentation of ideas as an individual or a group. This teacher response shows how Sale 545 used an inquiry model for part of their post-field studies:

> We had kids finding out what is the top predator of the food chain in Antarctica; we had some kids saying what's happening, what's coral bleaching at the Great Barrier Reef. (Teacher 1)

Teacher 1 gave an enthusiastic response when she described her role in facilitating student learning and she was clearly excited about the range of issues the students had investigated. Another teacher emphasises the importance of the field to classroom process in inquiry-based learning:

> In an inquiry based unit like we did with the Bug Blitz program, it's making sure the students have some background information before …

> that they can then build on, and then when you get back into the classroom really consolidating the knowledge that they gained. (Teacher 2)

Inquiry-based learning approaches cross trans-disciplinary frameworks in the pursuit of an inquiry learning process (Gordon, 2012), therefore becoming part of an integrated curriculum approach. The teacher participants contributed a range of comments during their interviews, providing evidence about the types and extent of integrated studies they had undertaken back in school. Teacher 1 listed a range of projects her class had completed post-field such as: a flowchart of activities, reflections of the field day, they investigated threats to and what is a wetland and created a page about bugs for a class book. Teacher 2 commented:

> We did a spelling activity... began looking at information reports… used some of David Attenborough's eco system and environmental videos … when we were looking at the different types of eco systems; a lot of the government websites as well. Reflections/art piece/writing information reports and poetry (Teacher 2)

A specific, post-field, negotiated learning project at Sale 545 provided me with insights into a way field and classroom learning were integrated, which I will outline next.

5.5.5: Post-field book project: Integrating student learning through writing and publishing

As part of the field program, Bug Blitz and the teachers at Sale 545 established a post-field book project. The purpose of the book was to engage students in a writing project that could extend their environmental field learning in classrooms, and when published, the student works could be shared in the wider school community. From the teachers' perspectives, another purpose of the book was to develop student writing and publishing skills.

The document samples highlighted below were valuable for showing the ways teachers integrated learning in their classroom curriculums and for understanding how experiential learning was completed by students, in field, school and community learning contexts. As teachers often do, I conducted close reading of samples of student writing to make various assessments and draw inferences

about student learning. And I analysed the content of students' writing overall to determine the integration of science and biodiversity learning.

In particular my analysis focuses on the process of students' learning through the book project; the students researched their subjects online, completed first drafts, edited their works and then published them using digital tools. The student writing samples also provided material that could be used to examine examples of students' experiential thinking. The subject matter reveals students reflecting, observing and abstract conceptualising about subjects, and the process of sharing the book provides evidence of them actively experimenting with new knowledge.

The group book, presented challenges for students but was a good process for the majority of them as one of the teachers describes. I asked Teacher 2:

> With the creation of the group book, what are your thoughts about that?
>
> The group book that's been an interesting one – some kids loved doing it; others not so much and I don't know whether that was because some of them aren't as confident with Information Computer Technology (ICT) as others … In my class we had some fantastic different works – a lot researched bugs … some did song lyrics to suit our field day experience; I think we had a couple of stories but it was a good process for the majority of them. (Teacher 2)

The topic of biodiversity was reinforced back in classrooms after the field day, and evidence of this was found in the students' writing. Figure 5.4 depicts the front cover of the finished book, which is reflective of the classification of bugs, and demonstrates an integration of science and art.

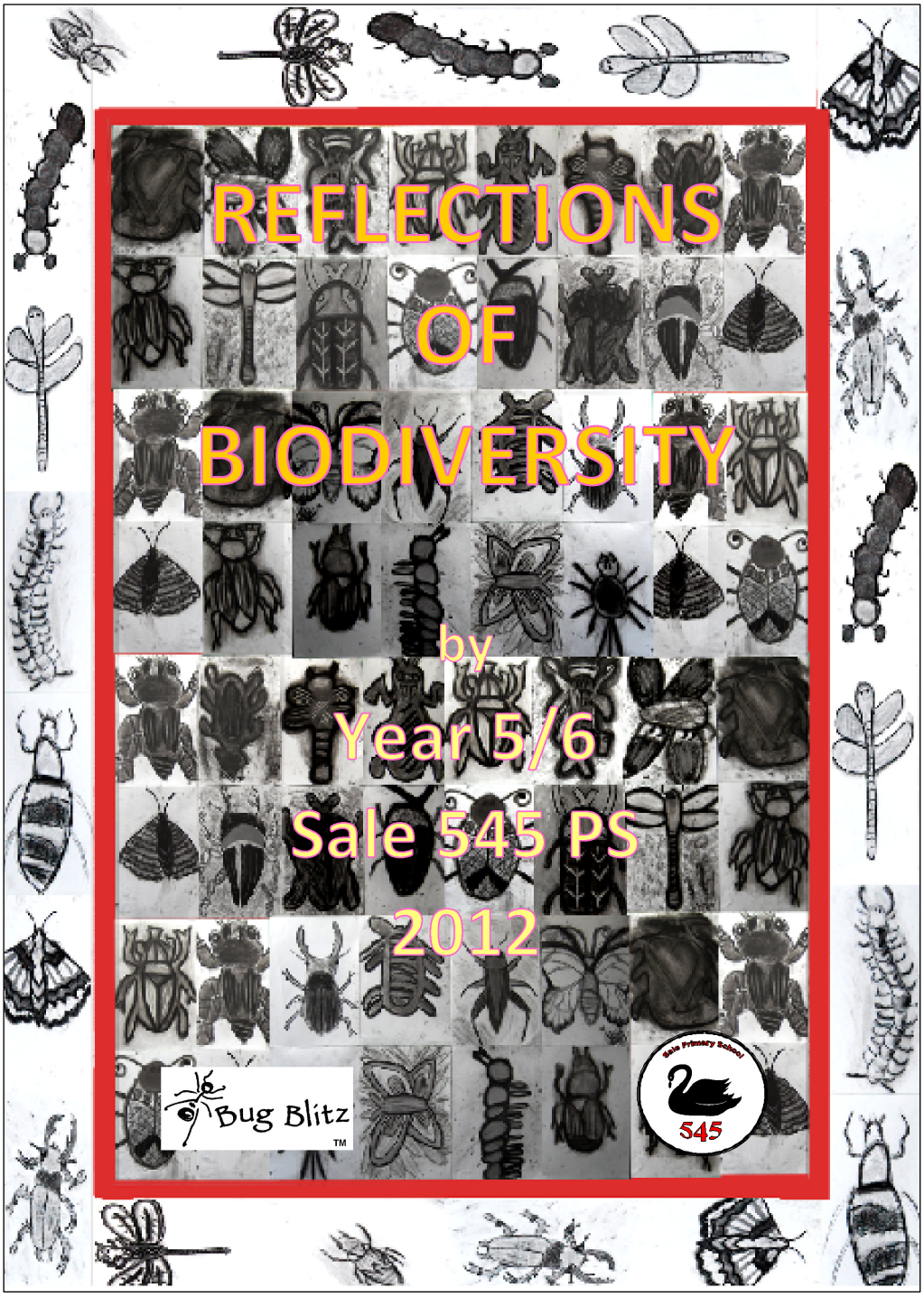


Figure 5.4: Front cover of student book from School 1

In another form, the front cover design for the book was used as the school's contribution to a combined schools art project. The book was also shared with other students at the school. Many of the student illustrations are anatomically reasonably accurate. The beetle and moth images around the edges are well proportioned and reflect correct body parts of insects. Science learning here is thus reinforced and represented in art.

5.5.6: Reinforcing environmental concepts in scientific writing

Writing scientific reports for the book flowed from student field experiences and classroom research. The following reports provide evidence of the depth of student research and their knowledge of scientific report writing. The Pseudoscorpion report was motivated after students found specimens on the trunk of an old Red gum tree at the field day. A female student wrote the report titled 'Grasshoppers', which again provides further evidence of detailed ecological learning. The students did not often refer to the book project during their interviews, as this project was not completed until well after the student interviews and Mindmaps were conducted. For this reason, I have drawn the inferences for learning from the student's published works of writing.

Figure 5.5: Year 6 student scientific report 'Pseudoscorpion'

During their interviews, a number of students mentioned their encounters with Pseudoscorpions in the field. The photo on the right of the student report is the actual Pseudoscorpion that was found during the field day. Being an invertebrate the students had never seen before, stimulated significant post-field research into this creature. Another student wrote the following report - Grasshoppers.

GRASSHOPPERS

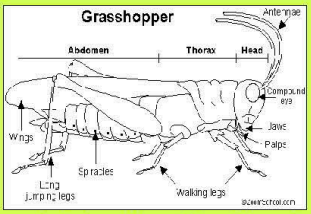
Grasshoppers are a type of insect. There are two types. One is the long-horned with long antennae. The other is the short-horned with the short antennae. They are great for the environment because they are important food for other animals. Some species eat weeds that are bad for cattle and horses.

Behaviour: They are most active at day but they usually feed at night. Most species only come together to mate. When the male wants to mate he can attract females by vibrating his wings or rubbing his wings against his leg.

Diet: Grasshoppers are mostly herbivores. They usually eat leaves but they also eat flowers, stems and seeds. Sometimes they eat dead insects for extra protein.

Protection: they are not endangered but when they are threatened by predators they will jump or fly away. Their predators include small mammals, birds, lizards, snakes, toads, frogs and any spiders that are big enough to eat them.

Appearances: The grasshopper has three main body parts. The head, the thorax and the abdomen. It has a hard shell over its body called an exoskeleton. Most species have two pairs of wings. They also have six legs with strong leg muscles.



Habitat: Grasshoppers live in all the continents accept Antarctica. They like dry open places with lots of grass and low plants, but some species live in the forest or jungles.

Life Cycle: They hatch from eggs then usually shed 5 or 6 times. After the last time they can reproduce. After mating the female produces 8 - 25 eggs. She can produce several egg pods before she dies. She tries to choose a good place to lay her egg, but that is the only care she gives.

Grasshoppers are insects that have many predators, but are not endangered species. They don't give care to their young and mostly like to live in dry, open places.

Figure 5.6: Year 6 student scientific report 'Grasshoppers'

The Grasshoppers report is filled with scientific detail about these insects, the depth of which is impressive. This report is an excellent example of a science report about a family of creatures. It begins introducing families of grasshoppers and comments on the roles grashoppers play in ecosystem health. The report describes grasshopper behaviours, diet, status, appearance, habitat, global distribution, and their life-cycle. In the next example (Figure 5.7), the student

describes a range of bug facts, beginning with the number of insect species, body parts, a specific family (Gerridae), social insects and communication.

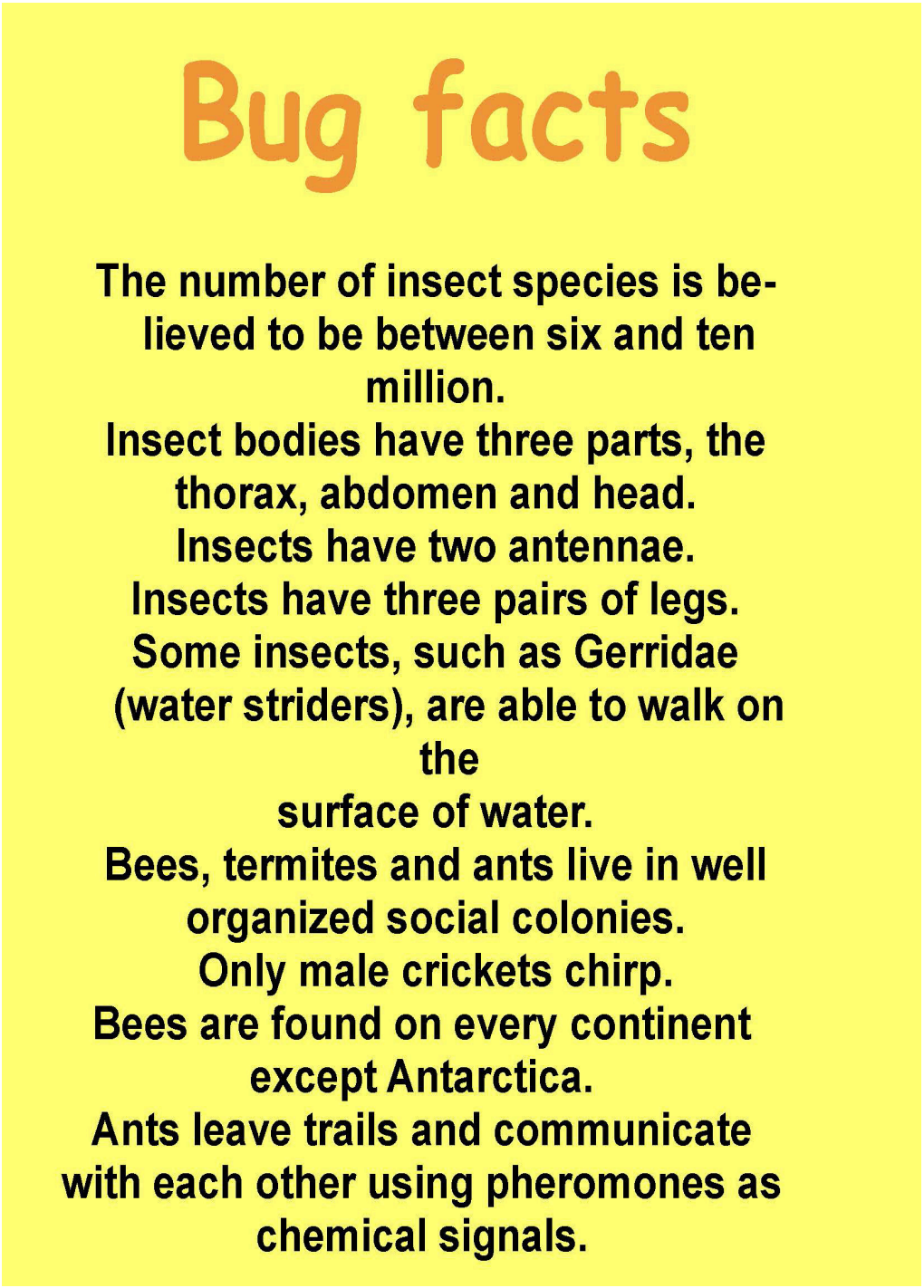


Figure 5.7: Year 6, student's page 'Bug facts'

The poster format produced by the student above contains an impressive array of conceptual learning about bugs, using a limited number of words. A wide variety of genres were used in the book project including a variety of reports (science, information, narrative, comic, recount and fictional), poems and diary writing.

The free verse poem about ants in Figure 5.8 demonstrates an integration of science, poetry, design and digital learning.

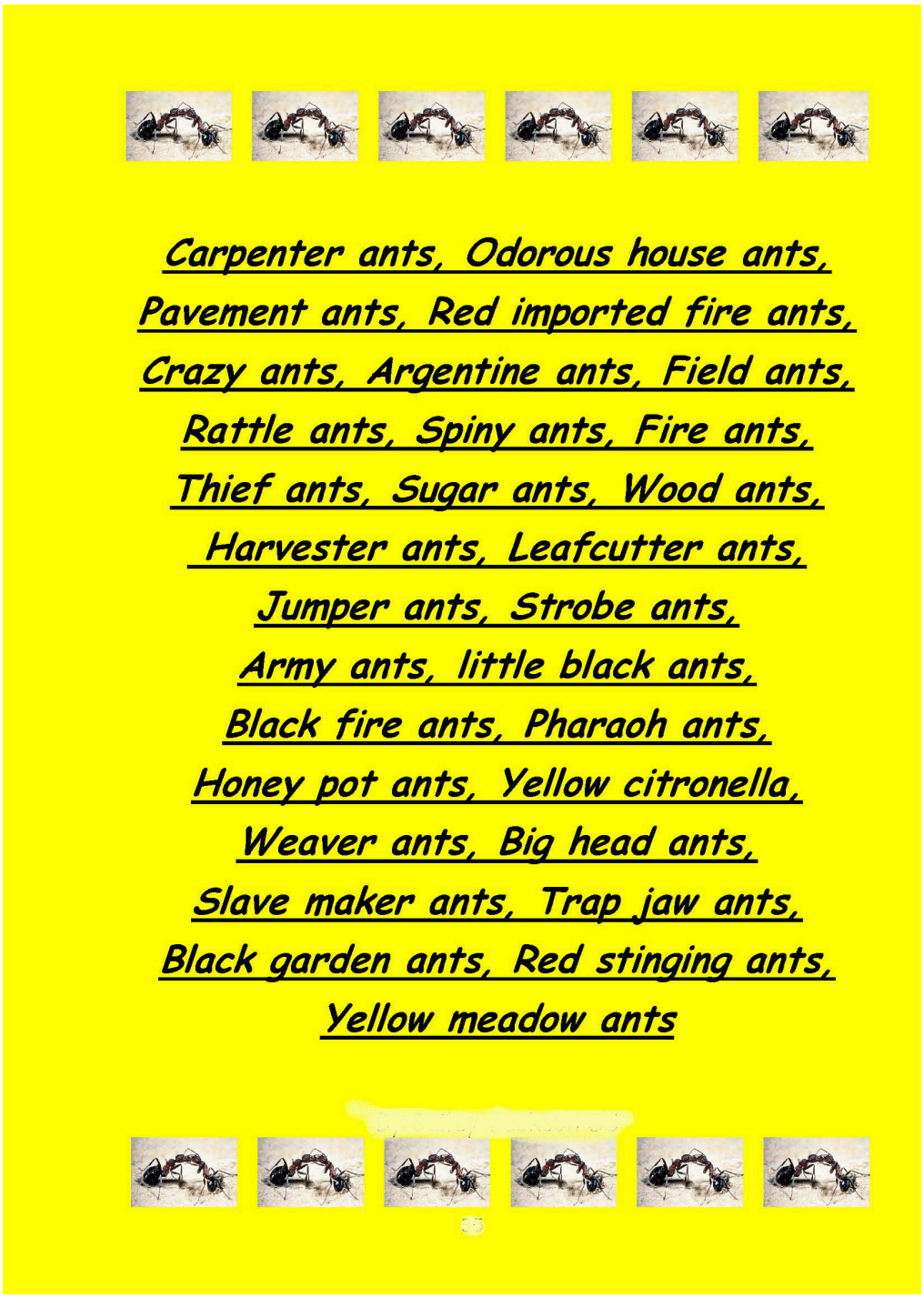


Figure 5.8: Year 6, student's page 'Ant Poem'

The common names here are again reminiscent of classification, with each name suggesting different ant features or behaviours. Considering the common names of insects like this can be linked directly to ecology. Coming up with the names of 31 different species of ants for her free verse poem confirms some well-ordered

research undertaken by the student. The writing samples from the student book demonstrate how various forms of writing were used to reinforce and deepen students' environmental learning. The writing samples also provided obvious links to the use of digital learning.

5.5.7: Integrating nature experiences with digital learning

The book project highlights substantial evidence of the ways field and classroom studies were integrated with literacy, science, digital learning and design. The students used word documents, added headings, text, pictures, diagrams, etc. to enhance the design of their page. Research and digital learning are automatically coupled together. The teachers directed the students to a variety of websites to research animals, ecosystems, environmental organisations and issues on-line. They tended not to use books as teacher 1 noted:

> … kids prefer to use the Internet anyway. (Teacher 1)

Teacher 2 describes how she encouraged her students to use environmental websites to investigate environmental issues, and how joining them can become a form of digital environmental action students can participate in. As she stated:

> We really looked at what as an individual can you do to influence what's happening in the environment. We looked at, as a group, web pages like the Coral Sea group and how you can join that to show your support. (Teacher 2)

Digital technology was integrated in classroom programs in a variety of ways to extend field learning. From Internet research to using MS Word to write, edit, design and publish their pages for the book required the students to use some elementary computer skills. Digital technology was even used to produce public artworks to share student learning, both for the cover of the class book (see section 5.5.5: Post-field book project) and for creating a metre squared polyvinyl artwork that is part of a group schools art project celebrating biodiversity (see Figure 5.9), which will be discussed next.

5.5.8: Integrating art and sharing learning

Sale 545 also partnered with Bug Blitz in the development of *Wetlands Evolution*, a public art project that occurred in 2012 in the Sale township. This post-field project involved a collaborative artwork on the topic of wetland biodiversity. The artist, Ralph Eberlein, ran workshops in five different schools, then composed and digitised the student works into a mural now displayed in a public garden in Sale. Teachers at Sale 545 selected the 50 most talented visual arts students to participate. Three of the seven panels that make up the *Wetlands Evolution* are shown below in Figure 5.9.

Figure 5.9: *Wetlands Evolution* mural in Lake Guyatt Environmental Playspace

These shared public artworks advocate 'for' the environment, in that they perform the function of reminding us that children value biodiversity and the non-human world. The art project's opening event involved students sharing poems and stories from their book in the gardens, and this added a new layer to the learning process.

From an eco-literacy perspective, Capra (2007) states, including art in EfS helps children to study patterns in nature, and community engagement is crucial in sustainability. This project exemplifies how integrating project-based learning that connects field and classroom contexts can lead to a greater extent of EfS learning in the curriculum.

5.5.9: The extent of pre and post-field learning, and integrated curriculum

The integration of field and classroom curriculum needs further investigation to determine how integrating EfS across disciplines increases the quality and extent of student experiences in schools. I could find no existing research that provided details of how this occurred after one-day field events, and in general it seems research into the post-field element of field learning is lacking. Understanding the extent of pre and post-field learning was important in this research, as I wanted to determine its influence on developing student environmental learning. I needed to understand whether post-field learning involved a few class lessons, many lessons or a completely integrated theme of studies including all disciplines of study.

At Sale 545, field related study occupied between four and eight weeks of class time. In the case of Teachers 1 and 2, the pre- and post- field trip learning activities completed by students were significant in scope, number and the time allocated to them. On examining Teacher 2's interview transcript, she had undertaken both pre- and post-field activities, integrated field learning with: science, literacy, dance, drama, art, thinking, digital learning, reflection, research and sharing of learning. The post-field studies at Sale 545 were linked to broader classroom themes: studying different ecosystems, human environment impacts and thinking about how we can lesson these. As demonstrated below, Teacher 1's intention was clear; they did not consider field day experiences in isolation from the classroom curriculum and purposefully integrated the two:

> We've always done a pre-activity and post-activities, because you want to make the kids, you value the activity or the excursion, you don't just do it just to fill in a day… we did a lot. (Teacher 1)

As well, Teacher 2 talked of how she took her students into the school grounds to investigate an ecosystem, so I found evidence of pre- and post-field learning at Sale 545. The level of pre-field learning involved preparing students for the excursion and safety considerations. The classes at Sale 545 completed an immersion day of activities before the field day, to excite the students and introduce the topic of wetland life to them.

The Toongabbie field day was held in November, which meant that the field program overlapped with Teacher 3s end-of-year testing and reporting

requirements. As a result of this, the students at Toongabbie only experienced a few related post-field activities, one of which was completing the Mindmaps. Standardised testing and reporting had interfered with the students chance to develop learning from their field experiences. For this reason, I focus my study on the post-field experiences of the students from Sale 545.

5.5.10: The experiential learning cycle in field and classroom learning

I have used an experiential learning framework to understand how the styles of experiential thinking, were experienced by students across the process of learning from field to classroom contexts. This first part of Kolb's experiential learning cycle (1984a) was demonstrated on many of the student Mindmaps, and can be categorised as learning 'about' biodiversity or environment.

On examining student Mindmaps, I circled words that could be interpreted as learning 'about' biodiversity. I noticed that most of the words the students listed to describe their learning experiences involved learning 'about' biodiversity and the environment. Because the Mindmap I chose was hand written and the digital copies were not legible enough for this thesis, I have created a table listing one student's responses to show examples of learning 'about' biodiversity (see Figure 5.10). This list represents the large majority of the words the student used to describe their process of learning in the field and at school on their Mindmap, and mostly indicates learning 'about' the environment.

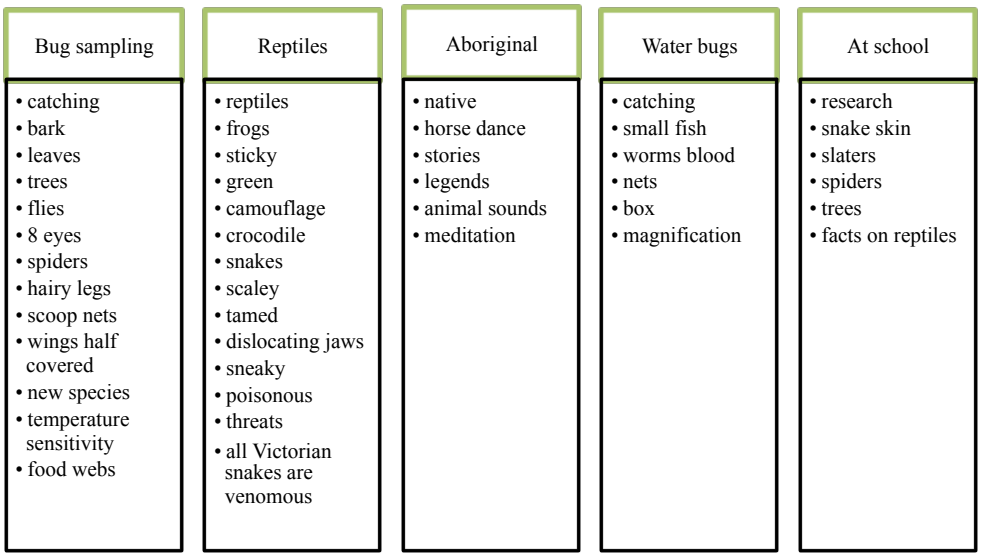


Figure 5.10: Student Mindmap: Toongabbie – Words Listed by Student Showing Learning 'about' the Environment

The student's words describe the features of animals, and factual information like snakes are poisonous. They also list the field activities, e.g. meditation, horse dance, catching bugs using nets, magnifying glasses and boxes, and researching back in class. The field events contained different 'hands on', concrete experiences.

Reflective observations were also evidenced in student interviews and post-field writing and research tasks. For example, a student wrote a scientific report for the book using a fictional creature he had created called Dragon Ant. In completing this process, the student had engaged with the 'abstract conceptualisation' part of Kolb's (1984a) experiential learning cycle.

> Description: Dragon Ants spit their venom. Their venom is like being covered in lava. Its armour is as thick as rock. They live in abandoned termite mounds in colonies of up to 12,000. (Segment of a student's report from the class book)

The final phase of Kolb's (1984b) experiential cycle, active experimentation, was best indicated by the students, whose research on ecosystems and human impacts, led them to exploring online environmental sites like the WWF as a way to take action (See Teacher 2 comment, section 5.5.7). Further, publishing and sharing their book about biodiversity, and producing a mural celebrating biodiversity could be thought of as active experimentation with knowledge. All of the different

phases of Kolb's experiential thinking, were included when field, classroom and community learning were connected, over a period of time.

5.6: The influences of field presenters on environmental learning

This final section of analysis is concerned with analysing data that addresses one of the overarching research questions: What influences, if at all, do field presenters have on environmental learning? The question is important because the learning process began in the field with students undertaking activities designed by the field presenters. These field experiences introduced students to the topic of biodiversity and ecological concepts. Having video evidence allowed me to examine the field presenters' environmental teaching aims, the pedagogical approaches they applied in their field workshops, and the students' learning experiences.

5.6.1: Facilitator expertise: impact on ecological learning

Across field days, students were exposed to five different field workshop facilitators, all of whom had expertise in their workshop subjects: Aboriginal culture, reptiles, insects etc. The student comments illustrate their appreciation of having access to different expert opinions:

> If I haven't caught that bug or I haven't caught that tadpole or something, they know more about it and I don't, so they would tell me about it, and … if they're sensitive or not. (Andrea)
>
> Yes because you've got experts there and – mm. (Barry)
>
> Yep he [Reptile handler] had lots of answers and expertise. (Indy)
>
> … on a board walk, … they told us about all the, like the trees that live in all the layers in the wetlands... (Kurt)

Teachers and students alike agreed that expert facilitators encouraged student questioning with the teachers commenting:

> I think having some experts on a field trip like Bug Blitz was a really fantastic thing for the kids to be able to ask questions. (Teacher 2)

> … it was exciting for the kids when they found something and you had the knowledge to be able to tell them a little bit about it or a lot about it (Teacher 1)
>
> To have people with the experience coming in, I think that's beneficial too. (Teacher 3)

Teacher 3 suggested there were benefits beyond knowledge learning with experienced people. There are risks and dangers in outdoor habitats, particularly wetlands. Such a situation occurred at the Sale Common field day when two Tiger snakes, ranked as the seventh most venomous species in the world, were sited in the wetland during the event, around 80 metres from the activity base. The group (field presenters and teachers) chose risk aversion by avoiding the vicinity the snakes were seen in. Experienced outdoor educators, like the field presenters, provided the groups with a feeling of security and confidence in the wetland.

Having access to a range of new experiences, expertise and knowledge opened the doors to further student inquiries of place perspectives. A student referred to places of origin in his response saying, "… We originated from England" and interestingly commented that his (Gnarnayarrahe's), "the Aboriginal peoples colony was here first" (Andrea). Andrea's comment was interesting, as Gnarnayarrahe's stories had stimulated her to think of place as a contact zone of perspectives, as suggested by the post colonial theory of Somerville et al. (2009) (see section 3.6: Philosophy of place-based learning). The field facilitators presented a range of different place and pedagogical perspectives.

5.6.2: Pedagogical approaches used by workshop facilitators

As with the above analysis, video data allowed me to analyse the pedagogical approaches used by the various facilitators in the field. Varied approaches may be one of the strengths of rotational styled field programs, as a greater diversity of teacher approaches are more likely to cater to a range of preferred learning styles in any group. As a mixture of activities, the workshops varied from question and answer, to discussion, measurement, discovery, story telling, music, animal shows and were procedural in approach. Some workshops were stationary, while others necessitated that learning groups move around the locations. The approaches used

by the presenters were noted by Teacher 1, who felt one of the workshops was overly teacher directed, less active and engaging than the other workshops:

> Gum Leaf Science -Yes the kids didn't find that activity as good, I think it was, from my perspective maybe the presenter wasn't as engaging as the other presenters … they had to sit still for quite a lot of the time. (Teacher 1)

The video data showed that the Gum Leaf Science lesson was teacher directed, highly structured and that some students became restless. Teacher 2, on the other hand, thought the Gum Leaf Science workshop was engaging and effectively delivered. The student interview and Mindmap data confirmed that most students still learnt the key aims of Gum Leaf Science, which involved identifying different gum trees and their uses e.g. suitability as firewood. Even though the Gum Leaf Science was highly structured and controlled for a field workshop, this type of pedagogical approach suits some students. Also the forty-minute rotations of activities at field days keep students engaged and moving to different workshop experiences, which can absorb a mixture of active and less active workshops overall, without disadvantaging student learning.

The teaching approaches applied by the field presenters were similar in ways, and yet significantly varied as highlighted in the next section.

5.6.3: The influences of field presenter approaches on student activity time

The pedagogical approaches used by field presenters can have a bearing on how much time students are actively engaged during field experiences. As a previous study suggested the more engaged students are, the greater the potential for field learning (Wattchow & Brown, 2011). Video data enabled me to estimate the amount of 'direct student activity time' within each field workshop. In direct student activity time, students are participating in an activity as opposed to passively listening to group instructions or explanations. Table 5.2 shows the direct student activity time for each workshop at the Sale 545 field day.

Direct student activity time - Sale Common Field Day – May 2012 Workshop duration 40:00 minutes.	
Activity 5. Catching bugs – rapid biodiversity assessment	33:00
Activity 3. Nest building and birds	28:00
Activity 2. Wetland Boardwalk	22:30
Activity 4. Gum-leaf science	17:16
Activity 1. Aboriginal culture	17:00

Table 5:2. Direct student activity time in workshops at Sale 545 field day

The two activities students favoured most at the Sale Common field day contained the largest amounts of direct student activity time when compared to the other workshops, and this could explain the students' perceptions. The differences in student activity time, that is, between Activity 5 Catching bugs – Rapid Biodiversity Assessment, and the lower three field activities on the table is that they vary in the amount of direct student activity time by 10-16 minutes. At a micro teaching level, this provides important insight for teachers and others to consider the amount of active student time in field workshops when planning activities. A variable regarding this suggestion, however, is that the Aboriginal workshop contained 17 minutes of direct activity time, yet was still highly popular with students.

Field learning does not always mean active experiences for students and as Morag and Tal (2012) found in their study of 22 field trips, most of the trips included some type of learning activity, however the majority of these activities were demonstrations in which most students were passive. The time students are directly engaged in activity during workshops could be a significant factor in improving student learning, however other factors like story telling and

Aboriginal knowledge are engaging for students and teachers also. The field presenters had a range of influences on student learning, and they willingly shared their knowledge and expertise on biodiversity. In having a positive influence on student learning, I was naturally curious to explore if the field experiences have an influence teachers' eco-literacy.

5.6.4: Field presenter influence on teacher learning

Even though field presenter impact is an important component of the study, so too is their influence on teacher learning. In relation to this focus I asked teachers the question: Did you learn anything about the environment in the field?

> How did I benefit as a teacher? Well it was – I guess it was good as a teacher because I had that knowledge of what the kids had seen as well. (Teacher 2)
>
> I was probably more supervising and making sure we're all … engaged. (Teacher 1)
>
> I learnt a lot of what the kids learnt as well, but as a teacher there was a lot more I guess management of the groups that occupied my time. (Teacher 2)

Based on these comments, it appears that managing and supervising students in the field can distract teacher learning. However, teachers also identified field presenter expertise as 'beneficial' for their learning. As expressed by the teachers from Sale 545:

> Yes because you can ask directed questions to the presenters [who are experts]. (Teacher 1)
>
> … to be able to talk to people who are experts in the field that they really enjoyed it, it's definitely beneficial (to me as a teacher as well). (Teacher 1)
>
> I know I came back more motivated to go through the unit… I came back ready to look at what are the different types of bugs? I came back with a different approach so yeah – I guess it does [benefit me as a teacher]. (Teacher 2)

Teacher 3 suggests field days have levels of learning for teachers, which are linked with their own attitudes.

> I think that's one level that needs to be recognised too … it's also the teachers doing a lot of learning too... (Teacher 3)

Another benefit for teachers was the view that a local habitat provided a useful resource. The students and teachers became more familiar with a genuine, local habitat, for learning. As the following teacher states:

> It (the field experience) made it easier for me to explore the Gippsland Lakes eco system with them (students) because I could refer to what they had seen and done. It was a useful resource for that rather than having to look elsewhere and create an experience that's not as a genuine. (Teacher 2)

Teachers can also benefit from accessing resources offered by non-formal environmental organisations to support teacher learning. As this teacher suggests:

> There's a lot of resources out there for teachers to use … I've been able to have a first hand experience working with Bug Blitz, working with CSIRO, working to have it first hand to know what it is, and also the Inch Quest stuff [program]. (Teacher 3)

These examples all involved the teacher having 'first-hand' experiences in the field. In the busy world of teaching, professional development opportunities remain important. The findings of this research suggest field presenters can influence teacher's environmental knowledge, which has implications for student and teacher eco-literacy.

5.7: Conclusion

The analysis undertaken in this chapter reveals some of the explicit learning outcomes students achieved from their field experiences, including new learning about biodiversity and Aboriginal environmental perspectives. The analysis suggests that a majority of students learnt the key workshop concepts, which they elaborated on back in the classroom environment. The analysis also reveals the key benefits teachers and students attributed to field learning, including how teachers connected field and classroom learning using reflection, research, post-field writing projects and other pedagogies.

The final chapter of this research draws the key findings of this study together, synthesising them into themes explaining: student field learning, how field and

class contexts were connected to enhance EfS and the influence of partnerships in environmental learning. The implications of this research suggest that biodiversity field learning provides a hopeful avenue for students to connect with nature and the environment. The conclusions lead to recommendations suggesting ways we can improve student eco-literacy and create a hopeful path towards a sustainable future, which includes field learning.

Chapter Six

Finding a way forward to a hopeful future

> If we are to balance and direct our remarkable technological muscle power, we need to regain some ancient virtues: the humility to acknowledge how much we have yet to learn, the respect that will allow us to protect and conserve nature, and the love that can lift our eyes to distant horizons, far beyond the next election, pay check or stock dividend (Suzuki, 1997, p. 208).

6.1: Introduction

This thesis has now come full circle and I return to the work of David Suzuki to further examine a way to find 'another path'. As he suggests, if we are to find a way forward towards a sustainable future we will have to be able to think in longer terms than "beyond the next election". This thesis has been a long journey and in this final chapter I also revisit the path I have travelled during this research, and offer suggestions on ways that we can move towards a sustainable lifestyle by building a more eco-literate citizenry.

Connecting with nature, offers another path. In this chapter I discuss the themes that tell the story of student environmental learning from field days to classrooms, and from classrooms back into the community. Working with children and teachers from two Victorian primary schools – Sale 545 and Toongabbie, the findings from this study highlight the benefits and value of connecting field learning and perhaps this is one way to reconnect and 'protect and conserve nature'. For students, it was the sensory and experiential elements of the field experiences that stimulated new environmental learning.

Understanding ways teachers integrate field and classroom learning, and the implications this has for improving the extent of student learning, is crucial in the argument I have been making throughout this study – that we need to act on the environmental crisis, using one of the major avenues for change available to all societies – education. Like all research, this study has limitations. Foremost of these are the sample sizes, the methods I chose to interpret the results of the study, and others I will discuss in this chapter. Recommendations for further research

and an outline of the contributions I believe this research has made to the field of EfS are presented to conclude this thesis. The sections to follow therefore contain a synthesis of my findings, reflecting on their relationship to existing research and providing explanations for my conclusions.

6.2: Conclusions: Biodiversity field days and developing eco-literacy

My experiences in nature as a child were the catalyst to this study and created the desire to explore childhood experiences in nature more generally. These experiences are the building blocks for connecting with the natural world and they play a vital, if not irreplaceable, role in all aspects of human development (Kahn & Kellert, 2002). It is likely that field experiences are fundamental to children developing knowledge, care and competence in being active citizens in EfS, essential elements of eco-literacy.

6.2.1: Environmental field learning and elaborating on concepts

In Chapter Four and Chapter Five, I described how I determined the learning aims set by the field presenters on the two student field days and how I used this knowledge to assess student learning. After completing this process, I found the majority of students at both field days recalled the key concepts from each field workshop and, when they were asked to elaborate, most students provided details of new information they learnt or the lessons they completed in the field. A similar finding was reported by Morag and Tal (2012), who equated this as knowledge learning. I used a student's Mindmap in Chapter Five (see Figure 5.1) showing the significant extent to which some students were able to elaborate on their field experiences.

On analysing the field workshops closely, I found they generally included learning about ecosystems, biodiversity, classification and human impacts on the environment. As I demonstrated in my analysis, the teachers at Sale 545 had also reinforced these concepts, making them explicit learning outcomes of their classroom programs post-field, as well. For this reason, it appeared that this conceptual learning was a mixture of field and classroom experiences. This

finding supports previous research (J. Farmer et al., 2007; Nundy, 2001), which states that field experiences help to improve students' ecological knowledge and encourage higher order thinking, particularly when post-field learning is included. In the context of biodiversity focussed field days, animals appear to provide a powerful source of attraction and stimulation for students.

6.2.2: Animals and developing biophilia

The participants in this research agreed that: interacting with animals during environmental field days motivates and stimulates students. Interaction with animals is supported in research by Ballantyne and Packer (2002) and Kahn and Kellert (2002) who recommend that educators take advantage of the motivation students' gain from interacting with animals in local habitats. In the field activities of this study, the students learnt: new information about animals that inhabit their local wetlands and school grounds; techniques for collecting invertebrates; and human impacts on biodiversity. In addition, the animal interactions motivated feelings in students reminiscent of what Wilson (1984), refers to as biophilia.

In his article "A sense of wonder", David Orr (2000) warns us that we need to make a choice between biophobia and biophilia, as science and technology have given us the power to determine the future of life on our planet. Orr's research suggests educators must find ways to help students to connect with nature. I cited Sobel (2008), who proposes we combine teaching knowledge and a 'love' of nature, to build feelings of connection or biophilia in students. Interacting with animals in the field can help reduce biophobic attitudes in students, as I found in this study when a student stated: 'Like, I thought they (bugs) were just creepy, but now they're pretty cool' (Steve). A recurrent theme in the interviews was a sense of excitement and motivation students' gained from interactions with animals in the field.

I have discovered, on my own path through this study for example, that the types of interaction with animals in the field could vary and that there are ethical, scientific and values based considerations for educators to address.

Working with animals is becoming a more prominent issue in society in general, with animal advocacy groups calling for ethical guidelines and laws, which respect animal rights. Such situations, as Orr (2000) suggested earlier, require us to make informed choices. The results of this investigation further support the notion that interacting with animals may help people to make biophilia connections with nature.

6.2.3: Building affective connections and field learning

The field days generated a positive influence on improving student feelings of care and concern for the environment, and they motivated some students to want to help the environment. However, the feelings students describe from a single-day field experience are not those of deep-connection to place that Wattchow and Brown (2011) assert are desirable. Rather, they support earlier propositions by Chawla and Duffin (2005) and Pfeiler (2007), who suggest that connections to nature can be cumulatively developed over time. At a personal level, feelings of connection with place were evident in student writing samples. This is best demonstrated in the words of the student poem below.

> I walk around and see all the nature,
> It's definitely more beautiful than the city's skyscraper.
> I'm almost sure I'm going to come back here,
> May be next week or maybe next year. (Alex)

Alex is sharing her desire to revisit the wetland location of the field day, in the future. Another student published similar poetic reflections of her field experience as follows:

> The buzzes from the bees, the tweets from the birds.
> The bugs swishing through the grass, swish, swish, splash!
> The sounds of the didgeridoo rumbling through the ground calling us all around
> As the leaves start to fall, the birds start to sing.
> As the bugs hide under the leaves and the birds start to fly away to the nest, they sleep over the wetlands.
> Watching as the sun goes down and the moon comes out to shine. (Ash)

These poems follow the metaphor of learning as a 'path', where our knowledge and connections to nature are built on lifelong experiences. For Ash, she reflects on her pleasurable field day experiences, which suggest a growing affinity for biodiversity in the wetlands. In understanding that field experiences have cognitive and affective benefits for students' environmental learning, I needed to understand any other important benefits and qualities of field learning, as perceived by the participants in my study. I will discuss my conclusions regarding these qualities next.

6.2.4: Embodied learning, storytelling and Indigenous culture in place

The teachers and students agreed that field experiences were engaging, included active 'hands on' learning, and involved places where students could 'see things' for themselves, outside of classrooms.

These qualities and experiences of engagement are consistent with embodied forms of learning as defined by Lane (2012), which enable students' minds, bodies and spirits to be actively present during the learning process. As a student in this research stated, the field experiences made him feel embodied, like he was a wetland or a wetland object. As Somerville et al. (2009) stated, new place pedagogy begins with shared stories of local places and embodied learning where differing perspectives of place are enacted. I used the example of a story Peter (a field presenter) shared with students about a local bird, the Oriole (see section 5.3.2) at the Sale Common. Following Peter's story the students built their own nests into the forks of trees and shrubs in the wetland. For the student Kenny, the combination of story and embodied learning resulted in him 'putting himself into their [birds] shoes.' This example demonstrates how story and embodied learning led to Kenny considering a perspective of becoming other, reminiscent of Stewart (2011) and Somerville (2011a) research suggesting the positive learning benefits of adopting such pedagogy.

The results of this investigation show other students who alluded to feeling 'other than human' perspectives during the program. This finding supports the view that

further research of the explicit inclusion of such pedagogy in EfS curriculum is warranted.

As well as learning ecological information and concepts, the students and teachers in the research project believe an Indigenous perspective of place is a highly valuable part of field learning. This finding goes to the essence of contemporary place pedagogy of Somerville (2010), who asserts that our relationships with place are formed through stories, embodied learning experiences, and a contact zone of place perspectives. My findings support Lowan (2009) who asserts, a way to encourage biophilia is to include Indigenous perspectives of connections to land, animals and culture. Many students, and all of the teachers, recounted this aspect as influential during their interviews. None more so than the following student who encapsulates the influence of Gnarnayarrahe's workshop as follows:

> From Gnarnayarrahe we learnt about some of the aboriginal stories and dances from where he was from and some of the language what he calls some of the animals and stuff we see around here like kangaroos and stuff and about the origin of his name, how it means little joey at the billabong and we learnt about how the pigeons and the mighty eagle and how the waratah flower became red because of the blood from the eagle and we learnt dances and stuff. It was very interesting. (Dusty)

The influence of story, Aboriginal culture, biodiversity and place are evident in Dusty's positive response, which provides an accurate account of Gnarnayarrahe's workshop. From a sustainability perspective, Capra (2007) suggests we do not have to begin from scratch, as we can learn from the practices of cultures who have successfully sustained themselves for thousands of years, compared to those who have not. It was fundamentally the different partners in the field days that provided a range of embodied experiences, and different place perspectives for students to consider, which I discuss in the next section.

6.2.5: Partners enabling place perspectives

An equally valuable contribution of learning partnerships in the field is the different perspectives of place and biodiversity that field presenters provide participants. For example at Sale Common field day, differing perspectives of place were varied: a government water authority representative, an Indigenous

person, and a local bird naturalist. Both the field days in this research included stories from a range of perspectives and in this way, brought people together to enact "new social ecologies in which the life forces and forms of the place become more dominant" (Somerville & Green, 2015, p. 31).

In this same way, the field studies in my research can be considered as place-based. A description of a Bug Blitz field day, Somerville and Green (2015) describe succinctly how Bug Blitz field days include place perspectives: "All of these things – the water, bugs, rural schools, teachers and children, Aboriginal stories and birds and fire awareness trailer – create an assemblage of place that the children visit over and over again in their learning" (p. 31). The students in my thesis experienced a range of perspectives, which included stories of place and the social assemblage of knowledge. My results support Somerville and Green's proposition and the field events in this research appear to have resulted in an exciting exchange of environmental views.

Another benefit of place-based learning experiences is they generally include a local ecosystem or 'place' for students to visit, as a model to compare with other non-local ecosystems. The transition from local field experiences to global ecosystems reflects the transition between field and classroom contexts, as I expand on in the next section.

6.3: Connecting local and global ecosystems in classrooms to explore human impacts

Exploring how teachers connect field and classroom learning has been a primary aim of this study. My findings agree with the previous research studies (Barker et al., 2002; Klinsky et al., 2010; Somerville & Perkins, 2010), which all suggest local places are an essential prerequisite for expanding to national and global environmental contexts. The local field context is of indispensable importance in this regard, as it provides the location for real experiences. In the context of this research, students examined human impacts on ecosystems in more depth once back in their classrooms. Their inquiries led them to exploring local, national and global scale environmental issues.

Field experiences motivate students to investigate environmental issues on wider scales, with exploratory activities suited to field and classroom learning contexts.

The range of human impacts on the environment listed by a variety of student participants was significant. Students cited climate change, coral bleaching, hunting, feral animals, deforestation, pollution, threats to waterways and reptiles, and the ecological links and effects of some human impacts. Most of the explicit learning about human impacts could be associated with ecosystem studies at Sale 545, as it was manifest in the curriculum here over Toongabbie. On close analysis, the Sale 545 student comments indicate an introductory level of knowledge of issues like climate change, which they made broad, general references to.

The students clearly knew that deforestation impacts biodiversity and that this can have an effect on animals. Such investigations can take significant research and learning time for students to understand more fully the complexities of environmental issues, before informed environmental actions can be planned and undertaken. At Toongabbie, student references to human impacts related to their field experiences. E.g. Students named impacts on reptiles, bugs and the health of waterways – all related to their local field experiences. As I explained in Chapter Five (see section 5.3.3), the extent of post-field learning at Toongabbie was minimal. At Sale 545, student references to human impacts related directly to the research and inquiry projects the pupils undertook back in their classrooms. E.g. Students named impacts on the Great Barrier Reef and Orang-utans in Asia. The impacts they named were more national and global in scale, reflecting post-field learning.

6.3.1: Research and inquiry

Teachers at Sale 545 revealed they used research and inquiry learning tasks to explore a variety of ecosystems and the human impacts on them post-field. The inquiry projects engaged the students in significant research, presentation and sharing of their learning outcomes with peers.

The way the classroom inquiry projects were structured, extended the students' learning of different ecosystems by requiring them to choose ecosystems other than wetlands, which they had already studied during their field experience. References were made to post-field inquiry projects during teacher and student interviews, and on the student Mindmaps from Sale 545.

These insights suggest that connecting local field experiences and post-field classroom inquiry studies can lead students to broadening their understanding of human impacts on local, national and global ecosystems. The realisation that local and global ecosystems are powerfully interconnected (Somerville & Perkins, 2010; Somerville et al., 2009), is an important part of developing student eco-literacy, which it appears can be positively impacted when teachers connect field and classroom contexts using inquiry learning.

For this reason, teachers have an important role to play in broadening and extending student knowledge to include local, national and global environmental contexts and issues in EfS curriculum.

6.3.2: Reflections, research and writing projects

In Chapter Five, I explained how I investigated student learning by analysing the types of lessons and projects the students were engaged in post-field. I found teachers at both schools had incorporated the writing of reflections and recounts of field experiences in their classrooms, immediately following the field days. A small number of students commented that reflection is vital for reinforcing field learning and helps them to consolidate personal knowledge.

This was best illustrated by the student named Tex (see section 5.5.2), where he applied the metaphor of papier maché; in the field you collect information, and you stick these pieces of information together to form understanding back in class. This view is supported in earlier research (Carlson, 2008), which shows that follow-up studies help to reinforce field concepts and allow students to process their field experiences.

Inquiry-based research and reflective writing were not the only post-field learning units of study the students at Sale 545 completed. Another project-learning task

motivated the students to complete a book about biodiversity, when back in the classroom, demonstrating how such tasks led to the integration of science, writing, design and digital learning in the process (described in detail in section 5.5.5). The student document samples I collected from book were a rich data source.

The book project also required a significant commitment of follow-up learning time back in classrooms. If I make an estimate as an experienced classroom teacher, I would say that students spent between five and seven hours of classroom time to produce their page for the book. Student learning on the topic of biodiversity deepened as a result of the follow-up projects. In this instance at Sale 545, the extent of post-field learning was significant and clearly multi-disciplinary. The book project involved contributions and support from partnerships in this research, which had a direct influence on field and classroom learning outcomes.

6.3.3: Overlapping contexts, a framework and Kolb's experiential learning cycle

This study highlighted aspects of Kolb's (1984b) experiential learning cycle in the programs undertaken as part of this research. I found that when in differing contexts, a framework (in, about, for) and an experiential learning cycle overlap, meaning the subsequent programs are likely to include cognitive, affective, and behavioural components of eco-literacy, interacting over time along a continuum of developmental stages (Hollweg et al., 2011), where learners are viewed as neither eco-literate or eco-illiterate..

In exploring experiential learning Beard and Wilson (2002) state that, being a cycle of learning, an experiential process has no necessary beginning or end. For my purposes, the 'beginning' happened 'in' local field habitats where the students were immersed in concrete experiences like making bird nests. The teachers and students in my study considered their field learning experiences to be embodied: hands on, seeing things for themselves, engaged and active. Concrete experiences

naturally lead to reflective observations in the field. I used the comments of the student named Indy, to show how this occurred (see section 5.4.4).

As Indy sat making an artwork from sticks in the field, she reflected on the state of the wetlands and how human pollution could impact on the life there. Students were having concrete experiences, observing, reflecting and conceptualising thoughts throughout the field days. I used an example earlier in this study (Beard & Wilson, 2002), which describes a complete experiential cycle as it could be applied to the scenario of seeing a snake in a habitat (see section 3.3). The experience of seeing a snake in this scenario triggered a complete learning cycle in the moments during and after the sighting. Returning to the field-day nest making, Teacher 2 indicated how as students made the bird nests, they reflected on the nests they made, conceptualised where to place them and then actively tested their theories by placing them in the habitat they were in. This is an example of such a cycle. In this thesis, I was mainly concerned with identifying the parts of an experiential learning cycle as they occurred over time and across contexts to influence environmental learning.

In identifying that the field events involved concrete experience and reflective observation parts of an experiential cycle, I used the student document samples to identify other elements of the experiential cycle that were applied back in classrooms. In Chapter Five (see section 5.4.1) I detailed a number of ways the teachers engaged their students in writing their reflective observations of the field events. Research that I reviewed previously (see section 2.11) suggested that fieldwork motivates students to complete related literacy tasks (Pfeiler, 2007). Stories of outdoor experiences sensitise students to feel care for the environment (Wason-Ellam, 2011), and using multi-modal literacies to engage students in communicating knowledge and taking actions for the environment can benefit students' ecological learning (Nixon, 2007). The connections I found between field experiences and literacy projects undertaken back in the classrooms in my study, reference a similarity of findings to those in this existing field of literature.

Further, integrating the literacy process with nature focussed field experiences, reflects the early nature writers I referred to in Chapter 2, in that students use ideas generated in a local field habitat and literacy to communicate and share their

experiences. Fieldwork and literacy go naturally together, and using the nature writers as a model for connecting the two contexts may well serve a purpose in EfS and school curriculums (which have a major emphasis on developing literacy skills). In saying this, the connections between the style of the nature writers and student writing in the book were not strong. None of the students used the style of writing a nature journal in the student book.

In following the thread of the students' writing at Sale 545, I presented examples of student writing in Chapter Five, in which students created fictional creatures based on the real animals they had encountered in the field. To do this, the students had to apply abstract concepts to create their fictional beasts. Another student created a page in the student book titled *Gross Bug Infections*, which featured close-up photographs showing the results of invertebrate stings and bites, and another created a page listing the top five 'bug' movies, e.g. A Bug's Life. These are examples of the students abstractly conceptualising about the biodiversity they encountered in the field.

The final part of Kolb's (1984b) experiential learning cycle involves students actively experimenting with knowledge gained during the learning process. I argue that when students share their written works, they are also actively experimenting with knowledge. They are testing the purposes of their stories; did they entertain or inform the audience with their content? When students share their learning, they are actively experimenting with the knowledge they have gained and acting 'for' the environment as well.

This study showcases that all of the phases of Kolb's (1984) experiential thinking cycle – concrete experiences, reflective observations, abstract conceptualisations and active experimentation – can be identified through the process of field to classroom learning. A fundamental problem with Kolb's theory according to Bergsteiner et al. (2010), is a lack of clarity in defining what constitutes concrete/abstract, passive/active or primary/secondary learning. For the purposes of this study, I used Kolb's typology to identify examples of student thinking styles, as they were experienced in the process of learning from field to classrooms. Acknowledging the earlier critique (2010), it should be recognised that there is a level of subjectivity in the analysis of such factors in this study. The

experiential process occurred naturally in the contexts of this study, as it was not pre-planned. These findings suggest that this process helps to develop eco-literacy in students and is more likely to occur when field and classroom learning are significantly integrated.

6.3.4: A platform for other learning in essential proportions

The work of Cutter-Mackenzie (1998) and Green (2011) refer to learning 'about' the environment as being the platform for learning 'in' and learning 'for' the environment. Cutter-Mackenzie states that the three terms (in, about, for) should be thought of as interdependent. The study supports these theorists view: that we have nothing to fear from teaching 'about' the environment. Earlier in this chapter I explained how the students in my study enjoyed learning new information about biodiversity in the field. In the previous chapter, I described how I came to this conclusion, and suggested that improving teacher awareness of the simple framework of learning 'in', 'about' and 'for' our environment could redress any imbalances that exist in current programs in schools. Planning to include these different approaches in EfS curriculum could make a significant difference in the balance of programs. When we are learning 'in' a habitat, learning 'about' nature seems to occur naturally, however it appears as though learning 'for' the environment is not the same. It generally has to be deliberately included to occur in EfS contexts.

The question this research asked is: What proportions of each approach should well-balanced EfS programs contain? Should the proportions be: 30 per cent learning 'in' outside of school environments, 40 per cent learning 'about' biodiversity and related content, and 30 per cent taking action 'for' the environment? Considering proportions is a worthwhile question for all educators to think about.

6.3.5: A lack of teacher knowledge

There is a large body of existing research supporting the notion that teachers lack environmental knowledge, due in large part to a lack of opportunities for teachers to undertake professional development in teaching EfS (Cutter-Mackenzie, 2009;

Dyment et al., 2015; Forbes & Zint, 2010; Lang, 1999/2000; Paul & Volk, 2002). My analysis of data suggests also that teachers lack knowledge and skills in using scientific field data to extend environmental-science learning back in classrooms.

The students wrote individual animal reports, however there was minimal evidence they had used field data for scientific analysis. According to Teacher 2, her students looked through the bug photos as a class group, discussing bug features, similarities and categorising them. As I found in my literature review (Bonney, Cooper, et al., 2009), citizen science projects can provide opportunities for teachers and their students to contribute data to real science projects, which is a form of environmental action and environmentally responsible behaviour.

The study suggests teachers could benefit from developing their knowledge of public sphere environmental actions, as classroom settings may be the best place for developing these types of actions in many cases. Even though I did find evidence of public sphere action in this research, the extent of such student investigations appeared to be minimal across the three classes involved. Both teachers at Sale 545 had undertaken a small amount of EfS in their teacher education courses. The teacher at Toongabbie had been teaching for 25 years and had completed some professional development through her participation in programs like the CSIRO CarbonKids and Bug Blitz programs. These programs were both experienced by Teacher 3 in recent years. This had no influence on the extent of EfS that occurred in the different schools in this research.

The evidence from this study strongly support the proposition that, when connected, field learning in the outdoors, classroom curriculum and community partnerships have significant implications for broadening and deepening the extent and quality of EfS in schools.

6.3.6: Restating how teachers connect field and classroom learning to improve student eco-literacy

During her interview, Teacher 2 described how her students participated in an immersion day where they did drama and science activities in the school grounds to build excitement before the field event. As Teacher 2 stated: Two of the

activities were based around dance and drama, and the kids had to present a performance based on how humans are impacting an eco system just from their prior knowledge. Bug Blitz Trust has an expectation that safe clothing and requirements for the field day are discussed in schools prior to events and teachers did this routinely at both schools. A small amount of pre-field learning was in evidence at Sale 545.

The first way teachers appear to have connected field and classroom experiences post-field, was to use the student motivation, generated in the field, to engage students in writing recounts and reflections of their experiences. Students at both schools did this. At Sale 545, some students made posters or flow charts mapping the different activities they had done. In this way, teachers incorporated pictorial mapping and recount writing. The emphasis was on recounting and reflecting on field experiences.

Field learning was extended at Sale 545, as the students were required by their teachers to complete an inquiry learning project about an ecosystem type: Antarctica, desert, rainforest, coral reef etc. This project required students to undertake research back in class. It was clear from various data, that students mainly used online tools for research and publishing in their classrooms, however the teachers also provided students access to library books for this task. Teacher 1 even indicated that she believes children prefer using the Internet for research, rather than traditional library books.

It was also clear that the inquiry projects led students to investigate human impacts and environmental problems in the ecosystems they explored. Teachers facilitated their students to investigate online sites relating to particular global issues, and explored ways they could take action for the environment online. In focussing on Orang-utan declines in Asia, Teacher 2's students explored products in their local supermarkets, which contain palm oil. In doing this, the teachers at Sale 545 connected local, national and global environmental issues. They also positioned the students to be able to make consumer choices to take action for Orang-utan conservation.

Following the tradition of an inquiry learning process, the students were required to share their findings by giving small presentations in class. Using an eco-literacy

perspective (Hollweg et al., 2011), the inquiry projects included students learning knowledge and understanding issues, environmental dispositions like developing concern were engaged and they gained competencies in exploring issues, questioning and developing solutions. Further, students exhibited environmentally responsible behaviour as they investigated consumer choice actions they could take. The inquiry project appears to have engaged students in essential elements of eco-literacy.

This project was connected with EfS curriculum in the classrooms at Sale 545. The teachers used inquiry learning to extend and revise student understanding of environmental concepts like biodiversity, classification, ecosystems and human impacts on ecosystems. It appears inquiry learning was incorporated within the Studies of Society and Environment domain in the classroom curriculum. This does reflect concerns in earlier research (Cutter-Mackenzie & Smith, 2003), which suggests that EfS learning can be limited when it is contained within a few curriculum domains like science, geography and social studies.

The students at School One also watched a David Attenborough DVD about life at Antarctica, and there is evidence Teacher 2 required students to complete an A-Z word table, using field day and ecosystem words for spelling. Teacher 2 confirmed: her class looked at lots of government websites relating to ecosystems and environmental issues. The students used the Internet for research and to investigate issues and actions.

Teacher 2 also confirmed her students used a Museum of Victoria web site to play a game reinforcing concepts about classification. This teacher used the photo sample of invertebrates collected in the field to engage students in further practice categorising and classifying creatures, to assist students with the production of their information reports. Visual modes of learning, like video and photos, were used to support post-field learning.

After the field day, students and teachers confirmed that they collected a sample of around 20 different species of invertebrates in their school grounds. Students used skills gained in the field and applied them back in their school grounds. The teachers directly transferred learning from the field, into classroom curriculum in

this way. This provides a further example of how local outdoor places were utilised by teachers for student learning.

The teachers at Sale 545 also participated in facilitating the publishing of a student book related to their field experiences, back in classrooms. As I described, the school partnered with a philanthropic group to complete the post-field project. Again it required students to undertake further research, encouraging more in-depth learning about biodiversity. This project required students to: research, draft, edit and publish their writing using digital tools and formats. The students used a range of different writing genres: science reports, poetry, narrative, diary writing and pictorial reports were all included in the book. The teachers at Sale 545 used writing and literacy to integrate and extend the science learning of the field trips.

The teachers also facilitated some students to express their environmental dispositions and feelings about the environment through poetry writing, thereby including affective domain learning.

In addition to the writing task, the teachers and Bug Blitz facilitated a session back in the school where an artist guided about 50 students in drawing bugs for the book's front cover design. The teachers took advantage of the opportunity to have an artist visit and work with students to enhance their art skills, again utilising philanthropic support. The book's front cover artwork was used as part of the design in the public art project, providing another example of sharing learning in the wider community.

A small number of students, who were selected by the teachers, shared readings from their book at the public unveiling of the mural project. In this way art, science, reading and sharing learning in the wider community were integrated within post-field learning. The teachers achieved these outcomes by participating co-operatively in partnership with other groups. The teachers used the supports offered to their school to benefit student learning, via sharing learning in the wider community. It is surmised that sharing experiences, like the examples in this research, have an influence on the development of student citizenship.

The teachers at Sale 545 connected field and classroom using a range of project learning tasks to help develop student knowledge and understanding of biodiversity and ecosystems. They investigated issues and problems in local, national and global contexts and investigated environmental actions in small groups using online tools. Using Hollweg et al. (2011) eco-literacy framework, students improved environmental knowledge, competencies in investigating problems, which in turn engaged students' dispositions like concern and environmentally responsive behaviours through investigating actions. Finally, post-field learning included students in a range of contexts for developing eco-literacy: physical, personal, social and political learning (Hollweg et al.).

In moving from evidence of post-field learning, another key purpose of this investigation is to understand any influence the field presenters may have had on developing student eco-literacy in the field and how they may have influenced post-field learning.

6.4: The influence of field presenters

This investigation was primarily focussed on understanding student and teacher perspectives of environmental learning, however these perspectives could not be understood fully without investigating the influence the field presenters had on student learning. This study set out to understand how participatory single-day biodiversity field events are implemented. In total, there were eight different field presenters involved in the two field days. Each field presenter selected their workshop aims, the pedagogical approach they would apply, the resources and aids they would use, and the activities the students would experience in the field. The field presenters had a major influence on the content and pedagogical approaches of the field days, and therefore, on student learning.

6.4.1: Sharing expert knowledge

The students and teachers in this research all agreed that field presenter expertise and knowledge was beneficial for their learning. With low levels of eco-literacy among teachers (Cutter-Mackenzie, 2009) and the general population (Ballouard

et al., 2011; Stewart, 2006; Theiss, 2009; Wilson, 1984), we need to find ways to develop our knowledge of biodiversity and eco-literacy.

Field presenters influence this by providing knowledge in their area of expertise; birds, bugs, reptiles, wetlands, water quality, trees and Aboriginal culture were all included in the field events in this study. In the Introduction (see section 2.3.2.1) I used existing research (Cresswell & Murphy, 2017; Environment Australia, 1998) to demonstrate that increasing extinction rates of biodiversity is one of the most critical environmental issues facing humanity, and as Wilson (2013) states, biodiversity sustains our human existence. The field presenters transfer new information about biodiversity to students and teachers in the field. This fills a need within Australian curriculum to learn more about biodiversity, and maybe we may better conserve it.

6.4.2: A sense of field security

Having local knowledge, most of the facilitators were familiar with the risks at the wetland habitats where the field days were held. As I inferred in Chapter Five (see section 5.6.1), a safety issue was encountered during one field day when two Tiger snakes were sighted in the vicinity of the event. Collectively the teachers and facilitators agreed on strategies to mitigate the risks and the students were informed of the plan. Safety is an important consideration for teachers in risk averse societies (Gill, 2007; Mannion, Fenwick, & Lynch, 2012), and the field presenters' appeared to support an understanding that wetlands are biodiversity hotspots for plants, birds, fish, insects and snakes.

In reality, according to American reptile biologist Andrew Durso (2013), the chance of dying annually from snakebite in the USA is around 1in 50 million, whereas worldwide it is around 1in 200,000. We have to keep a check on a propensity to overstate risks to a point where they prevent people from visiting places like wetlands and forests. Encouraging student and teacher awareness of the dangers and ways to behave safely in places like wetlands is probably key in encouraging schools to support student field trips. In general, it is surmised that

non-formal environmental educators can provide feelings of safety amongst participants.

For some students, encounters with potentially dangerous creatures like some spiders, insects and snakes, it appears can motivate interest in biodiversity. As one student stated during his interview, "we even got to catch the poisonous bugs" (Tex). When I asked another student about her favourite activity at the Toongabbie field day, she replied:

> Most people who are scared of snakes and crocodiles and all that, I actually got to hold one. (Tina)

Risks are a part of exploring less-humanised places like wetlands, however it appears that some students are possibly excited and motivated by an element of risk taking.

6.4.3: Influencing student motivation

In the Introduction, I stated my intention to provide a general view of the student motivation that was generated through the field experiences in my study. I discussed earlier research (Carlson, 2008; A. Farmer & Watt, 1997; Powers, 2004) suggesting that field experiences can be a significant force in motivating student interest in the environment, and enthusiasm for further learning post-field.

My results strongly concur with the earlier research showing field experiences motivate student interest, enthusiasm and further learning. The overwhelming majority of students, who were asked if the field days motivate interest in biodiversity and further learning, agreed they do. In part, this is the result of the influence of field presenters. As Teacher 1 stated, student motivation from the field trip continued to influence her students for three months after the event. In Chapter Five, Teacher 2 even described how she felt more motivated to teach EfS after her field experiences. The field experiences appear to have positively motivated student and teacher interest in biodiversity and the environment.

6.4.4: Directing student activity time in the field

The influence that field presenters have on student field learning can be influenced by the pedagogical approaches they apply in their workshops. Teacher 1 commented how she believed that one of the field workshops was overly structured, and this resulted in the students being less engaged in learning (see section 5.6.4). The teaching skills of field presenters are also a factor in field days like those in my study.

Having video data, I was able to analyse the amount of direct student activity time involved in the workshops at Field Day One. During student and teacher interviews I was able to determine the students' two most-favoured workshops from the field day. An overwhelming majority of students, who participated in Field Day One, referred to nest building and sampling bugs as favoured field workshops. When I compared the workshops in this way, a contrast appeared between them.

The most popular workshops were those where student activity time made up at least three-quarters of the lesson. In the other three lessons, around half of the forty-minute workshop time was devoted to direct student activity. The amount of direct student activity in field workshops has a positive influence on student engagement and learning. Field presenters and teachers may benefit from considering this when they plan field workshops. The correlation between direct student activity and student engagement is a generalisation I inferred from the data. The Aboriginal workshop and the wetland boardwalk provide exceptions to this, as they contained significantly less student activity time and were clearly still popular with students and teachers anyway. Regardless of this, my data shows evidence of a correlation between direct activity time and students' engagement in learning.

Other factors can also influence student engagement. Even though story telling can involve passive student listening, if well delivered, stories can engage and stimulate student interest in place perspectives. The findings of this study suggest the amount of direct student activity time in field workshops is likely to be a significant factor in student satisfaction and engagement. This follows on from

earlier research (Carlson, 2008), which encourages educators to search for possible best practices in field learning.

6.4.5: An influence on teacher learning

The teachers at Toongabbie and Sale 545 agreed that the field days were beneficial for them as teachers, however their personal learning was interrupted by their teaching responsibilities and student supervision needs. At the Sale Common field day, an autistic student found the outdoor setting disconcerting and the teachers had to manage this situation. It took the teachers away from participating in the field workshop. A recent report I referred to in Chapter Five (Green & Caldow, 2016), showed pre-service teachers benefitted from field learning experiences, which helped to inform these pre-service teachers of *where* learning can occur and ways that environmental education can be integrated within classroom curriculum. The value of 'hands on' experiential learning, outdoors learning contexts and community partnerships are benefits of field learning, which show promise for teacher professional learning.

As I have reiterated throughout this thesis, my path began in the field as a child exploring nature, continued through years of teaching EfS in schools, until my current role as a Biodiversity Educator with Bug Blitz. In this time I have been the child/student, the teacher and the field presenter, and I have reflected these perspectives in this thesis research. In considering interactions between these perspectives, I have examined student field learning, how teachers connect field and class learning and the impacts of partnerships in biodiversity education. I will now draw the implications of my findings.

6.5: Implications of the findings

This study provides a possible model for planning and implementing biodiversity focused field days in local habitats, which are experiential and place-based in approach. When field and classroom learning contexts are connected with an experiential learning cycle, the program will probably include learning 'in', 'about' and 'for' our environment. This provides a framework for developing eco-

literacy in students, as it includes opportunities to learn environmental knowledge, care and practical action competence. The findings of this study have a number of practical implications, however an important discussion in this section explores the notion that the field of EfS has yet to fully define what constitutes taking action 'for' the environment. This section raises further implications regarding the use of animals in EfS for developing biophilia in students and discusses the need to realise the importance of biodiversity conservation and human sustainability in a digital age.

This research raises important questions about the extent of post-field learning that may have occurred in the participant schools and suggests this could have ramifications for developing student eco-literacy. The results of this research suggest it could also be time to reconsider mandatory field trips. There are new and diverse ways of undertaking outdoor sustainability and biodiversity field days. Involving partners in the field, classrooms and the community, provides diverse perspectives of place for students to experience. This is reminiscent of developing an eco-literate community where according to Capra (2007), solving problems involves bringing groups of people together in networks of support and conversation, where each group plays their part in developing their own and student eco-literacy in the process of learning. In this way, field days are not always the same. Programs are dynamic and depend on local people, partners and the places in which they are located. Like nature, with diversity comes resilience.

6.5.1: The nature of and possibilities 'for' action and citizen science

Field experiences provide rich natural data sources for students to gather and record field data. In my research, there was lots of 'hands on' learning at the field days and I collected photographic records of the different invertebrates students found, which could be used scientifically by the students post-field. The implications for EfS of this type of 'hands on' learning, has wider implications for the way citizen science can contribute in meaningful ways to the body of scientific knowledge.

One of the goals for science in Victorian schools is to collect and use field data to make inferences, create and test hypotheses as they relate to field issues

(Victorian Curriculum and Assessment Authority, 2016). As National Geographic (2016) said of citizen science: "new networks and communities of interested citizen scientists are created each day to learn more about the world and how we can contribute to understanding it." My implication, in this instance, relates to improving teacher knowledge of collecting and using field photo data to contribute to online databases of local biodiversity, thus engaging with citizen science.

I believe that this is not a common strategy currently used by teachers in biodiversity or science education, as was suggested in research I reviewed (Bonney, Ballard, et al., 2009; Newman et al., 2016), which described programs targeted to mainly adult audiences. It is surmised from the findings of this research, that teachers often neglect to use field data to complete any purposeful action process back in school. This could also be in part that, crowded curriculum demands do not allow teachers enough time to broaden and deepen student learning adequately, as the teachers in this study indicated is the case. In surmising again, teacher lack of knowledge of citizen science is probably also a significant factor restricting its current use.

There are many possibilities for developing environmental actions in classroom contexts and as Kumler (2010) suggests, a combination of eco and non-eco-management actions will be needed to build student eco-literacy. As I have indicated, a great area of need in EfS may be to improve teacher knowledge of the ways action projects 'for' our environment can be facilitated in classroom contexts. As I outlined earlier in Chapter Five, much of the student learning I investigated during the programs in this study could be classified as learning 'about' the environment. In general, it therefore, seems appropriate to suggest that educators aim for a suitable balance between learning 'about', 'in' and 'for' our environment in the planning stage of programs.

In Chapter Five I outlined the two partnership-learning projects, which influenced further learning and could be considered as public sphere action projects. I refer to the student book *Reflections of Biodiversity* and the public art group mural *Wetlands Evolution.* Both of these projects involved a celebration of nature and

biodiversity through children's writing and artwork. In being publically shared, can these projects be considered as public sphere actions 'for' the environment?

An exception to the view that publishing and sharing the student book qualifies as environmental action was noted during my conversation with Teacher 2 when I asked:

> Do you think that the actual book project – going out and sharing that qualifies as some sort of taking action for our environment?

She replied:

> Given the pages that my students have created, possibly not because … individual pages are not focussed on what's happening to the environment or to species. It's just giving a profile. I think if we had of looked at putting in pages of showing the impact that humans are having on the environment then yes because that is making others aware, but given what the content that I've got contributed. I'm not sure that that would be something that would be achieved. (Teacher 2)

To date there has been little agreement on the full extent of learning experiences, which could qualify as action experiences. For Teacher 2, the content of action learning should explicitly include human impacts and environmental issues. The final products in the book contained few images or messages of environmental issues, crisis or protests, they simply celebrated concepts like life cycles, nocturnal and diurnal, water creatures, insect features etc. The implications of this research suggest we develop new ways for teachers and students to undertake environmental action projects in all contexts.

An issue that emerges from this finding is defining what constitutes taking action 'for' the environment or: What is environmentally responsible behaviour? Can it be said that sharing a positive message celebrating knowledge of a spider's life cycle for example, does not raise environmental awareness to the degree that highlighting an issue may. Perhaps we are comparing different aspects of environmental awareness: awareness of life and awareness of environmental issues. It may be that a focus on developing creative private and public sphere actions in classroom contexts will best serve to increase the extent of actions 'for' the environment currently in curriculum.

Mixed with opportunities to participate in direct actions like tree planting, creative private and public sphere actions could also allow more student choice and ownership in the environmental actions and issues they choose to explore. It appears, that improving teacher eco-literacy will be key in developing a greater extent of student action in EfS.

It could even be said that going on a field day is, in itself, a form of action 'for' the environment, considering the crisis I have referred to in Chapter 1. Considering field days as a form of action 'for' the environment is a perspective worthy of further examination. Field experiences provide a platform for developing a range of environmental skills, processes, knowledge and actions; given the suggestions of Cutter-Mackenzie (2009) and Green (2011) that the extent of EfS in schools is inconsistent, field experiences in schools could be considered a form of environmental action. In this sense, learning 'about' biodiversity is also an action 'for' the environment; as it prepares students to take undertake informed, participatory actions. From a teacher perspective, it could be argued that engaging students in an environmental field day is a way teachers can personally take action 'for' the environment.

Further, environmental field days could be considered as a potential carbon-trading item. Large polluters could invest in EfS, as a way to encourage the sustainable use of resources and to develop eco-literate citizens through education. EfS could become a carbon-offset item that is valued for reducing human impacts on the environment. This could be of value in providing students agency in understanding sustainable living, which I suggest could reduce their carbon footprints through improved environmental knowledge. If recognised, this may provide students with a real stake in their own future. Students could rightfully access some of the colossal sums of money that will probably be exchanged by giant energy suppliers and consumers, industries, carbon traders and governments, in a last minute grab to reduce CO^2 levels in our atmosphere.

The notion that environmental learning can have a direct influence on students reducing CO^2 is, at this stage, a purely hypothetical suggestion that has not been tested with any research to my knowledge. Even though this entertains a neo-liberal philosophy of trading pollution against the environment, in times of

transition to sustainable living this could boost funding to support programs in places such as, schools, wetlands, museums, environmental and sustainability centres. Direct reductions in energy and water that might result from student participation in such programs could be measured, however subjective credits would also need to be considered to account for improvements in student knowledge and attitudes, all assets of an eco-literate citizenry.

There are probable links between improving student eco-literacy, the ability to adapt to changing climate and living more sustainably. Transforming energy use may be our primary means for reducing CO^2 in our atmosphere, however energy use is only one factor in our environmental crisis (Flannery, 2005; McKibben, 2010; Orr, 1994b; Suzuki, 1997; Wilson, 2002, 2017). The idea that EfS field days and other EE programs could be possibly traded as carbon offsets, has implications for the ways that EfS could be funded in the immediate future. And, as I found exploring the Anthropocene in Chapter One (Nordic Environmental Social Science, 2013), it was Einstein who suggested that we cannot solve new problems using the same old thinking.

6.5.2: Interacting with animals to connect with nature

As I explained earlier, interaction with animals appears to help people to develop biophilia, however there are issues about using and interacting with animals and habitats for education (Balcombe, 2000). There are impacts when a large group of students undertake a Bug Blitz in a small area. Bits of bark are stripped from trees in search of spiders and insects, and students capture various creatures for study. In the scale of the insect world, such impacts are minimal however animal rights perspectives need to always be respected.

This study provides evidence of two ways animal interaction occurred during field events (see Chapter Five) and supports suggestions that interacting with animals helps students to experience biophilia. Interacting with animals is a crucial strategy to encourage connections with nature and it is argued by Myers and Saunders (2002) "that animals provide a *bridge* for caring about the natural world." The findings of this research agree, while also cautioning us to consider the ethics involved in working with animals. The implications for those who use

animals in education may be supported with the development of a code of practice or guidelines for teachers. Keeping this in mind, animals appear to have a great capability to stimulate excitement and interest in people of all ages, especially young students. My observations lead me to surmise that interacting with animals could be a key influence on developing biophilia in students. Like being in a habitat, interacting with animals is most likely another bridge for connecting people with nature.

The field experiences in this research improved student knowledge of biodiversity, an important aspect of being eco-literate.

6.5.3: Biodiversity loss and classroom conservation

In the fight against biodiversity loss, many individuals and organisations are contributing in battles to conserve endangered species around the world. The Coral Sea Group and the World Wildlife Fund, were two such organisations that students engaged with in this study.

In Chapter Five (see section 5.4.3), I reiterated another example of students actively experimenting with knowledge they had gained during the program. As I explained, whilst researching ecosystems online, Teacher 2 and her students found the WWF website which alerted them to the plight of Orang-utans in Asian rainforests impacted by clearing of native forests for palm oil plantations. As Teacher 2 said in the interview: "We focused a lot on looking at, well, what can we do as humans to help or to lesson our impact on the environment?" In the case of threatened Orang-utans, the students considered consumer action choices: if they do not buy products with palm oil, this will lesson its demand and therefore the impacts on rainforests and Orang-utans. Choosing an iconic species reflects a criticism of EfS suggesting that local species are sometimes ignored for more distant and iconic species to study (Ballouard et al., 2011), however if we are to connect local, national and global contexts in a digital world, this appears inevitable.

The teacher facilitated her students to engage in public-sphere action using the Internet as a source for action. Whether this learning transferred into students'

personal actions in their out-of-school lives, was not investigated in this research. What this confirmed is that field experiences could be linked with making a positive impact on student understanding of biodiversity conservation. In many ways this process reflects all of the elements of eco-literacy: knowledge, dispositions, competencies, environmentally responsive behaviours and contexts.

During a conversation with Teacher 2, she described how her class had also visited the Museum of Victoria website and played a classification game. The Internet is a growing world of environmental organisations promoting many different aims and causes. Sites contain detailed information about issues such as, climate change, plastic waste and threats to Orang-utan, Tiger and Chimpanzee habitat etc. The sheer number of biodiversity and environmental sites on the Internet could be seen as yet another indicator of increasing environmental concerns around the globe. This also has implications for educators, who have to decide which sites may be environmentally, politically, socially and ethically appropriate in a world of fake news[14] and websites of variable quality.

6.5.4: The overall extent of integrated field and class learning

This research also provides information about the extent of EfS when field and classroom learning contexts are connected to improve student eco-literacy. In Chapter 5, I explained how the teachers at Sale 545 spent between four and eight weeks of classroom learning time on related post-field studies, and I described some of the post-field learning projects they completed. I used the example of Teacher 2 to analyse how she connected field and classroom studies, and I estimated that the students in her class had committed around 30 hours of their classroom program time to field-related EfS. The studies were integrated across a wide range of curriculum disciplines and included, inquiry, discovery, reflection, research and experiential learning. The results of my thesis offer some important insights into the extent of environmental learning that can occur when field and post-field learning are integrated.

In considering the extent of classroom time possible, Teacher 2 estimated the time

[14] Fake news: deliberate misinformation spread via news and online media sites

her class undertook related studies over an eight-week period. I estimated that students spent around 30 hours of class time studying the topic over that period. This infers that teachers only spent a small amount of the class-time they had available, for related post-field study. These findings suggest that, in general there appears a large window for improvement in the extent of post-field learning actually implemented. The implications of this are, if only a relatively small amount of the post-field classroom time appeared to have a positive influence on student learning, we could speculate that spending more of the available post-field time on related studies should improve student environmental learning even further. It has to be recognised that these results involve interpretive and subjective estimates of the amounts of time involved in post-field studies, and therefore are not generalizable.

As I began in Chapter 1, we are being encouraged to respond to our environmental crisis with urgency with Wilson (2002) calling the current millennia the century of the environment. Fifteen years later Wilson (2017) again warns us emphasising education: "Unless humanity learns a great deal more about global biodiversity and moves quickly to protect it, we will soon lose most of the species composing life on Earth" (p. 1). This increases the pressure to transform the extent of EfS in schools by implementing field day programs that are integrated with classroom curriculum. As Rickinson (2008, p. 447) suggests, citing Scott & Gough (2003), 'there will be no sustainable development happening, where learning is not happening.'

Faced with the urgency of this situation, aiming to increase the extent and quality of biodiversity studies in schools is a way we can respond to the issue of declining biodiversity. To successfully achieve such goals, we will benefit from exploring barriers that may inhibit teachers from including EfS in their classroom curriculum.

6.5.5: Crowded curriculum and testing limit post-field study

I found in Analysis, at Toongabbie post-field learning was inhibited by Teacher 3's end of year assessment and reporting obligations. This raises questions about

the impacts of the crowded curriculum and excessive testing regimes, which can take up significant amounts of teaching time. It may be as Finnish education expert Pasi Sahlsberg suggested in a recent media interview (McGowan, 2018), when assessment dominates school systems it narrows the curriculum and changes the meaning of learning.

Field days are positive learning experiences in their own right, and my results support Rickinson et al. (2004) assertions, that student environmental learning is improved when teachers can integrate school curriculum objectives. This was the experience for the students in this research study, where teachers from Sale 545 explicitly planned learning goals to meet some curriculum objectives. However, even the teachers at Sale 545 agreed that curriculum standards could make follow-up learning difficult, as they felt pressure to cover all of the standards set in a limited time.

These findings support further comments about the state of the Australian education system by Finnish education expert Pasi Sahlsberg (McGowan, 2018): it may be time to lessen central controls and excessive standardised assessment regimes and give teachers back some autonomy in curriculum planning and design. Allowing teachers more autonomy to choose to increase EfS is probably vastly more preferable than government mandates, however compulsory field trips might start the ball rolling towards greater action in EfS.

6.5.6: Reconsidering compulsory field trips

A main aim of this study has been to explore student and teacher perspectives of the value of single-day biodiversity field events for developing student eco-literacy. In reviewing relevant literature, I found evidence suggesting field trips are in decline (Barker et al., 2002; Mannion et al., 2012; Rickinson et al., 2004). In the context of EfS, Green (2011) states that there is great inconsistency in how EfS is taken up by teachers in Australian primary schools. Reinforcing the value of field events could increase the extent of field learning in school curriculum and compulsory field trips could help to address the inconsistency of EfS that Green identified in her research.

The positive results in this research support the call to reconsider mandatory environmental field days in local habitats, as part of our school curriculum (Rickinson et al., 2004). One field day each year for all school children has the potential to significantly improve the extent of EfS being currently undertaken in schools. However, without government directives and support for teacher education programs, major increases in the extent of field learning are, in my view, unlikely. The combination of findings provides some support for the conceptual premise that field learning be made mandatory in EfS. If EfS field experiences become a mandatory part of school curriculum, implementation issues will probably challenge our existing capabilities to change rapidly. Partnerships could play an important role in such developments.

6.5.7: The role for the non-formal sector in EfS

The nature of the unique partnerships between philanthropic organisations, schools, environmental organisations, community groups, local government and business during this research, offers information for stakeholders about ways to develop such partnerships in EfS. According to earlier research (Somerville & Green, 2012, p. 65): "The non-formal and informal sectors are important sites of innovation and have great potential to enrich the pedagogies of education for sustainability in the formal sector," and this research contributes in that vein.

The teachers involved in my study believed that the field experiences had enriched their knowledge of biodiversity. I reiterate earlier research I cited (see Chapter 2) discussing the cost of field programs, Barker et al. (2002) who suggested the question we should ask ourselves is: How can we afford not to have field experiences? There will be costs involved and partnerships sometimes support educational projects in this way, however there will be significant costs in scaling up the extent of EfS across our country.

We will require contributions from citizens, philanthropy, governments and corporations to transform our education systems to increase the extent and quality of EfS on the large scale required if we are to learn to adapt to what McKibben (2010) predicts will be an unstable environmental future on a renamed planet he calls 'Eaarth'. After all, according to Capra (2007), one of the profound lessons

we need to learn from nature is sustainability always involves the whole community. Partnerships could also have a role in teacher education.

6.5.8: Influencing teacher learning in the field

Finally, after assessing the influence of field presenters on student learning, I naturally wondered if the field experiences had any influence on teachers' environmental learning. As I showed in Chapter Three, teacher knowledge and eco-literacy are considered low (Cutter-Mackenzie, 2009), and teachers lack confidence and skills for teaching EfS, due in part to a lack of opportunity or support for teacher professional development in this area (Mannion et al., 2012; Paul & Volk, 2002). Two of the teachers in this thesis research, indicated that only a small component of their teaching course involved EfS.

Field-based learning in teacher education programs could be used as a way to develop teacher eco-literacy and pedagogical knowledge. Some recent research (Green & Caldow, 2016) shows promising results from this style of learning in teacher education. "What is good for the goose is good for the gander" is an old saying we are all familiar with and relevant in this view. If experiential field programs are so effective in student learning, then this style of learning may benefit the development of teacher eco-literacy in the same ways.

Such programs could be extended to include programs for field workshop facilitators, to support them to improve the implementation of field education. One of the issues that emerges from these findings is, there are a large number of participants in the non-formal education sector who could benefit from professional development in EfS. This has implications for field educators in government environment departments, shires and the ecotourism industry, who all take part in educating the community about biodiversity and the environment, as well as teachers. As it stands, the non-formal world of biodiversity education and EfS is mostly unregulated and no teaching qualifications or licencing, besides a Police permit to work with children, is required to participate as a field educator. In saying that, it is presumed that many field presenters have a mixture of formal

and non-formal learning experiences, and significant knowledge in their fields of expertise to share.

After identifying the implications of this study, the next section will discuss the limitations of the thesis. This research strongly supports the proposition that connecting field and classroom learning using place-based, experiential and integrated learning, is a way to improve the extent and quality of biodiversity education within EfS.

6.6: Limitations of this research

This research is a qualitative study undertaken with a small sample of students and teachers in one region of Victoria. With this acknowledgement comes recognition that the findings of my study include generalised interpretations and conclusions. I have experimented with a range of data collection methods, using and interpreting some of the results in creative ways..

This research has been engaged in exploring the framework for EfS of learning 'in', 'about' and 'for' our environment. My belief is that when all of these elements are present in a program, such programs better serve the development of student eco-literacy, as they contain cognitive, physical, affective and behavioural action experiences, through the integration of field and classroom contexts.

One of the methods I used to collect student data, the student Mindmaps, provided both visual and literate data for analysis (see p. 138). I circled student responses indicating learning 'about' the environment on a small number of Mindmaps. This suggested that most of the learning students' perceived was learning 'about' the environment, as the majority of responses on the student Mindmaps were circled. One explanation for this result is that the students' understanding of the concept of action 'for' the environment is low, which limited students' ability for recording such responses on their Mindmaps. A more likely explanation is that much of their learning actually involved learning 'about' the environment. On further investigation I found evidence of students engaging in action projects 'for' the environment back in classrooms, and of course being a field day, they experienced learning 'in' a field habitat. One of the most important questions for

educators that this research raises is: What proportions of learning 'in', 'about' and 'for' the environment should programs be? I used my data creatively to make these judgements and this should be kept in mind. Perhaps, reframing the title of the student Mindmaps would have also yielded different results.

Suggestions that biodiversity field events or other EfS projects could be used in carbon trading schemes in the future are purely hypothetical. These suggestions are based on existing research and what appears to this author, as a desperate need to increase the extent of EfS currently being implemented in schools. Increases in the extent of EfS delivered in schools will have to be funded.

When studying biodiversity and EfS it seems only natural that learning experiences will be dominated by learning new information 'about' the topics being studied. Including field experiences ensures that learning 'in' and 'about' the environment is catered for, however it appears necessary to consciously plan and implement learning projects 'for' the environment in a deliberate way to ensure their inclusion in EfS curriculum. In concluding the limitations of my study, the following section will suggest recommendations for future research in EfS.

6.7: Recommendations for future research

As my journey in this investigation nears completion, I come to the point of recommending future research arising from this study. After concluding the value of field learning for teaching eco-literacy is substantial, I assert that, in the context of biodiversity education, field experiences be considered as an essential element. If reports of a decline in the extent of field learning in schools (Barker et al., 2002; Rickinson et al., 2004) are correct, we will need to reverse this trend.

1. I recommend and encourage school education departments to survey schools to determine the extent of EfS currently undertaken in both field and classroom contexts in Australia.

Of particular interest to my study is the topic of biodiversity, which forms one of the core themes of sustainability education. We will benefit from knowing the extent of sustainability education and approaches used in EfS so that we can

properly react to what scientists predict will be a challenging environmental future (Flannery, 2005; Lovelock, 2006; McKibben, 2010; Orr, 1994b; Suzuki, 2010; Wilson, 2002). Knowing these things will assist in setting targets for growth in the extent, quality and delivery of EfS.

2. More research is also needed to find ways that field and classroom contexts may be best integrated to improve the breadth and depth of environmental and biodiversity learning.

I found little existing research that provided any significant detail of how post-field learning occurred in the studies I reviewed. In addressing a gap in research Rickinson et al. (2004), suggest a need to explore how field and classroom learning are integrated (see Chapter 2). I have provided more detail of post-field learning in this research, outlining the diverse use of resources and pedagogies teachers are likely to use in a partnership approach for EfS. However, my results leave many questions about the extent of post-field learning at Sale 545 unanswered.

3. My study recommends further research to extend our understanding of how to increase the extent of post-field activity to develop student-environmental learning outcomes.

Ultimately my study recommends connecting field experiences with classroom experiences using place-based, experiential and integrated learning approaches.

4. I further recommend that more research is undertaken to understand student and teacher knowledge about learning 'for' our environment, and to investigate new ways environmentally responsive behaviours could be applied in field, classroom and community contexts.

Further discourse about what constitutes being action 'for' the environment could also help to open new thinking in this area, including the consideration of potential actions like carbon trading for EfS. It would be interesting to assess this possibility. My findings support earlier research (Kumler, 2010), which suggests that we further explore public-sphere actions 'for' our environment in classroom contexts, as they are the least used by teachers.

5. Further research is required to investigate the roles and values of interacting with animals and other ways students and teachers develop

biophilia, and feelings of connection with place, nature and our environment.

I found that students were highly influenced by experiences interacting with animals during their field programs. The students all caught terrestrial bugs and macro-invertebrates, and some experienced a reptile show. This 'snake show' had a 'wow' factor for the students and it stimulated incredible excitement and memories for the students, as did catching bugs. However, both reptile shows and catching invertebrates have impacts on biodiversity and the environment. Catching bugs has an impact on local biodiversity. As I explained in my analysis, in the scale of the invertebrate world, the impact is minuscule. A far greater number of insects would be killed on a drive through the country on a warm summer night. Even so;

6. More research investigating the issue of using or interacting with animals in EfS may benefit the development of informed and ethical guidelines for such practices in education.

In doing so, we will be best advised to remember we need to connect children with nature and not distance ourselves further from it. There is evidence showing the further we separate children from interacting with animals in educational contexts like zoos, the less engaged students become (Myers & Saunders, 2002). For example, children are not as engaged seeing animals in enclosures as they are patting or touching animals. Interacting with animals can be a doorway for children to consider the ethics of studying biodiversity. Further research and discourse is required to support teachers who may consider engaging with animals in education.

7. I believe further investigation is also needed to explore the role of field experiences for developing teacher and facilitator eco-literacy, and their knowledge of environmental pedagogies.

As Cutter-Mackenzie and Smith (2003) indicated in their study about teacher eco-literacy, about 50 per cent of teachers have had no training in EfS, and I suspect that the figure would be even greater if we applied it to non-formal workshop facilitators. Up-skilling facilitators' pedagogical knowledge could be very beneficial for student learning at field events, and using field contexts for teacher

and facilitator education could be crucial in quickly developing eco-literate educators, capable of facilitating eco-literate students. The following section outlines the contributions of this thesis to the existing body of research in EfS.

6.8: The contributions of my study to research

Fundamentally, my study has contributed to a number of gaps identified in research (Rickinson et al., 2004). In the first instance, the authors of this review suggest we continue to investigate the value of field learning and how it is integrated with classroom contexts. They further suggest that researchers investigate the explicit learning outcomes of field experiences and ways local contexts can be used for EfS.

In particular, this study involved investigating the value of single-day biodiversity field events for developing student eco-literacy. There is a substantial body of research that examines the value of field learning in EfS (Ballantyne & Packer, 2002; Barker et al., 2002; Chawla & Duffin, 2005; J. Farmer et al., 2007; Nundy, 1999, 2001; Rickinson et al., 2004; Wattchow & Brown, 2011), however these studies are not specifically in relation to single-day field events, like those in my study. My research confirms that single day field events can have a significant influence on developing student knowledge about biodiversity, their understanding of human impacts on the environment and how to actively care for it. The study has gone some way towards enhancing our understanding of the values students and teachers attribute to field learning. The explicit student learning outcomes I detailed (see Chapter 5), were a result of connecting field and classroom experiences.

This research provides a clearer understanding of how teachers connect local field and classroom contexts to improve student eco-literacy. When teachers integrate field and classroom learning it reinforces field experiences, consolidates environmental conceptual learning and extends children's knowledge of biodiversity and the environment to include learning 'in', 'about' and 'for' the environment. It is a simple formula: quality field experiences + integrated classroom learning = improved student eco-literacy. This is a generalised equation that hides a number of significant variables in its terminology, with the most

important being ‘quality’ educational experiences, in both field and classroom contexts.

A second consideration is the extent of integrated classroom learning implemented. The elements of quality and best practices for field learning has been the subject of ongoing study (Carlson, 2008; Morag & Tal, 2012), and this research supports a continual cycle of evaluation and analysis to clearly determine best practices into the future.

This research highlights the need for field presenters and teachers to plan field workshops, which dedicate the majority of their time to direct student activity. A best practice for facilitator’s consideration is to aim to include around 75-80 per cent of field lessons, where students are actively engaged. The study has gone some way towards enhancing our understanding of the value of local field learning and how teachers integrate it with their classroom programs to develop student eco-literacy.

During this program, a number of small partnership learning projects successfully helped students to extend their environmental learning and improve digital publishing and writing skills. This follows earlier research (Nixon, 2007; Pfeiler, 2007), which espoused the benefits of connecting literacy and environmental learning. Such project-learning tasks can result in excellent student learning outcomes, which can be then used as a way to share information ‘about’ and ‘for’ biodiversity in wider contexts.

Ways we can use multi-modal literacies, as Nixon (2007) describes, to communicate environmental knowledge and take action, is an area of EfS which I believe is not well understood or used by teachers and students. Like it or not, the digital world and technology offer students a great range of exciting tools for scientifically exploring biodiversity, and for sharing knowledge and learning. This research agrees with previous assertions by Louv (2011), who suggests that in times of rapid change like the present, it will be the nature smart who will best adapt, as they balance the virtual with the real to develop a deeper understanding of nature.

6.9: Conclusion of Findings: My own learning journey

> To those who feel content to let the Anthropocene evolve towards whatever destiny it mindlessly drifts to, I say, please take time to reconsider. To those who are steering the growth of nature reserves worldwide, let me make an earnest request: Don't stop. Just aim a lot higher (Wilson, 2017, p. 6).

In the Introduction of this thesis, I introduced references from Wilson's (2002) book, *The Future of Life,* to provide scientific opinion about our environmental crisis. As Wilson's quote above suggests, there is hope, however given the urgency of the threats Wilson (2017) articulates in a recent report, we need to aim a lot higher and actively fight the progression of the Anthropocene. Improving the extent and quality of EfS can help develop a more eco-literate citizenry who are more equipped to confront the challenges created by humanity in the last 150 or so years of industrialised civilisation (Orr, 1995).

In my Introduction I investigated the effects of urbanisation and its influence in causing a general feeling of detachment from nature and a resultant lack of care for it (Louv, 2009; Orr, 1994b; Wilson, 2002). Cities in some places are so large now, we have built nature out to keep expanding them (Orr, 1994b), and the cyber world according to Louv (2011), also threatens to disconnect people further from real natural places. The bridge to connecting with biodiversity and nature is experiences in local environments. Field experiences are essential in EfS, for this reason.

As an educator, I see the value of local places, such as wetlands and nature reserves, for building connections with local biodiversity and place; this is why I believe that field trips are essential for school students. Field experiences are, as Cutter-Mackenzie (1998) and Green (2011) suggest, the platform for much other environmental learning, and my findings support this proposition. The belief that field experiences are beneficial for student learning is supported by the existing research I referred to in my Introduction. The findings of this research indicate, when teachers include a significant amount of post-field learning; student environmental field learning can be extended further through inquiry, research and reflection.

The field experiences in this research included a range of perspectives of place, experiential and embodied learning, and learning partnerships providing expertise, local knowledge, safety and a sense of working together. Bringing people together is believed to enable the creation of new social ecologies of place and an understanding of the biodiversity that form them (Somerville & Green, 2015). Despite its exploratory nature, this study offers some insights into the value of including diverse perspectives of place, which can enrich and balance EfS in the field. Furthermore, the crisis we find ourselves in will require all people and groups, societies and cultures to play their part in building an eco-literate citizenry capable of living sustainably, or as Suzuki (1997) puts it, in balance with all living things on earth.

For the last part of my journey, I have been intensively involved in learning about invertebrates and biodiversity, as I have explored local habitats with children during the hundreds of field days I have participated in with Bug Blitz. As I pointed out in Introduction (Wilson, 2013), biodiversity loss is a major environmental issue, an interconnected consequence of our environmental crisis, and therefore warrants being a major topic of EfS. As I have argued above, the learning opportunities on the topic of biodiversity are as varied as the biodiversity itself. According to Capra (2007), in human communities ethnic and cultural diversity may play the same role as biodiversity does in nature – diversity sustains resilience; and biodiversity is also fundamentally interconnected with human sustainability in the same way.

My findings indicate that learning ‘in’ and ‘about’ our environment can be a celebration of local biodiversity, and when shared with the wider community I hypothesise that celebrations of nature represent a form of environmentally responsible behaviour. As I have learnt more about biodiversity, my feelings and sense of biophilia have increased. My most memorable encounters with nature all happened whilst I was in the field, which has been the basis for much of my personal environmental learning and my strong belief in its value.

To develop such an experiential cycle, students share their learning in the local community and another layer and diversity of learning is added to their experience. Along the path, students learn new knowledge and practical ways they

can take action ‘for’ the environment. They become more eco-literate. To conclude using the words of environmentalist David Suzuki (1997, p. 239) “There is joy in the companionship of others working to make a difference for future generations, and there is hope”. Education for sustainability provides us with the ‘hope’ for the world that Suzuki refers to, by working together for future generations of people.

We, as humanity, can choose to use EfS pro-actively or reactively, as a response to our environmental crisis. Some might suggest we are already in a reactionary position regarding environmental crisis (McKibben, 2010). The time for choice is upon us. The path we are all travelling on has become a fork in the road. Applying EfS proactively provides humanity with greater hope for sustainable living, than the other way around. Education is underperforming in its duty to develop eco-literate citizens who are capable of living sustainably, and the climate change time clock is ticking. It is time to go into the field and reconnect with nature, for biodiversity conservation could be a barometer of our progress in EfS and sustainable living. A fundamental way we can begin to adapt to an uncertain environmental future on Earth is to improve the extent of EfS in school curriculums the world over, to develop a more eco-literate citizenry who are capable of living more sustainably in the future. Doing this is an investment in hope and a practical way to take action ‘for’ our environment, using education more widely as a vehicle for change.

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Appendices

Appendix A: Plain Language Statements (Schools)

COPY OF EMAIL TO SCHOOL PRINCIPALS

Dear Principal,

My name is John Caldow and I am currently undertaking a research project as a Doctorate of Philosophy student at Monash University, Gippsland.

The title of my study is: Connecting biodiversity field studies to classroom activities using an experiential process.

The aim of the study is to investigate student and teacher perceptions of learning during and after an environmental field studies program. My study is endeavouring to evaluate the value of field programs in Environmental Education curriculum and how, if at all, follow-up studies and projects are undertaken back at school to improve educational outcomes. I'm also interested in exploring how place-based activities like field days may influence student attitudes and feelings towards the environment and the different pedagogies and curriculum resources used by presenters and teachers during the process.

As well as being a student I am currently employed by Bug Blitz Trust as Program Director and I'm responsible for facilitating environmental education field day programs.

I'm seeking your permission to conduct this research in your school. If permitted I seek a letter from your school to confirm this prior to any data being collected.

I am also asking if you could distribute, on my behalf, an invitation to teachers at your school who may be interested in voluntarily participating in this research project.

I have attached the Explanatory Statement for Principals/Teachers, which explain; what the research involves, possible benefits, the nature of research, storage of data, confidentiality and results.

Teachers who are interested in participating can contact me directly for further information or to register their voluntary participation in the research project. If they choose to participate I will send a full pack containing Explanatory Statements for parents, children, teachers and field presenters. This pack will also contain Consent Forms for all groups.

I reiterate that participation in this study is voluntary and teachers may withdraw from the study at any stage.

Choosing not to participate will have no effect on your school's participation in Bug Blitz Field programs at present or in the future.

Thank- you for considering this invitation.

Mr. John Caldow
Monash University
Gippsland Campus (Faculty of Education)
Northways Rd,
Churchill
Victoria, 3842, Australia.
T: +[redacted]
[redacted]

EXPLANATORY STATEMENT

PRINCIPALS AND TEACHERS

Title: - ***Connecting Biodiversity Field Studies with Classroom Curriculum*: *Understanding children's learning and teachers' perspectives***

NOTE: **This information is for you to keep**

You are invited to take part in the above study. The project has been initiated by me, the principal investigator, Doctorate of Philosophy student John Caldow at Monash University, Gippsland. As well as being the principal investigator I currently hold the position of Program Director for Bug Blitz Trust and I'm employed by them to facilitate environmental field studies programs. The aim of the study is to investigate student and teacher perceptions of learning during and after an environmental field studies program. My study is endeavouring to evaluate the value of field programs in Environmental Education curriculum and how, if at all, follow-up studies and projects are undertaken back at school to improve educational outcomes. I'm also interested in exploring how place-based activities like field days may influence student attitudes and feelings towards the environment and the different pedagogies or teaching techniques and curriculum resources used by presenters and teachers during the process.

What the research will involve

If you agree to participate in this project you will be asked to take part in a Bug Blitz Environmental Field Program with your class. During the field day I may observe and take notes whilst you are participating. Activity presenters may be filmed during the field day whilst presenting. You may be filmed participating in sessions however; the focus of video recording will be on activity presenters.

After participating in a field program you will be asked to implement a Mindmap activity – What I've learnt – Biodiversity and Environment, with your students after the field event,

in your class. You will be asked to collect the student Mindmaps and hand them to me for data analysis as part of my study.

You will also be asked to take part in a face-to-face interview of 45mins to one hour in duration. During the interview you will be asked about your perceptions of the value of the environmental field experience from teacher and curriculum perspectives and any student learning outcomes you have observed. I will ask you to describe ways that you may have included follow-up studies in the classroom, discuss curriculum materials used and pedagogies associated with the field and classroom components. The interview will be conducted at your school.

Your school will be asked to provide counselling to any students or teachers who require it as a result of this research.

Possible benefits

It is hoped that the study will provide benefits for you and your school, the broader community and organisations that provide environmental programs for schools, the outcomes of such programs and it may suggest ways to improve future programs.

Nature of research

Participation in the research is voluntary. You can withdraw from the research at any stage during the process. There is no level of discomfort expected in this project and you will have the opportunity to view your video and interview transcripts and make alterations to anything you are not happy with.

Storage of data

All information gathered will be kept in accordance with Monash University rules and guidelines. Data will be kept confidential and secure in a locked filing cabinet at Monash University for 5 years and then destroyed. Other than the final thesis, it is envisaged that other reports or publications may arise from the research.

Confidentiality

Individual participants will not be identified in any report. Pseudonyms will be used instead of real names.

Results

A summary of findings can be provided to your school. Please contact John Caldow at [redacted]

If you would like to contact the researchers about any aspect of this study, please contact the Primary Researcher:	If you have a complaint concerning the manner in which this research CF11/2231 – 2011001253 is being conducted, please contact:
Mr John Caldow Monash University Gippsland Campus (Faculty of Education) Northways Rd, Churchill Victoria, 3842, Australia. [redacted]	Executive Officer, Human Research Ethics Monash University Human Research Ethics Committee (MUHREC) Building 3e Room 111 Research Office Monash University VIC 3800 [redacted]

Thank you. John Caldow Primary Researcher

CONSENT FORM

PRINCIPALS AND TEACHERS

Title: - ***Connecting Biodiversity Field Studies with Classroom Curriculum*: *Understanding children's learning and teachers' perspectives***

NOTE: This consent form will remain with Monash University researcher for their records

I agree to take part in the Monash University research project specified above. I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to take part means that:

I agree to be interviewed by the researcher

□ Yes □ No

I agree to allow the interview to be audio recorded

□ Yes □ No

I agree to implement student Mindmap activity – What I've learnt – Biodiversity and Environment, in class after the field event

□ Yes □ No

I agree to be observed or filmed during field event

□ Yes □ No

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being penalised or disadvantaged in any way.

I understand that any data the researcher extracts from the field event/film/student Mindmaps/interview for use in reports or published findings will not contain real names and that pseudonyms will be used.

I understand that I will be given transcripts of data concerning me for my approval before it is included in the write up of research.

I understand that any information I provide is confidential and that no information that could lead to the identification of any individual will be disclosed in any reports on the project or to any other party.

I understand that all data will be securely stored and accessible to the research team and could be used in future research.

Participant's name_____

Signature_____

Date: _____

Appendix B: Plain Language Statements (Field Presenters)

COPY OF EMAIL INVITING FIELD PRESENTERS

Dear Field Presenters,

My name is John Caldow and I am currently undertaking a research project as a Doctorate of Philosophy student at Monash University, Gippsland.

The title of my study is: *Connecting Biodiversity Field Studies with Classroom Curriculum*: *Understanding children's learning and teachers' perspectives/*

The aim of the study is to investigate student and teacher perceptions of learning during and after an environmental field studies program. My study is endeavouring to evaluate the value of field programs in Environmental Education curriculum and how, if at all, follow-up studies and projects are undertaken back at school to improve educational outcomes. I'm also interested in exploring how place-based activities like field days may influence student attitudes and feelings towards the environment and the different pedagogies and curriculum resources used by presenters and teachers during the process.

Bug Blitz Field Days involve a range of activity presenters working in the field presenting various workshops about Biodiversity and our Environment to school students and teachers. To investigate perceived learning by students and teachers I would like to video record and/or write field notes about your presentation in order to identify key concepts that are contained in them and the ways that you present such information.

Three weeks after a field day, teacher participants will ask student participants to complete a Mindmap (a graphic knowledge organiser like a semantic map) – What I learnt about Biodiversity and Environment. It is my intention to identify any correlations between field presentations and student responses of perceived learning that may be indicated on their Mindmap. Any such indicators will be used as evidence of student learning.

Teachers will be interviewed three to five weeks after the field day and asked about their perceptions of learning during the field experience. Correlations that may exist between key concepts in field presentations and teacher responses will be identified.

As well as being a student I am currently employed by Bug Blitz Trust as Program Director and I'm responsible for facilitating environmental education field day programs. Choosing to participate or not will have no effect on present or future partnerships or participation in Bug Blitz programs.

I have attached a copy of the Explanatory Statement and Consent Form for Field Presenters which includes information about: What the research will involve, Possible benefits, Nature of research, Storage of data, Confidentiality and Results.

I would like to invite you to participate voluntarily in this research project. I remind you that your participation is voluntary and that you may withdraw from this study at any time.

Thank-you for considering this invitation.

Mr John Caldow
Monash University
Gippsland Campus (Faculty of Education)
Northways Rd,
Churchill
Victoria 3842, Australia.
[redacted]

EXPLANATORY STATEMENT

FIELD PRESENTERS

Title: - ***Connecting Biodiversity Field Studies with Classroom Curriculum*: *Understanding children's learning and teachers' perspectives***

NOTE: **This information is for you to keep**

You are invited to take part in the above study. The project has been initiated by me, the principal investigator, Doctorate of Philosophy student John Caldow at Monash University, Gippsland. As well as being the principal investigator I currently hold the position of Program Director for Bug Blitz Trust and I'm employed by them to facilitate environmental field studies programs. The aim of the study is to investigate student and teacher perceptions of learning during and after an environmental field studies program. My study is endeavouring to evaluate the value of field programs in Environmental Education curriculum and how, if at all, follow-up studies and projects are undertaken back at school to improve educational outcomes. I'm also interested in exploring how place-based activities like field days may influence student attitudes and feelings towards the environment and the different pedagogies, teaching techniques and curriculum resources used by presenters and teachers during the process.

What the research will involve

If you agree to participate in this project you will be asked to take part in a Bug Blitz Environmental Field Program. During the field day I may observe and take notes whilst you are presenting your activity or you may be filmed during the field day whilst presenting to determine any key concepts involved in your presentation.

Possible benefits

It is hoped that the study will provide benefits for you and your school, the broader community and organisations that provide environmental programs for schools on the outcomes of such programs and ways to improve future programs.

Nature of research

Participation in the research is voluntary. You can withdraw from the research at any stage during the process. There is no level of discomfort expected in this project and you will have the opportunity to view your video and interview transcripts and make alterations to anything you are not happy with.

Storage of data

All information gathered will be kept in accordance with Monash University rules and guidelines. Data will be kept confidential and secure in a locked filing cabinet at Monash University for 5 years and then destroyed. Other than the final thesis, it is envisaged that other reports or publications may arise from the research.

Confidentiality

Individual participants will not be identified in any report. Pseudonyms will be used instead of real names.

Results

A summary of findings can be provided to your school. Please contact John Caldow at [redacted]

If you would like to contact the researchers about any aspect of this study, please contact the Primary Researcher:	If you have a complaint concerning the manner in which this research CF11/2231 – 2011001253 is being conducted, please contact:

Mr John Caldow Monash University Gippsland Campus (Faculty of Education) Northways Rd, Churchill Victoria, 3842, Australia. [redacted] [redacted] [redacted]	Executive Officer, Human Research Ethics Monash University Human Research Ethics Committee (MUHREC) Building 3e Room 111 Research Office Monash University VIC 3800 [redacted] Fax: +61 3 9905 3831 [redacted]

Thank you.

John Caldow
Primary Researcher

Consent Form

Presenters of Field Activities

Title: - ***Connecting Biodiversity Field Studies with Classroom Curriculum*:**
Understanding children's learning and teachers' perspectives

NOTE: **This consent form will remain with the Monash University researcher for their records**

I agree to take part in the Monash University research project specified above. I have had the project explained to me and have kept a copy of the explanatory statement for my records. I understand that agreeing to take part means that:

I agree to allow my field day presentations to be Video-taped for research purposes

☐ Yes ☐ No

I agree for the researcher to observe me (through written notes and/or photography)

☐ Yes ☐ No

I agree to be photographed which will appear in reports and/or publications.

☐ Yes ☐ No

If you have ticked yes to being photographed, would you like photographs where you are identified pixelated (blurred)

☐ Yes ☐ No

I also understand that:

□ Any data that the researcher extracts from the interview/s / photographs for use in reports or published findings will not, under any circumstances, contain names.

- □ Any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.
- □ Data from the interview/s / photographs will be kept in a secure storage and accessible to the research team (chief investigator). I also understand that the data will be destroyed after a 5-year period unless I consent to it being used in future research.

Activity presenters name (if applicable):

_____

Signature: _____ *Date:* _____

Appendix C: Plain Language Statements (Children and Families)

EXPLANATORY STATEMENT CHILD PARTICIPANTS

Study: ***Connecting Biodiversity Field Studies with Classroom Curriculum*: *Understanding children's learning and teachers' perspectives.***

NOTE: **This information is for you to keep**

My name is John Caldow. I work for Bug Blitz Trust and I'm also conducting a research project towards a Doctorate of Philosophy at Monash University. I'll be writing a book called a thesis, which is like a big essay, all about what students and teachers think about environmental field experiences and any related activities you might do back in your classroom.

I have chosen you because your class is involved in a Bug Blitz Field Day.

At the field day there will be different adults presenting you with activities about environmental science and biodiversity. Some presenters may be videotaped in the field whilst they present activities to you. You might be videotaped or I might observe you as you participate and write field notes.

When you get back to school your teacher will ask you to complete a Mindmap "What I've learnt – Biodiversity and Environment." You'll get a couple of sessions to complete it. I would like to collect your Mindmaps for my study.

I would like to interview you after the field day to ask about your field day experiences and related learning activities about biodiversity and environment you may have done back at school. There will be no right or wrong answers.

I may ask you some questions.

Can you tell me about anything you've learnt?

Which activities have you enjoyed?

What do you think of field days/trips?

What makes a great learning activity in the field?

How does participating make you feel about science and the environment?

Could you tell me any activities you did after the field day at school?

Your parents or guardians will need to read about this study and they will tell you whether you can be involved. You don't have to participate if you don't want to. Your participation is voluntary. You can choose not to participate in part or all of the project and you can withdraw at any stage of the project without being penalised or disadvantaged in any way.

If I interview you back at school it could take 35 minutes. I'll ask you to share your Mindmap with me and I'll ask questions like those listed above.

Your involvement will help me learn about Environmental Science Education Programs and your thoughts and feelings about them.

If you would like to participate you should complete and sign the consent form with your parents and take it back to your teacher for me to collect. If you change your mind just tell your teacher. Because interviews take so long I'll probably only have time for a few long interviews but I'll try to interview as many people as I can.

The university rules say that all the information I collect must be securely stored for five years. It won't have your real name on it to protect and keep your identity secret.

When I've finished my study I'll provide your school with a report to share the findings of my investigations.

If you have any queries or would like to be informed of the research findings, please contact John Caldow at: [redacted] Information regarding the research findings will be accessible for 5 years.

If you would like to contact the researchers about any aspect of this study, please contact the Primary Researcher:	If you have a complaint concerning the manner in which this research CF11/2231 – 2011001253 is being conducted, please contact:
Mr John Caldow Monash University Gippsland Campus (Faculty of Education) Northways Rd, Churchill Victoria, 3842, Australia. [redacted] [redacted] [redacted] or jmcaldow@activ8.net.au	Executive Officer, Human Research Ethics Monash University Human Research Ethics Committee (MUHREC) Building 3e Room 111 Research Office Monash University VIC 3800 [redacted] Fax: +61 3 9905 3831 [redacted]

Thank you. John Caldow Primary Researcher

EXPLANATORY STATEMENT (PARENTS)

Title: ***Connecting Biodiversity Field Studies with Classroom Curriculum*: *Understanding children's learning and teachers' perspectives.***

NOTE: **This information is for you to keep**

Your child will be invited to take part in the above study. The project has been initiated by me, the principal investigator, Doctorate of Philosophy student John Caldow at Monash University, Gippsland. As well as being the principal investigator I currently hold the position of Program Director for Bug Blitz Trust and I'm employed by them to facilitate environmental field studies programs.

The aim of the study is to investigate student and teacher perceptions of learning during and after an environmental field studies program. My study is endeavouring to evaluate the value of field programs in Environmental Education curriculum and how, if at all, follow-up studies and projects are undertaken back at school to improve educational outcomes. I'm also interested in exploring how place-based activities like field days may influence student attitudes and feelings towards the environment and the different pedagogies or teaching techniques and curriculum resources used by presenters and teachers during the process.

If your child agrees to participate in this project; they may be asked to take part in a 35 minute face to face interview at school. Questions may be asked like: Can you tell me about anything you've learnt? Which activities have you enjoyed? What do you think of field days/trips? What makes a great learning activity in the field? How does participating make you feel about science and the environment? Could you tell me any activities you did after the field day at school?

I will endeavour to interview as many students as practicable however it may not be possible to interview all participants.

The field days will involve your child rotating through various activities. A field presenter/s will guide each group activity. To identify key concepts the presenters may include in their sessions, video footage focussing on presenters will be taken during some field days. Any video footage of students will be secondary to presenters however your child may be filmed whilst they participate in interactive workshops in the field and so could be filmed.

Parents who do not wish their children to be filmed can explicitly request this and these children will not be located in the focus on the presenters. A section is included on the Consent Form if you wish to exclude your child from any filming. During some field events I may observe your child engaging in activities during the event. In my thesis your child's name will be replaced by a pseudonym.

Your child will also be invited to complete a Mindmap activity back in class "What I've Learnt – Biodiversity and Environment" with their teacher's guidance. They will be asked to provide their completed Mindmap to me for use in the study. I may ask them to tell me about their Mindmap during an interview to investigate what they have learnt.

It is hoped that this study will provide educational benefits for schools, teachers and students participating in environmental field days. It is further hoped that it will provide valuable insights for providers of environmental education programs like; philanthropic organisations, museums, councils and government authorities who endeavour to improve the effectiveness of their contributions to environmental education.

It is envisaged that as a consequence of this study there are no foreseeable risks of harm or discomfort. I am a qualified primary school teacher with 20 years experience in schools. I have a current Police Check that allows me to talk to your children during school activities. Students will be offered counselling support from within the school if there are any issues arising from this research. This is not anticipated.

The university rules say that all the information I collect must be securely stored for five years. It won't have your child's real name on it and a pseudonym will be used to protect and keep their identity secret.

When I've finished my study I'll provide your school with a report to share the findings of my investigations.

If you have any queries or would like to be informed of the research findings, please contact John Caldow at: [redacted]. Information regarding the research findings will be accessible for 5 years.

If you would like to contact the researchers about any aspect of this study, please contact the Primary Researcher:	If you have a complaint concerning the manner in which this research CF11/2231 – 2011001253 is being conducted, please contact:
Mr John Caldow Monash University Gippsland Campus (Faculty of Education) Northways Rd, Churchill Victoria, 3842, Australia. [redacted]	Executive Officer, Human Research Ethics Monash University Human Research Ethics Committee (MUHREC) Building 3e Room 111 Research Office Monash University VIC 3800 [redacted]

John Caldow - Primary Researcher

Consent Form

Parents/Guardian's of Child interview participants

Title: ***Connecting Biodiversity Field Studies with Classroom Curriculum*: *Understanding children's learning and teachers' perspectives.***

NOTE: **This consent form will remain with the Monash University researcher for their records**

I agree to take part in the Monash University research project specified above. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to take part means that:

I agree to allow my child to participate in the study

☐ Yes ☐ No

I agree to allow my child's Mindmap "What I've learnt about Biodiversity & Environment" to be collected and used for data.

☐ Yes ☐ No

I agree to allow my child to be interviewed at school by the Primary Researcher

☐ Yes ☐ No

I agree to allow my child to be video recorded during the field day.

☐ Yes ☐ No

I agree to allow the interview to be audio recorded

☐ Yes ☐ No

I agree to make myself available for a further interview if required

☐ Yes ☐ No

I agree to allow my child to be photographed during the project which may appear in reports and/or publications.

☐ Yes ☐ No

If you have ticked yes to being photographed, would you like photographs where you are identified pixelated (blurred)

☐ Yes ☐ No

I also understand that:

- □ Any data that the researcher extracts from the workshop / children's research / interview/s for use in reports or published findings will not, under any circumstances, contain names.
- □ I will be given a copy and transcript of data concerning me for my approval before it is included in the write up of the research.
- □ Any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.
- □ Data from the workshop / children's research / interview/s will be kept in a secure storage and accessible to the research team. I also understand that the data will be destroyed after a 5 year period unless I consent to it being used in future research.

Child's name: _____

Parent/Guardian's _____

Signature: _____ *Date:* _____

Appendix D: Questions for Students

Can you tell me about things you've learnt during the field day?

Which activities have you enjoyed?

What do you think of field days/trips?

Did participating in a field day motivate you to want to learn more about biodiversity and environment back at school?

What makes a great learning activity in the field?

Could you tell me about any related activities you did after the field day at school?

Can you tell me what you know about biodiversity and the environment?

How does participating in the program make you feel about science and the environment?

Can you describe the activities you did that you believe you learnt most from?

Appendix E: Questions for Teachers

Could you explain your thoughts about Environmental Education?

Could you tell me your assessment of the activities during the field day experience?

Was participating in the field day beneficial for you as a teacher? Please explain your response.

What are the student learning outcomes you observed during the field day?

Can you explain the student learning outcomes you observed during the program, including follow-up studies at school?

What and how did you implement any related follow-up activities in class?

Could you please describe the types of curriculum resources and materials you used during the program?

How could field programs be designed to improve student-learning outcomes?

Appendix F: Field Day Rotation Timetables

May 2012 – Sale 545 primary

	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5
Group 1.	Aboriginal culture & knowledge	Wetlands Boardwalk Layers of Wetlands	Bird nests Make a nest	Gumleaf Science Identify/measure/ smell	Rapid Biodiversity Assessment Arthropods
Group 2.	Rapid Biodiversity Assessment Arthropods	Aboriginal culture & knowledge	Wetlands Boardwalk Layers of Wetlands	Bird nests Make a nest	Gumleaf Science Identify/measure/ smell
Group 3.	Gumleaf Science Identify/measure/ smell	Rapid Biodiversity Assessment Arthropods	Aboriginal culture & knowledge	Wetlands Boardwalk Layers of Wetlands	Bird nests Make a nest
Group 4.	Bird nests Make a nest	Gumleaf Science Identify/measure/ smell	Rapid Biodiversity Assessment Arthropods	Aboriginal culture & knowledge	Wetlands Boardwalk Layers of Wetlands
Group 5.	Wetlands Boardwalk Layers of Wetlands	Bird nests Make a nest	Gumleaf Science Identify/measure/ smell	Rapid Biodiversity Assessment Arthropods	Aboriginal culture & knowledge

November, 2012 – Toongabbie primary

	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5
Group 1.	Aboriginal relationship to country & biodiversity	Reptiles of Australia	Macro-invertebrate sampling	Rapid Biodiversity Assessment Arthropods	Sculpture from Found objects & raffia
Group 2.	Sculpture from Found objects & raffia	Aboriginal relationship to country & biodiversity	Reptiles of Australia	Macro-invertebrate sampling	Rapid Biodiversity Assessment Arthropods
Group 3.	Rapid Biodiversity Assessment Arthropods	Sculpture from Found objects & raffia	Aboriginal relationship to country & biodiversity	Reptiles of Australia	Macro-invertebrate sampling
Group 4.	Macro-invertebrate sampling	Rapid Biodiversity Assessment Arthropods	Sculpture from Found objects & raffia	Aboriginal relationship to country & biodiversity	Reptiles of Australia
Group 5.	Reptiles of Australia	Macro-invertebrate sampling	Rapid Biodiversity Assessment Arthropods	Sculpture from Found objects & raffia	Aboriginal relationship to country

Appendix G: Dates and Times of Field Days, Student and Teacher Interviews

Student Interviews

Sale 545 (Field Day 30/5/12)

The students were interviewed, 27-28 days after the field event.

26/5/12 from 9:00am-1:30pm

27/5/12 from 9:00am-1:30pm

Toongabbie (Field Day 7/11/12)

The students were interviewed 24 days after the field event

1/12/12 from 9:00am-12:30pm

Teacher Interviews

The teachers at Sale 545 were interviewed 103 days and 111 days after the field event.

Teacher 2 was interviewed on the 10/9/12

Teacher 1 was interviewed on the 18/9/12

The teacher at Toongabbie was interviewed 41 days after the field event.

Teacher 3 was interviewed on the 17/12/12